HS2

High Speed Two labour and skills demand and supply forecasting and analysis

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Contents

List of figures

List of tables

List of abbreviations

Glossary	
CITB	Construction Industry Training Board
CSN	Construction Skills Network
E&P	Electrification & power
EE	East of England
EM	East Midlands
EU	European Union
GDP	Gross domestic product
GL	Greater London
GRR	Gross recruitment requirement
HESA	Higher Education Statistics Agency
HVAC	Heating, ventilation and air conditioning
JSA	Jobseeker's Allowance
LFS	Labour Force Survey
M&E	Mechanical and electrical
MWCC	Main Works Civils Contracts
NE	North East
NEC	Not elsewhere classified
NI	Northern Ireland
NISRA	Northern Ireland Statistics and Research Agency
NPISH	Non-profit institutions serving households
NSAR	National Skills Academy for Rail
NVQ	National vocational qualifications
NW	North West
O&M	Operations & maintenance
ONS	Office for National Statistics
SC	Scotland
SCL	Sprayed concrete lined
SE	South East
SFA	Skills Funding Agency
SS&T	Signalling, systems & telecommunications
STEM	Science, technology, engineering, and mathematics
SW	South West
TBM	Tunnel boring machine
WA	Wales
WCML	West Coast Main Line

Glossary	
WLC Ltd	Whole Life Consultants Limited
WM	West Midlands
YH	Yorkshire & the Humber

1 Introduction

1.1 Context

High Speed Two (HS2) is a new high speed rail network for the UK, connecting London with major city regions in the Midlands and the north of England. The infrastructure is a Y-shaped network, with connections to the West and East Coast Main Lines to allow trains to run beyond the Y network to serve places such as Liverpool, Preston, Cumbria, York, Newcastle and Scotland.

Phase One of HS2 will see a new high speed line constructed from Euston to north of Birmingham, where it will re-join the existing West Coast Main Line (WCML). Passenger services are planned to commence on the Phase One route in 2026.

The Government has announced its intention to accelerate the delivery of the section of Phase Two between the West Midlands and Crewe (Phase 2a). At the northern end it will connect with the WCML to the south of Crewe to allow HS2 services to join the WCML and call at Crewe station. Passenger services are planned to commence on the Phase 2a route in 2027 subject to parliamentary approval of the Phase 2a hybird Bill.

Phase 2b of HS2 will complete the full Y network. The southern end of the Western Leg connects to Phase 2a (south of Crewe) and goes onto Manchester with a connection back to the WCML south of Wigan. The Eastern Leg connects to the Phase One route and goes onto Leeds, with a connection back to the East Coast Main Line at Church Fenton, south of York. Passenger services are planned to commence on the Phase 2b route in 2033 subject to parliamentary approval of the Phase 2b hybird Bill. Figure 1 shows the route of the new HS2 high speed infrastructure and the regions through which it passes.
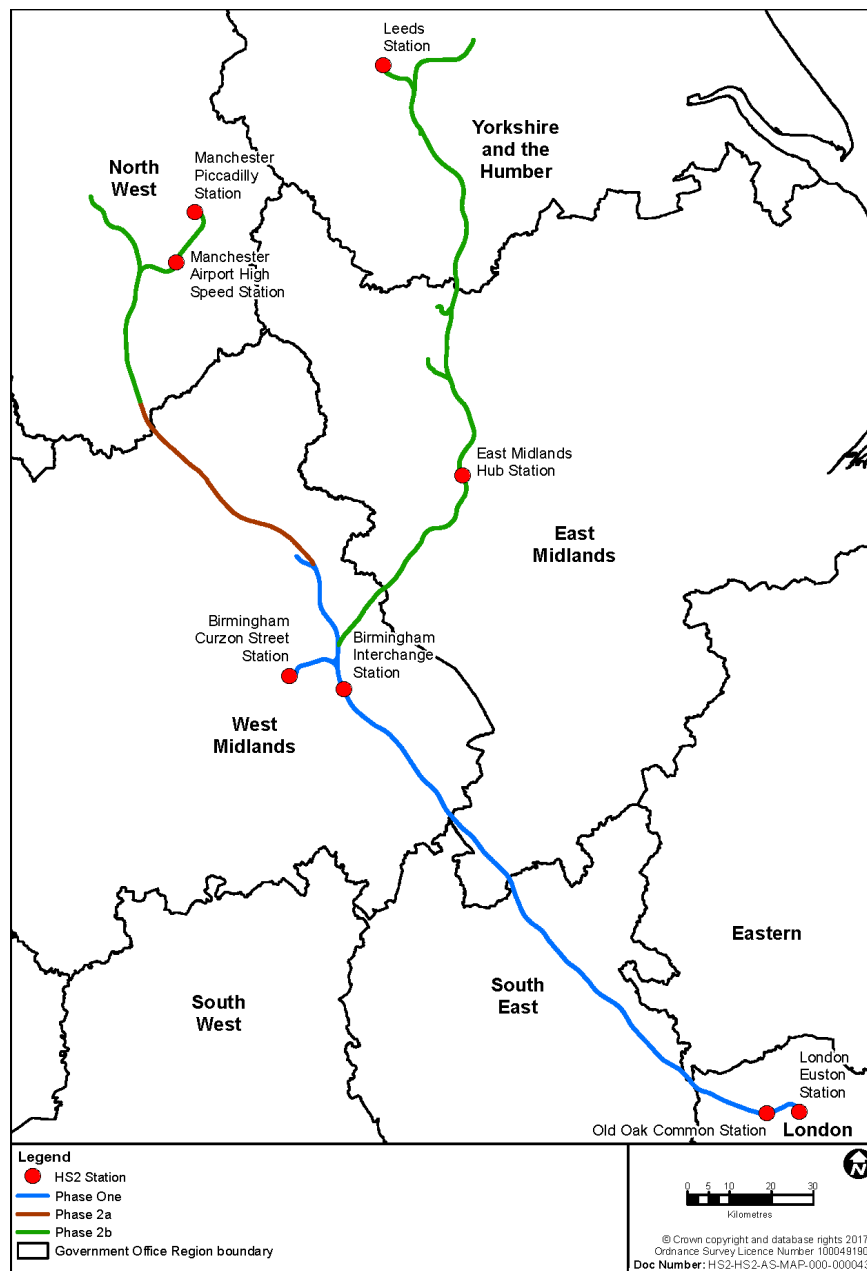
Figure 1: HS2 route with regions and phases

1.2   Purpose of the report

One of the strategic goals for the HS2 programme is to create opportunities for skills and employment. To meet the objectives of creating sustainable job opportunities for young people, local people and those from diverse groups and of fostering and developing talent to create an engaged and highly skilled workforce for the delivery of HS2, HS2 Ltd is developing a Skills, Employment and Education strategy. The strategy will encompass the design, planning and construction of the HS2 programme.

This report provides supporting evidence for the Skills, Employment and Education strategy. The analysis in this report assesses the labour and skills that will be required to deliver the construction and rail engineering elements of the HS2 programme against an assessment of the future availability of those skills. This analysis is then used to provide a preliminary assessment of potential mismatches between HS2 labour and skills requirements and their availability. This mismatch analysis can help inform the design and delivery of the HS2 Ltd Skills, Employment and Education Strategy.

The labour and skills that will be required to operate HS2 services are not assessed in this report.

The analysis in this report uses HS2 programme cost estimates to produce preliminary, top-down estimates of HS2 labour and skills requirements. Royal Assent for the HS2 Phase One hybird Bill was achieved in February 2017 and the Main Works Civils Contracts (MWCC) for Phase One were let in July 2017. The MWCC tier one suppliers have been procured using a two stage process that allows for the design, development and construction planning to be followed by the detailed design stage and construction. Enabling Works Contracts for Phase One have been awarded and HS2 Ltd is engaging in a programme of further procurements to deliver Phase One. As these contracts are awarded and contractors are mobilised, they will provide bottom-up evidence on labour and skills requirements that can be used to supplement and refine the preliminary top-down estimates provided in this report.

1.3   Overall approach

In April 2017, a consortium comprising Whole Life Consultants Ltd (WLC Ltd), the Construction Industry Training Board (CITB), the National Skills Academy for Rail (NSAR) and Experian were commissioned by HS2 Ltd to deliver forecasts of labour and skills demand and supply associated with the construction and delivery of the HS2 programme.

The overall approach is illustrated in Figure 2. This report distinguishes between the construction and rail engineering work required to deliver HS2. For both types of work this report:

1. Determines the demand for labour and skills arising from the HS2 programme to estimate the volume of workers required to deliver HS2;
2. Assesses the future demand for labour and skills arising from the overall construction and rail engineering sectors and the available supply of labour and skills; and then

3. Overlays the sector-wide labour and skills demand with supply to determine potential mismatches, interpreting this in the context of the labour and skills requirements of the HS2 programme.

Construction			Rail engineering		
HS2 labour and skills construction demand analysis (4.1 and 5.1)	Construction sector labour and skills demand forecast (3.3)	Construction labour & skills available supply (3.4-3.5)	HS2 labour and skills rail engineering demand analysis (7.1 and 8.1)	Rail engineering sector labour and skills demand forecast (6.2)	Rail engineering sector labour and skills available supply (6.3-6.4)
Construction mismatch analysis (4.2 and 5.2)			Rail engineering mismatch analysis (7.2 and 8.2)		

Numbers in parenthesis refer to sections of this report

Figure 2: The relationship between demand, supply and mismatch analyses

1.4 Structure of the report

Following this first section, the report is structured as follows.

- Section 2 provides an overview of total labour and skills required to deliver construction and rail engineering activities across all phases of HS2.
- Section 3 provides forecasts of overall requirements for labour and skills in the UK construction sector and their available supply, in order to assess labour market conditions during the construction of HS2.
- Section 4 provides forecasts of construction labour and skills required to deliver Phase One and Phase 2a (combined) of the HS2 programme and reports the results of the mismatch analysis for these Phases.
- Section 5 provides forecasts of HS2 construction labour and skills requirements and mismatch analysis for Phase 2b of the HS2 programme.
- Section 6 provides forecasts of overall requirements for labour and skills in the UK rail engineering sector and their available supply, in order to assess labour market conditions during the delivery of the HS2 rail engineering programme.
- Sections 7 and 8 provide forecasts of HS2 rail engineering labour and skills requirements and mismatch analysis

2 Labour demand generated by HS2

2.1 Introduction

Planning for Phase One and Phase 2a of HS2 is more advanced than for Phase 2b. The hybrid Bill for Phase One of HS2 secured Royal Assent in February 2017 and activity started in the same year. The hybrid Bill for Phase 2a of HS2 was introduced into parliament in July 2017. The intention is to bring forward a hybrid Bill for Phase 2b in 2019. Reflecting the differing levels of maturity in planning, Phase 2b is treated separately from Phase One and Phase 2a and this report provides less detailed forecasts for Phase 2b in assessing labour and skills demand and mismatches.

Labour demand for the HS2 programme was estimated using data provided by HS2 Ltd on the location and forecast cost of HS2 construction and rail engineering activities. Cost data were provided at point estimate. The forecast demand for both construction and rail engineering labour and skills is generated using CITB's Labour Forecasting Tool. The underlying models are based on a series of labour coefficients representing the number of person-years required to produce £1 million of output. The labour coefficients are different for each occupation and type of project. The tool can forecast the labour requirements month-by-month and occupation-by-occupation given the value of a project, together with its start and end dates and location. Workforce numbers are expressed in this report as people employed (person-years/year). The peak workforce is the maximum number of people employed in a single year.

2.2 Combined labour demand from the HS2 programme

The combined labour demand from HS2 construction and rail engineering is shown in Figure 3. This shows a peak labour demand of around 30,000 people in 2021/22 driven primarily by Phase One and Phase 2a. A secondary peak in the early 2030s of around 25,000 people is driven primarily by Phase 2b. The Phase One workforce is forecast to continue beyond the opening of Phase One services in 2026, due in large part to construction activity at Euston station to deliver Phase 2b.
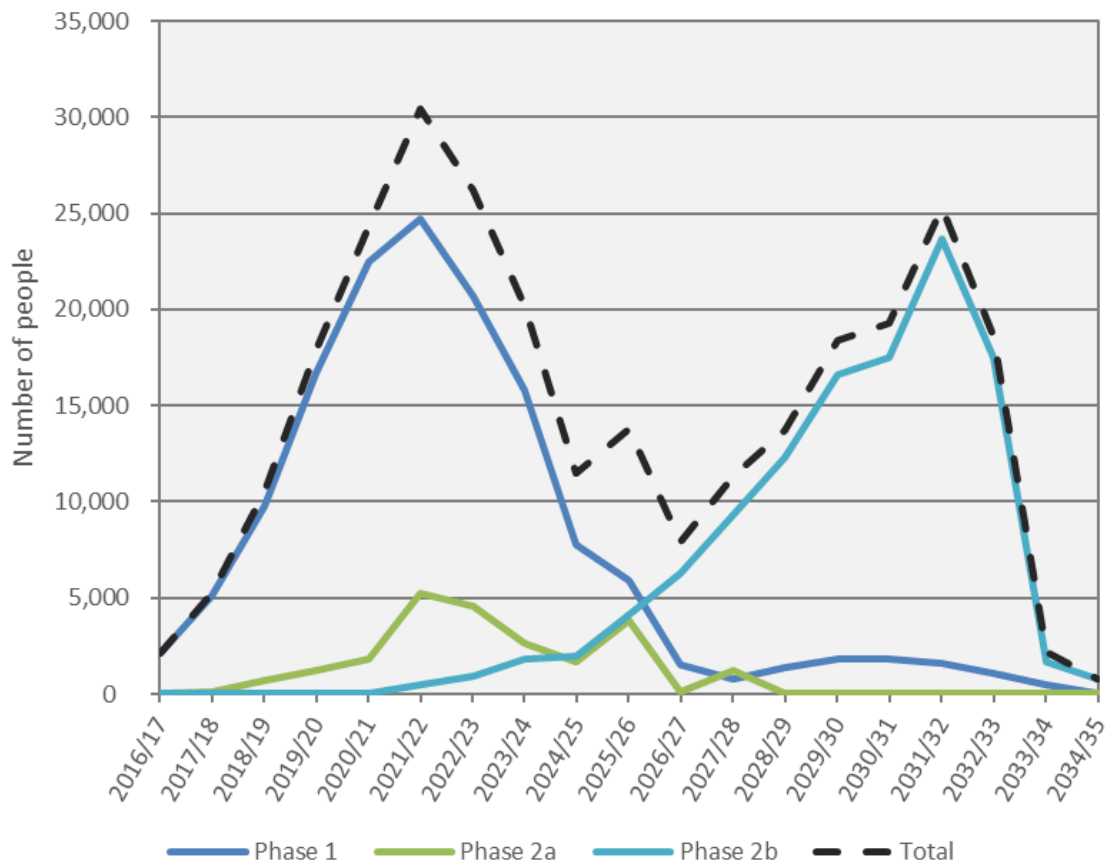
Figure 3: HS2 Construction and rail engineering workforce by phase

Table 1 shows the breakdown of the total person-years and peak labour demand arising from each of the three phases.

Phase	Total person-years	Peak workforce	Timing of peak
Phase One	141,500	24,700	2021/22
Phase 2a	23,100	5,300	2021/22
Phase 2b	115,000	23,700	2031/32
Total[1]	**279,600**	**30,500**	**2021/22**

Table 1: HS2 Construction and rail engineering workforce by phase

Figure 4 and Table 2 show a breakdown of total labour demand across Phase One, Phase 2a and Phase 2b split between construction and rail engineering skills. The construction labour demand is around 73% of the total with rail engineering accounting for the remaining 27%.
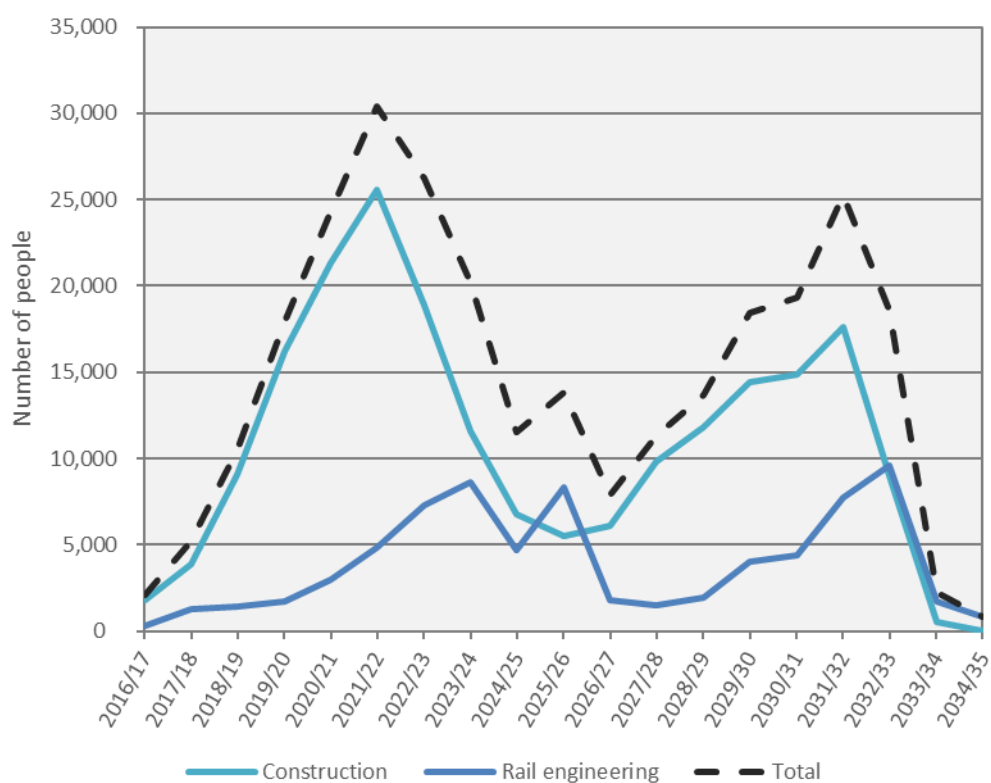
Figure 4: HS2 Construction and rail engineering workforce

Phase	Total person-years	Peak workforce	Timing of peak
Construction	204,800	25,600	2021/22
Rail engineering	74,800	9,600	2032/33
Total²	**279,600**	**30,500**	**2021/22**

Table 2: HS2 Construction and rail engineering workforce

3 Construction sector analysis

3.1 Introduction

The HS2 programme is one of many planned construction projects to take place during the next two decades. The construction of HS2 will take place alongside total UK construction activity that is anticipated to total more than £130bn per year. This construction activity in the wider sector will draw on many of the same labour and skills pools required to construct HS2. It is important to account for these wider requirements of the UK construction sector, as well as their available supply, in order to indicatively identify occupations and skill sets where the HS2 programme may face recruitment challenges.

Section 3 is further broken down into five sub-sections:

- 3.2 The construction sector today, which provides a short overview of recent trends in output and employment.
- 3.3 Forecasts of economy-wide demand for the construction sector output and labour. This sub-section presents a central forecast and two alternative scenarios.
- 3.4 Forecasting available supply in the UK construction sector, which outlines the factors which affect available supply and how it is forecast.
- 3.5 A quantitative assessment of the available supply of construction labour and skills, as well as consideration of the factors that influence their supply.
- 3.6 Consideration of the pipeline of construction workforce training.

The implications of the analysis presented in section 3 are investigated in the construction sector mismatch analysis conducted for Phase One and Phase 2a in section 4.2, and for Phase 2b in section 5.2.

3.2 A snapshot of the UK construction sector

The UK construction sector produced output in 2016 of around £140bn and employed around 2.6 million people[3]. These include construction trades & operatives, designers, and those involved in the management of construction. The volume of activity in the construction sector is closely related to the performance of the wider economy. Figure 5 shows UK construction output from 2003 to 2016, covering a full economy cycle. Between 2003 and 2008, when the UK economy was buoyant, construction output averaged around £135bn per annum[4]. It dipped to just £116bn per annum in 2009 during the sharp downturn in the UK economy. Construction output has recovered since 2013, surpassing pre-crisis levels in 2016.
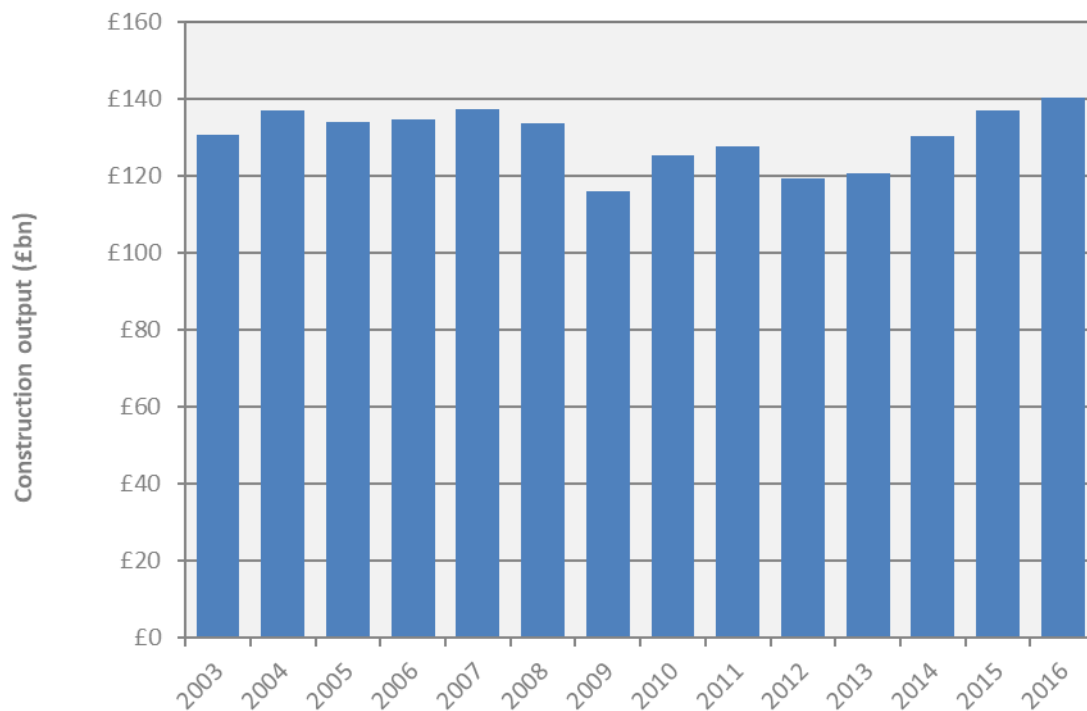
Figure 5: UK construction output[5], 2003-2016

(Source: ONS/NISRA[6], 2017)

In recording construction output the Office for National Statistics (ONS) breaks the construction sector down into a number of different sub-sectors. Figure 6 shows the share of construction output for each sub-sector from 2003 to 2016. Although overall output declined notably between 2007 and 2009, this impacted construction sub-sectors to varying degrees. Private housing output was the hardest hit, whilst commercial also suffered a significant drop in activity over the same period. In contrast, output increased in the infrastructure and public non-housing sub sectors between 2007 and 2009.
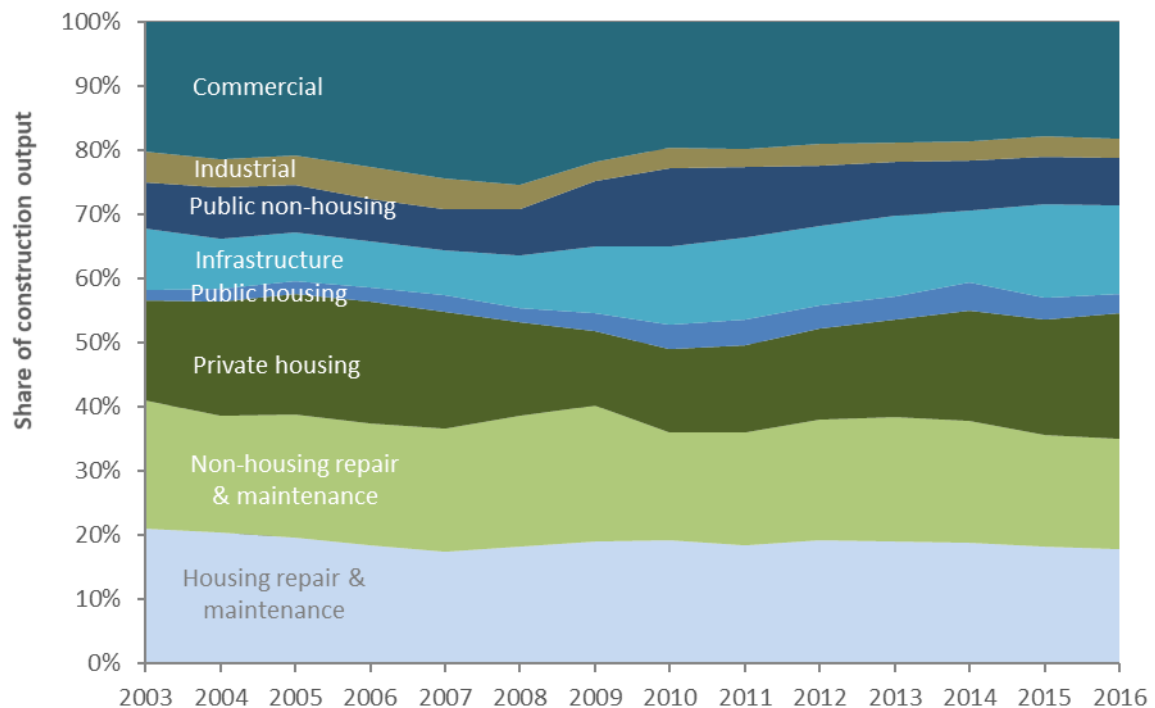
Figure 6: UK construction output by construction sub-sector[7], 2003-2016 (source: ONS/NISRA, 2017)

At a regional level there are substantial variations in the changes in construction output year-on-year. The recovery in construction output since 2008/09 has generally been stronger in the South East, Greater London and the East of England than in other regions of the UK.

Figure 7 shows total workforce in the UK construction sector from 2003 to 2016. The construction workforce increased by 15% between 2003 and 2008, when the workforce peaked at 2.86 million. It dropped to 2.57 million in 2010 as a result of the recession. While the construction workforce levels have not quite recovered to pre-recession levels they have returned to positive growth since 2014.
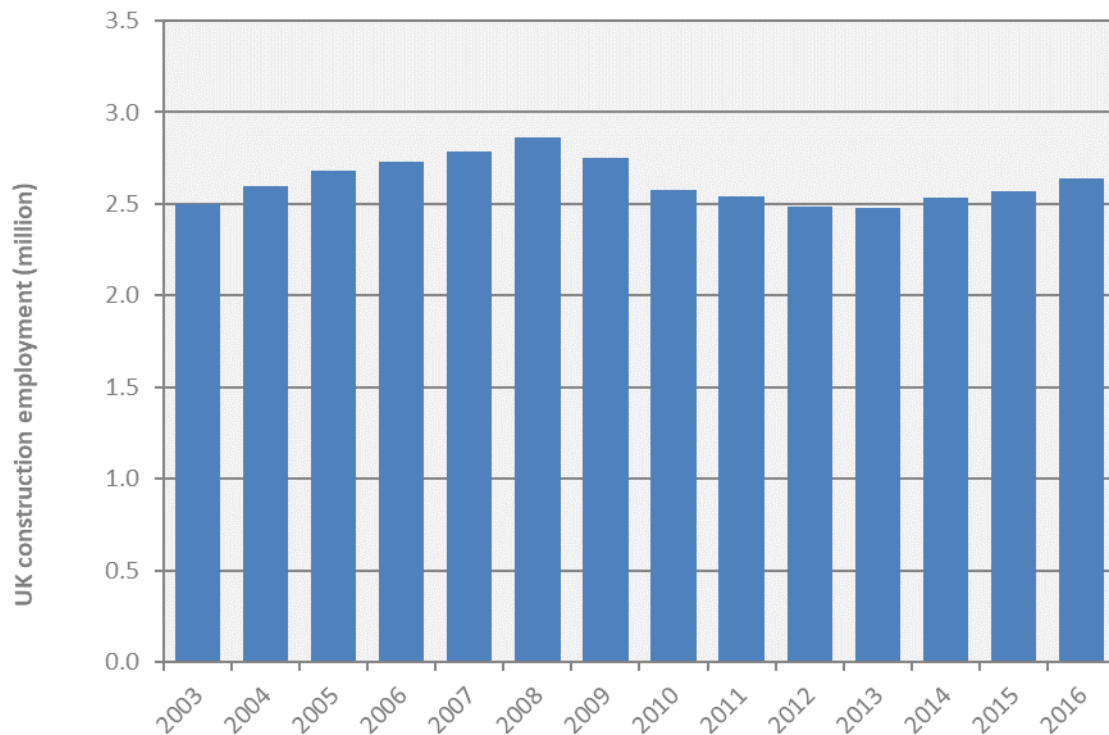
Figure 7: UK construction workforce, 2003-2016

(Source: ONS, CITB/Experian, 2017)

The construction workforce shows less variation between regions than construction output, with all regions closely mirroring the trend for the UK construction workforce.

3.3 Forecasts of economy-wide demand for construction labour and skills

3.3.1 Purpose and overview

Forecast construction output and numbers employed in construction by region are derived from the latest CITB Construction Skills Network (CSN) forecast run by Experian. This is a five-year forecasting methodology which currently estimates to 2021 and has been specifically extended to 2033 for the purposes of this commission. The CSN model derives the size of the workforce required to deliver the forecast volume of activity at a future point in time using a panel estimating process to determine the historical relationship between volume of activity and labour demand. As it is based on historical trends, it inherently takes account of changes in productivity in the historical data.

The outputs of the CSN are validated by CITB's Technical Reference Group, and through a series of 12, bi-annual, regional observatories. They are also tested against historical data. The tools used to produce these forecasts are Experian's heavily customised version of the National Institute of Economic and Social Research's model called NIGEM[8], which is used to produce the macroeconomic forecasts, both nationally and regionally; the mixed Delphi/econometric approach to construction output forecasting; and the demand model developed on behalf of the CITB to inform the Construction Skills Network.

The baseline view of construction sector demand has been projected to 2033. To test the robustness of the forecasts two alternative scenarios have been developed alongside the baseline. The first scenario considers the impact of a sharp downturn in the UK economy, equivalent in depth and duration to the credit crunch of 2008/09, and the second scenario provides a partial assessment of the impact of lower long-term UK population growth.

3.3.2   The construction sector demand baseline forecast

3.3.2.1.   Macro-economic demand baseline forecast

Construction output tends to track gross domestic product (GDP) trends, albeit with more volatility. Like most output sectors of the economy construction tends to be pro-cyclical.

There are a number of economic indicators that impact directly on the construction sector.

- Consumer spending – this generates demand for retail and leisure space, new house building and housing repair & maintenance.
- Business investment – this tends to be concentrated in the industrial and commercial sectors, generating demand for the construction of commercial space such as offices and of industrial space.
- Employment growth – this influences the demand for new industrial and commercial space to accommodate the increased numbers of jobs.
- Interest rates – these are used as a proxy for the cost of finance for property developers, which is a factor in determining the profitability of investment in construction activity.

The strength of construction sector output influences demand for labour and skills in the construction sector. When the economy is growing strongly, this generates higher demand for the output of the construction sector, which in turn requires higher levels of construction sector employment to deliver that output, all else being equal. The opposite it true when the economy slows or contracts.

Forecasts of the outlook for the UK macro economy are always subject to a high degree of uncertainty. In its November 2017 Economic and Fiscal Outlook, the Office for Budget Responsibility noted that huge uncertainty remains around the diagnosis for recent weakness in the UK economy and the prognosis for the future[9]. The forecasts in this report of future construction sector output and labour and skills requirements are conditioned on a macroeconomic forecast provided by Experian in spring 2017, which are similarly subject to a high degree of uncertainty.

In the baseline macroeconomic forecast used in this report, GDP growth is projected to average 2.2% a year between 2017 and 2033. Over the entire period from 2017 to 2033, household spending growth is projected to average 2% a year and total investment growth 2.2%. Employment (on the workforce jobs measure) is forecast to grow at an average annual rate of 0.6% rise each year. The forecast assumes that the Bank of England base interest rate does not start to rise until 2019, as the forecast pre-dates the decision by the Monetary Policy Committee to increase the official bank rate from 0.25% to 0.5% in November 2017 and subsequent rise to 0.75% in August 2018. The forecast assumes that interest rate increases will be gradual, reaching 4% by 2028.

The current baseline forecast assumes that following exit from the European Union (EU), the UK will secure trade access to the EU market that is broadly comparable in its terms to access under the European Single Market. No adjustments have been made to underlying population projections, given the continuing uncertainty over future migration policies. The forecast assumes that the UK economy returns to trend growth in the early 2020s.

The resulting forecasts for the key macroeconomic variables are shown in Appendix A for the baseline.

At the UK level, construction output is forecast to expand at an average annual rate of 0.8% between 2017 and 2033. By comparison, the 10-year moving-average growth rate between 2007 and 2016 was 0.9%. Looking over a longer time period, the compound annual growth rate between 1997 and 2016 was 1.4%.

3.3.2.2. Baseline forecast for labour and skills requirements of UK construction sector

The forecast average annual expansion in construction output of 0.8% is forecast to coincide with an average annual reduction in UK construction sector labour demand of 0.2% per year over the same period. This is a function of increasing productivity in the sector, as well a forecast shift in the composition of construction sector output towards less labour intensive sub-sectors such as infrastructure. This represents a decline of around 79,000 or 3% in the labour and skills demand over the period until 2033 compared to employment levels in the UK construction sector in 2016. The resultant labour demand forecast to 2033 is shown in Figure 8.
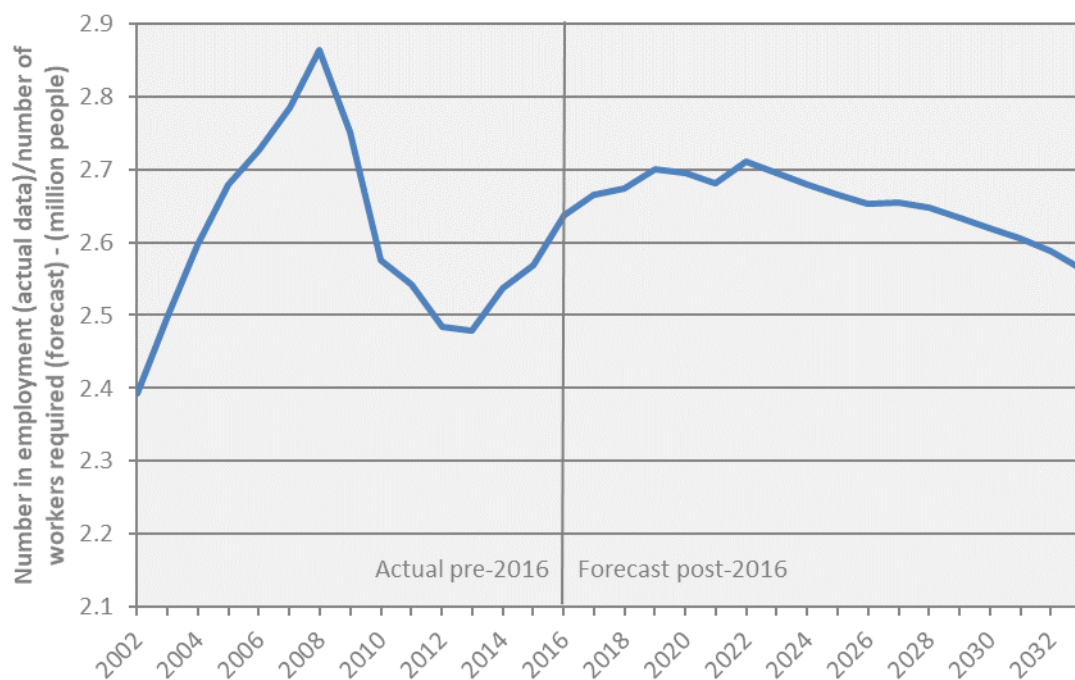
Figure 8: UK baseline forecast for construction sector labour demand (source: CSN, Experian)

The average annual growth rate to 2033 is forecast to vary from region to region. Forecast growth in construction demand reflects to some extent the regional forecasts for construction output.

Greater London is forecast to see the highest annual average construction output growth of 1.5%, so, the region's annual average labour demand expansion rate is also expected to be the highest at 0.6% (Figure 9). The weakest total construction output growth is forecast in the East Midlands, hence the region is anticipated to experience a decline in demand for construction labour.
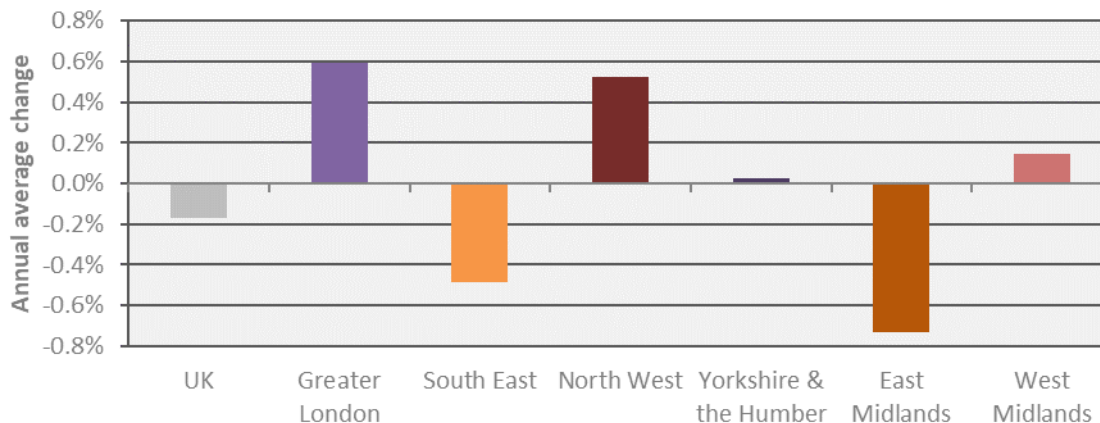
Figure 9: Total construction labour demand forecasts by regions along the HS2 line, 2017-2033
(Source: Experian)

Appendix B shows a detailed breakdown of the labour demand in the regions along the HS2 line of route by both occupation and region.

3.3.3 Alternative scenarios for labour and skills requirements of UK construction sector

As noted previously, the forecasts for the UK macro economy and hence for construction sector output and employment are subject to a high degree of uncertainty. To understand how alternative forecasts might impact on output and labour demand in the UK construction sector, two alternative scenarios have been considered. These scenarios have been simulated by shocking the main macroeconomic indicators in the baseline forecast that are judged to be most directly relevant in determining demand for construction (GDP, consumer spending, business investment, employment growth and interest rates).

The analysis of scenarios considers how a sharp downturn in the economy or lower population growth rate would indirectly impact on the UK construction sector, by considering their impact on demand conditions in the wider economy and hence the demand for construction. The analysis does not take account of direct impacts on construction, such as whether lower population growth rates would reduce the size of the potential UK construction workforce. The results from this scenario analysis should therefore be considered as a partial and incomplete representation of their impacts on UK construction.

3.3.3.1. Scenario 1: A sharp downturn in the UK economy

This scenario explores the impact of a sharp downturn in the UK economy, similar in depth and duration to that triggered by the financial crisis in 2008/09. The scenario has been designed such that the trough in demand triggered by the economic downturn coincides with the forecast period of peak construction activity on the HS2 project (2021 and 2022). There is a time lag between the output impacts and the labour demand impacts of the simulated downturn, thus, under this scenario the GDP path diverges from the baseline forecast beginning in 2020 with GDP falling by 0.6% and a further decline of 4.3% in 2021. GDP is predicted to start rising in 2022 but it is not until 2026 that GDP returns to the same growth rates as under the baseline forecast. Overall, over the period from 2017 to 2033 GDP is forecast to grow by an annual average of 1.4% under the downturn scenario, compared to 2.2% in the baseline forecast.

Lower GDP growth under the economic downturn scenario between 2021 and 2026 is also reflected in the paths for consumer spending, business investment and employment. The downturn scenario mitigates the need for interest rate rises, which remain lower than under the baseline over the entire period until 2033.

Under the economic downturn scenario, the lower demand for construction sector output is forecast to result in lower levels of demand for construction labour and skills (Figure 10). After a steep decline between 2021 and 2022, demand for construction labour and skills under the economic downturn scenario is forecast to grow from 2023 to 2025.
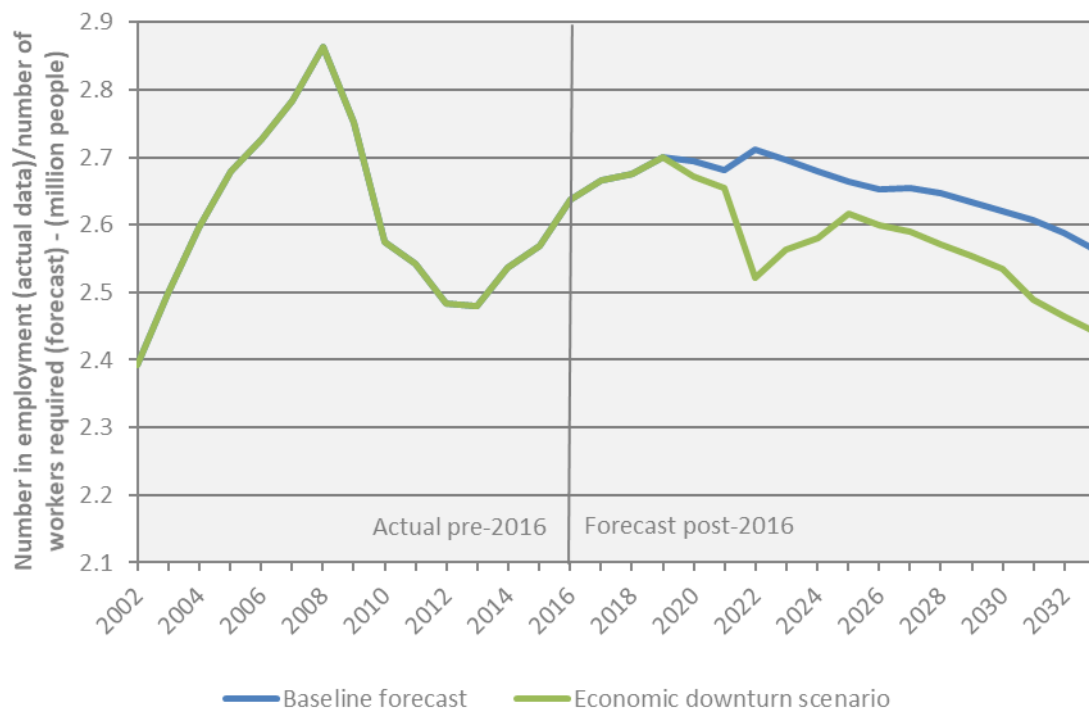
Figure 10: UK construction labour demand forecasts, 2017-2033
(Source: Experian)

3.3.3.2.   Scenario 2: A lower population growth scenario

Population growth has historically made a substantial contribution to UK GDP growth. The second scenario is to understand how reducing forecasts for future UK population growth might impact on the growth rate of the economy, and hence on the demand for the output of the construction sector.

Population growth in the baseline forecast is based on ONS central population projections[10], which projects annual average UK population growth of 0.6% over the period from 2017 to 2033. The alternative scenario uses the ONS low case population projections, with annual average growth over the same period of 0.4%. On the lower growth scenario, the UK's population would be 1.8 million lower in 2033 compared to the central projection. The scenario estimates the impacts on GDP of this ONS projection for lower population growth, while maintaining consumer spending and business investment as a constant share of GDP. The analysis does not take account of direct impacts on construction, such as whether lower population growth rates would reduce the size of the potential UK construction workforce. The results from this scenario analysis should therefore be considered as a partial and incomplete representation of impacts on UK construction. Under this scenario, annual average GDP growth between 2017 and 2033 is forecast to fall from 2.2% in the baseline to 1.8%.

Lower construction output growth under the low population growth scenario leads to forecasts of slightly weaker demand for construction labour and skills (Figure 11). By 2033, the cumulative effect of lower population growth is to reduce demand for construction labour and skills by an estimated 70,000 people (3%) compared to the baseline forecast.
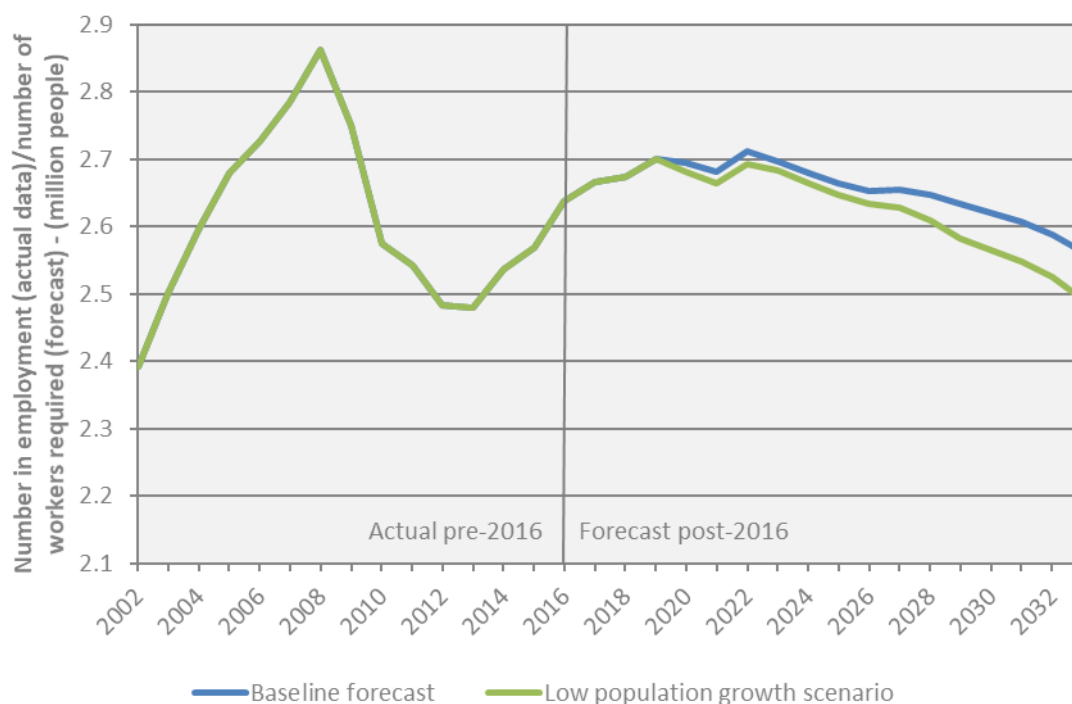
Figure 11: UK construction labour demand forecasts, 2017-2033
(Source: Experian)

3.4 Forecasting available supply in the UK construction sector

A key purpose of this report is to assess and understand those occupations and skillsets where the UK construction sector may face challenges in recruiting and retaining the skills they need, and relate these to the labour and skills requirements of the HS2 construction programme. To do this forecasts for the future demand for labour and skills in the UK construction sector (presented in section 3.3) are considered alongside an assessment of their available supply.

Labour supply consists of people who are employed, as well as those people defined as unemployed or economically inactive, who can be considered to be potential labour supply to meet the labour and skills requirements of the UK construction sector. Many different groups can be drawn upon to meet a sector's demand for appropriately skilled construction workers. Figure 8 gives an overview of these sources and sinks.
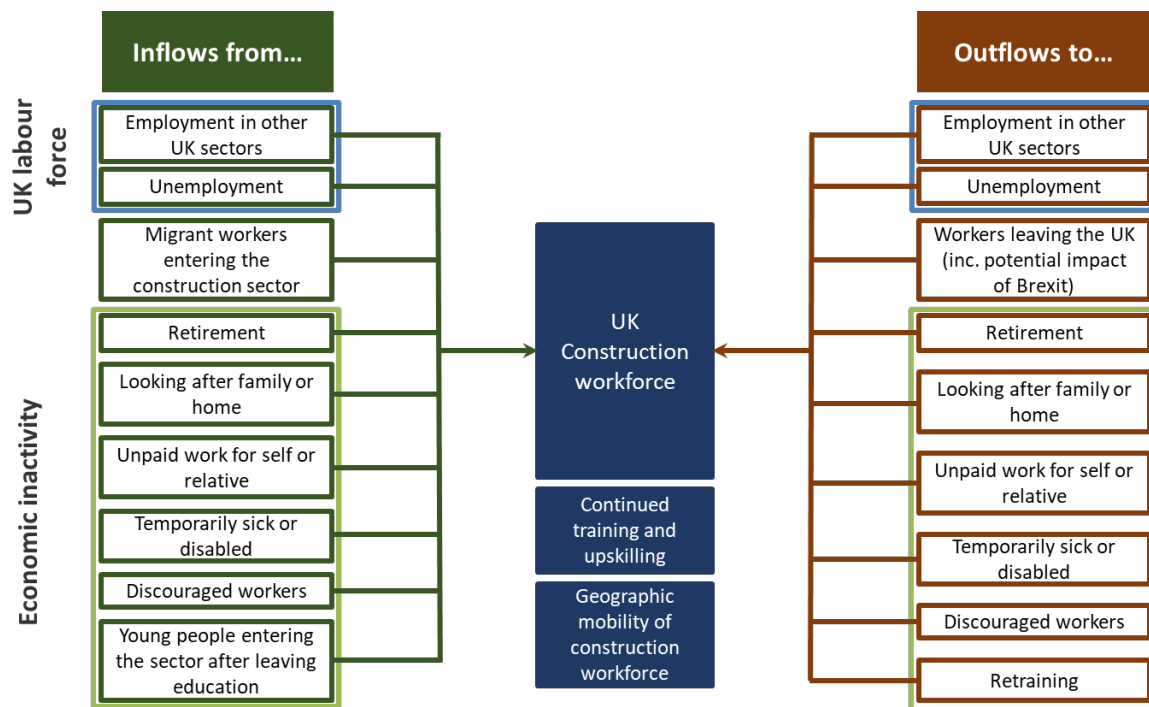
Figure 12: Sources and sinks of employed construction workers in the UK

The analysis in this report provides a quantitative assessment of the minimum available supply. This analysis begins by forecasting outflows from the currently employed UK construction workforce, taking into account retirements, movements into other industries, becoming unemployed or leaving the workforce for reasons such as disability, illness, injury or family reasons. These initial supply forecasts do not include inflows into the workforce. Forecasts for potential inflows are subsequently picked up in the mismatch analysis.

The forecast of available supply in the UK construction sector is conducted for 28 construction occupations. The forecast assumes that for each occupation, the future rate of outflow from the current workforce is equal to its occupation-specific historic outflow rate, averaged over the period from 2006 to 2016. This historic period covers periods of both growth and decline in UK construction sector output and employment and hence attempts to 'smooth out' cyclical fluctuations to identify long term outflow rates[11]. The approach of using historic outflow rates as a proxy to forecast future outflow rates does not explicitly account for factors such as an ageing workforce or any changes in the skills requirements of the UK construction sector due to changes in technologies or ways of working.

Outflow rates are derived from an analysis of ONS Labour Force Survey data (LFS) for each of the standard occupational classifications that have been aggregated into the 28 occupational groups used in the analysis (outlined in Appendix D). The historic outflows in the LFS data has been calculated as percentage of the construction

workforce for each occupation to generate a rate. These data take account of flows out of the construction sector to:

- other industries;
- unemployment;
- "other" (defined as unpaid work for self or relative, looking after family or home, temporarily sick or injured, long term sick or disabled, retired).

Due to limitations and restrictions on the data it is not possible to produce region-specific outflow rates. For each occupational group, a UK-wide outflow rate is applied in each region. This approach therefore cannot explicitly account for the mobility of construction labour and skills between regions within the UK. In addition, the analysis is unable to explicitly account for outflows due to international migration, as the Labour Force Survey (LFS) sample is restricted to households within the UK.

3.5 Quantitative assessment of recruitment requirement in the construction sector

Figure 13 shows the labour recruitment requirement profile for the construction sector in the six regions along the HS2 line of route. This profile is the difference between the remaining available supply (as the existing workforce erodes, before taking account of inflows) and the demand for construction sector workers. The profile is the forecasted number of full time equivalent job opportunities that would be generated if historical outflow rates were to remain the same and forecasted demand.
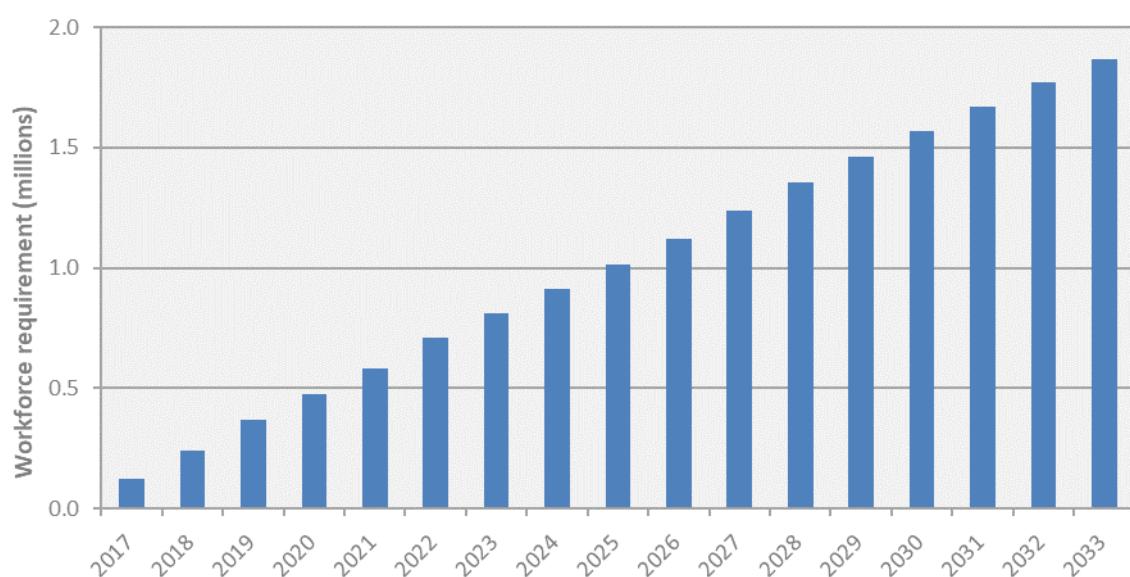
Figure 13: Estimates of cumulative gross recruitment requirement sector-wide construction in HS2 regions

The following sub-sections review some of the factors that may cause future outflows from the UK construction sector to differ from their historic outflow rates.

3.5.1 Demographics

The demographic profile of the workforce has an impact on the supply of available construction labour and skills by determining the balance of young people who might enter the construction sector and progress up the career ladder compared to older people working in construction who are more likely to retire.
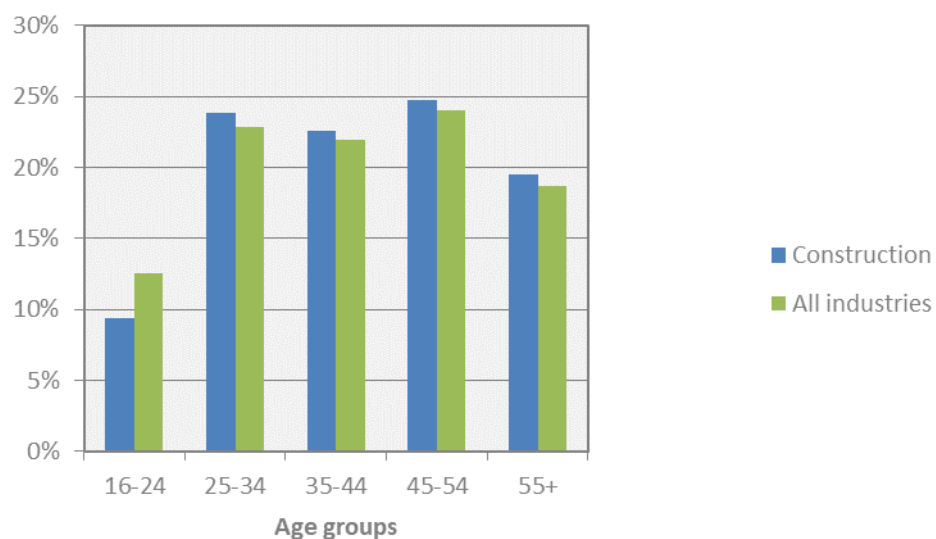
Figure 14: Age profile of construction and all industries
(Source: ONS Labour Force Survey, 2017)

Overall, Figure 14 shows that the construction workforce profile mirrors closely the overall age profile of all industries in the UK. However, there are two notable differences:

1. the construction sector has a significantly lower share of workers aged 16-24 – 9% compared to 13% for all industries; and
2. the construction sector has a higher share of older workers aged 45-54 and 55+.

Figure 15 presents the share of workers in each age bracket in the UK construction sector, which has largely remained stable since 2012.
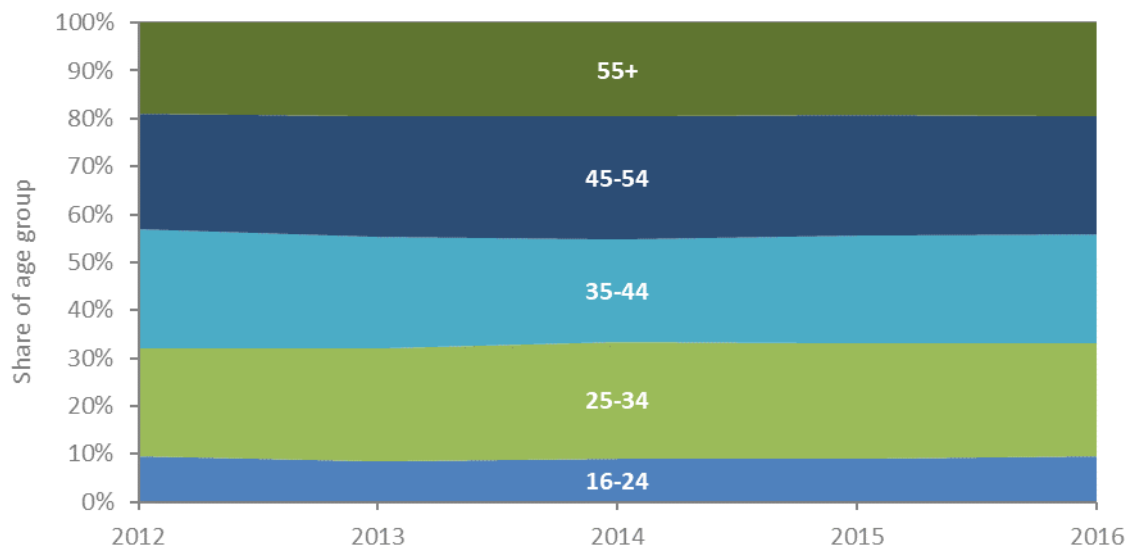
Figure 15: Age profile of construction workers over 2012-2016
(Source: ONS Labour Force Survey, 2017)

Although there is very little variation across the age groups overall there are some more notable changes within the individual construction occupations. In sections 4.2.2 and 5.2.2, the age profile for each of the priority occupations for further analysis is assessed in more detail.

3.5.2   Mobility within the UK

Research into mobility carried out in 2015 suggested that the average travel to work distance for a UK construction worker was 22 miles, compared with 28 miles in 2012[12]. This suggests that construction workers have been more easily able to find work within a closer proximity to their current residence as the UK construction sector recovers from the recession.

Figure 16: UK Construction workers' travel distance
(Source: CITB, 2015)

However, despite relatively short average distances to work, construction workers are willing to travel further distances when required. Figure 16 shows the distance from workers' current residence (including temporary residences) to their current site of work compared with the furthest distance worked from their permanent/current home. Only 20% of all construction workers have worked no more than 20 miles away from home and a further 31% have worked between 21 and 50 miles away. This leaves 47% that have worked more than 50 miles away from their permanent or current home.

Analysing mobility over the longer term, 75% of construction workers lived in the same region in which they started their construction career in 2015. However, this varied by region. Greater London (50%) and the South East (55%) both experience much higher levels of workers travelling inwards from other regions. Indeed, the South East 'imports' the greatest proportion of construction workers (42%), although the majority come from neighbouring regions within the UK.

When mobility over the shorter term by region is considered it is possible to get an indication of those regions where the movement of people into and out of the region is greater. Table 3 looks at the region/nation workers are currently working in, compared to the region/nation of their last site of work. This indicates that there are some regions where people are more likely to remain in that region than move to another when it comes to changing site. The North West (89%), North East (86%), and Yorkshire and Humber (82%) are particularly notable in this regard. The South East is notably much lower at 56%, as a large volume of workers currently operating here noted London as their last site of operation (19%). Similarly, 11% of people currently operating in London cited the South East as their last site of work. There also appears to be relatively high degrees of mobility between the East of England and London.

Region/nation of last site	Region/nation currently working in											
	EM %	EE %	GL %	NE %	NW %	NI %	SC %	SE %	SW %	WA %	WM %	YH %
East Midlands (EM)	60	7	*	*	1	0	0	3	1	1	6	4
East of England (EE)	5	49	4	1	0	0	0	7	1	1	1	1
London (GL)	2	23	77	2	1	4	1	19	4	*	2	1
North East (NE)	1	3	0	86	0	0	0	0	0	0	0	6
North West (NW)	3	2	1	1	89	1	*	*	1	7	3	2
Northern Ireland (NI)	1	1	*	0	*	86	2	0	0	1	*	0
Scotland (SC)	1	0	1	3	0	2	94	0	*	1	*	1
South East (SE)	6	9	11	1	1	*	*	56	9	1	2	2
South West (SW)	*	1	1	*	0	*	0	7	76	2	5	0
Wales (WA)	1	1	*	0	1	0	1	*	2	83	3	*
West Midlands (WM)	8	1	1	1	3	1	1	1	3	1	75	1
Yorkshire & the Hum. (YH)	9	2	*	3	1	0	1	0	1	0	*	82
Republic of Ireland	0	*	*	0	0	3	*	*	0	1	1	0
Other parts of Europe	0	0	*	*	*	*	1	*	*	0	*	0
Outside Europe	0	*	0	0	1	1	*	*	*	0	0	0
Other/unsure	2	1	1	2	1	1	1	5	2	1	1	*

Table 3: Construction workers region/nation of last site before this current one
*denotes less than 0.5%
(Source CITB 2015)

The South East and London are notable amongst the regions of HS2 construction in terms of their ability to draw workers from other regions to address recruitment requirements in these regions. In contrast, the evidence suggests that construction in the regions that make up Phase 2b means will not be able to draw on workers from other regions to the same extent.

3.5.3 International migration

The general pattern of the flow of non-UK construction workers entering the UK shows a peak entry point in 2008 at close to 128,000 workers (5.3% of the total workforce in 2008), followed by a period of decline during the recession, before increasing again.

Figure 17 shows non-UK construction workers by country of origin[13]. The largest numbers of non-UK construction workers entering the UK in the decade to 2015 originated from Poland. The other stand-out country is Romania which has displayed strong growth since 2010. The remaining three countries (Lithuania, India and Bulgaria) have remained relatively stable since 2006.
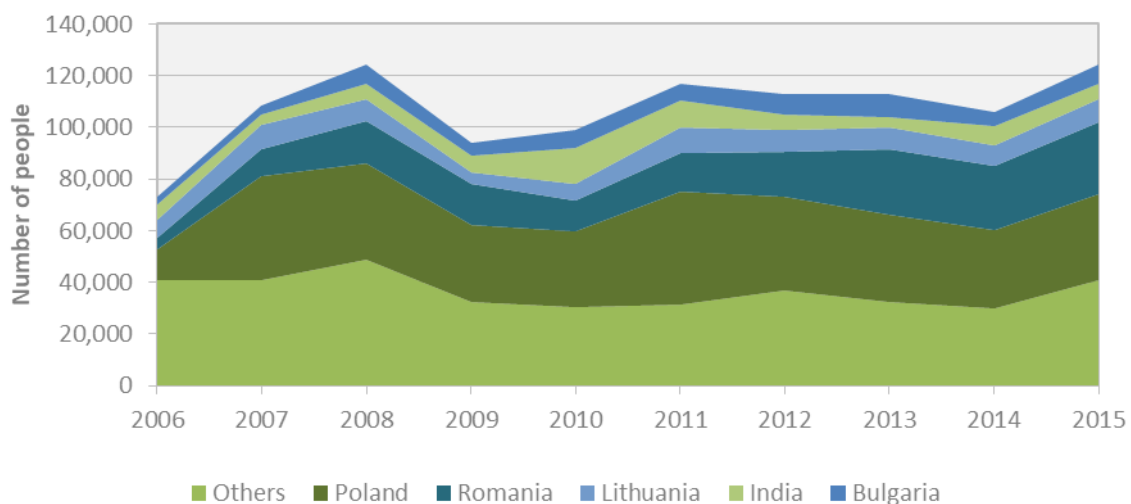
Figure 17: Construction workers of non-UK origin entering UK by country of origin
(Source: ONS Labour Force Survey, 2017)

3.6 Construction workforce training

An important consideration in understanding the inflow of workers to the construction industry is from the number of people undertaking training relevant to construction.

3.6.1   Overview

For most occupations in the construction sector, specific competence training is required. The main exceptions are plant mechanics/fitters and plant operatives, whose skills are transferable from and to other industrial sectors. Recognised qualification achievements are made up of two main strands: Further Education, typically taking the form of national vocational qualifications (NVQs) and including apprenticeships; and Higher Education, made up predominantly of degree and postgraduate qualifications, but also including foundation degrees, HNCs and HNDs. Training to NVQ level 2 is a competence requirement for any operative intending to work on major construction sites, though for trades occupations, a level 3 qualification is generally required. For managerial and professional occupations, an NVQ level 4 or higher is required. Further Education is principally responsible for training at levels 2 and 3, including apprenticeships, though some colleges are now offering qualifications at level 4 mainly in association with Higher Education establishments. Higher Education remains the principal provider of managerial and professional undergraduate and postgraduate degree qualifications.

Figure 18 demonstrates a gradual increase in Further Education achievements in recent years, of which approximately half are level 2. Figure 19 shows a decline in Higher Education achievements since the peak in 2010/11, though significant reductions have been mainly confined to the building and planning subject areas.
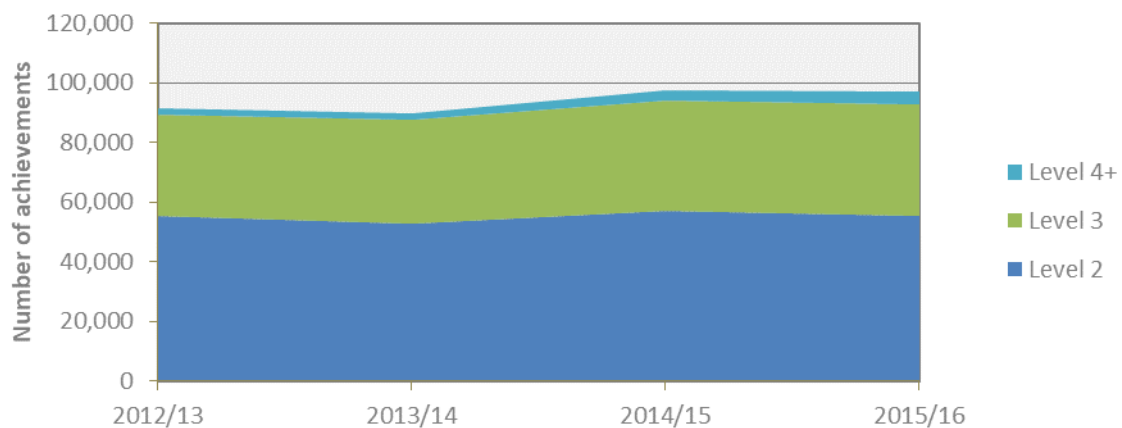
Figure 18: Further Education construction competence achievements – including apprenticeships, 2012/13-2015/16
(Source: Ofqual, 2017)
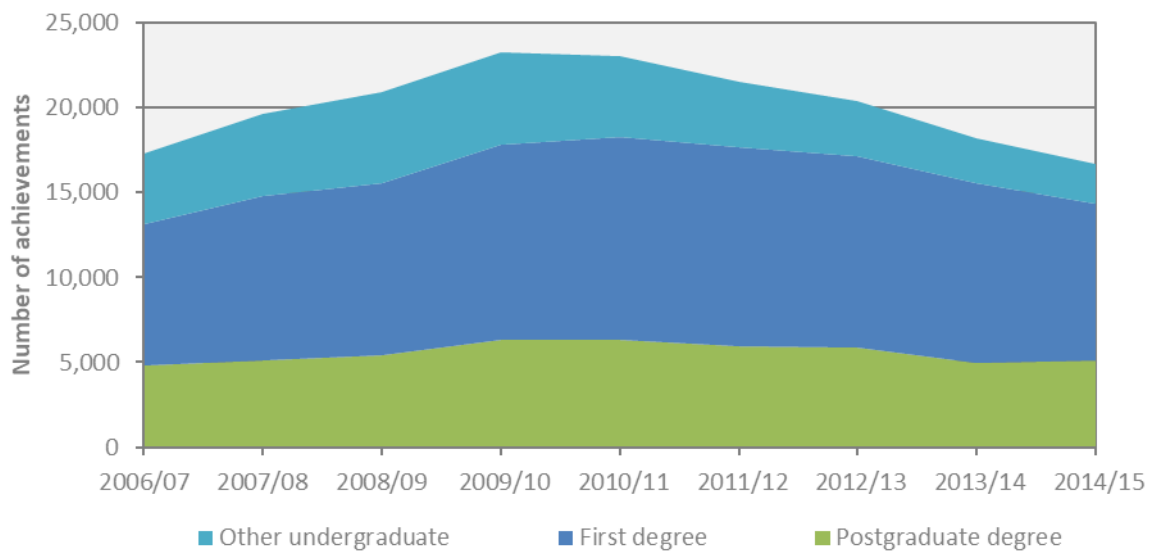
Figure 19: Higher Education construction achievements, 2006/07 – 2014/15
(Source: HESA[14])

Further Education is normally accessed close to where the trainee lives, whilst people are willing to travel considerable distances to access Higher Education.

Table 4 shows the regional breakdown of Further Education achievements and apprenticeship starts in construction related subjects. The regional distribution is reasonably uniform, although London and the South East have lower rates of construction apprenticeship starts compared to other regions.

Type of training	London	South East	West Mids.	East Mids.	North West	York & the Hum.	Avg.	Phase One and 2a regions	Phase 2b regions
Further Education achievements	5.2%	3.0%	5.1%	4.7%	4.6%	6.0%	4.6%	4.3%	5.1%
Construction apprenticeship starts	1.0%	1.8%	2.1%	2.6%	3.0%	2.9%	2.0%	1.5%	2.8%

Table 4: Training achievements for 2015/16 as a % of 2017 workforce
(Source: Ofqual (2017) and Skills Funding Agency (2017))

3.6.2 Qualifications in the construction workforce

The qualification profile of the existing UK construction workforce is shown in Table 5. For the occupations involved in design and construction management roles, the main qualification level is at NVQ level 4 and above. For the construction operative occupations there are far smaller percentages of the workforce qualified at level 4 and above with most being qualified at level 2 and level 3.

	Design and construction management	Construction operatives
First degree	27%	4%
NVQ level 4 and above (including first degree)	62%	12%
NVQ level 3	13%	19%
Trade apprenticeships	3%	15%
NVQ level 2	10%	15%
All with NVQ level 2 and above	88%	62%
Below NVQ level 2	7%	13%
Other qualifications	3%	14%
No qualifications	2%	11%

Table 5: Qualifications profile of UK construction workforce, 2015/16
(Source: ONS Labour Force Survey (2017))

The distribution of qualifications and the levels of achievement can vary depending upon where the worker is based. Recent research suggested that workers were more likely to hold a construction-specific qualification in the North West (71% of the workforce in this region) and Yorkshire & the Humber (68%) than in the South East (58%) and London (52%)[15].

The distribution of qualifications also depends on occupation, with some more likely to hold formal qualifications than others (see Appendix C).

3.6.3   Apprenticeships (Further Education)

For construction operatives, apprenticeships will be one of the main routes for new entrants into the sector, especially learners who are aged between 16 and 24 years seeking to enter from school or Further Education. Construction apprenticeships typically take around two years for a level 2 with a further year if progressing to level 3.

As the construction sector emerges from a period of deep recession, confidence has largely returned and numbers of apprentices are on the increase. Apprenticeship starts across the HS2 regions increased by around a third between 2012/13 and 2015/16 (Figure 20).
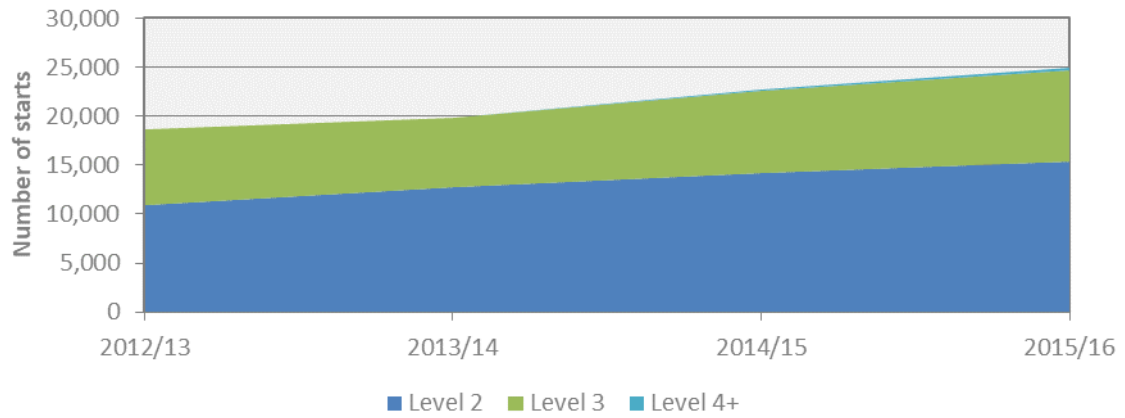
Figure 20: Construction apprenticeship starts by level, regions along HS2 line of route

4 Construction demand and mismatch analysis: Phase One and Phase 2a

4.1 Construction demand

4.1.1 Methodology

In order to produce a profile for the labour and skills required to deliver the construction of Phase One and Phase 2a of HS2, it is necessary to know the type of work taking place and the programme of work. HS2 Ltd have provided data indicating the annual spend by cost pillar. The following cost pillars have been allocated to construction work:

- tunnels;
- civil engineering;
- stations; and
- depots & sidings.

The following cost pillars have been allocated to rail engineering and are dealt with separately in other sections of this report:

- railway systems;
- on network costs (works relating to existing infrastructure); and
- traction & rolling stock.

The following general assumptions have been made:

- all modelling uses point estimate costs;
- where a spend is given for a specific calendar year, it has been allocated to the start of the financial year (for example, 2016 is allocated to 2016/17);
- the price ruling date is 2015Q1; and
- costs exclude VAT.

It is necessary to allocate work to one of the project types which are built in to the Labour Forecasting Tool. The labour coefficients for each project type are based on detailed analyses of historic data from the Office for National Statistics and data collected from historic site records. Each of the activities within the analysis have been assigned to the most appropriate model from amongst the project types listed below:

- Non-housing new-build buildings
- Stations
- All infrastructure:
  - Roads and motorways
  - Railways and underground railways
  - Construction of utility projects for fluids
  - Construction of utility projects for electricity & telecommunications
  - Construction of water projects
  - Tunnels SCL (sprayed concrete lined)
  - Tunnels TBM (tunnel boring machine)
  - Bridges
  - Cut and cover tunnels
  - Embankments and cuttings
  - Portals

The construction results are presented for each of 28 occupational groups and eight skills levels. The construction occupational aggregates have been derived by CITB from the 166 relevant job titles that appear in the Office for National Statistics' Standard Occupational Classifications (2010). Aggregation of job titles is necessary because analysing data at the job title level would result in samples that were too small to allow robust statistical analysis. Appendix A provides additional details.

For the construction forecasts three models have been developed for each stage of a sub-project. The three stages address:

- **Design services**, encompassing those involved in the design process, including senior managers and support staff within design organisations;
- **Management of construction**, encompassing those staff involved with the management of the delivery of the construction or installation and including the professionals employed for the construction stage of a project (e.g. architects employed to supervise the work); and
- **Construction operatives**, encompassing those operatives involved with the delivery of the construction or installation.

The forecasts assume that productivity growth in the construction sector will be 0.5% per annum. This assumption is consistent with the long-term average growth rate for output per hour worked in the UK construction sector between 1978 and 2014[16].

4.1.2   Results

Figure 21 and Table 6 show that the demand for construction labour and skills during Phase One and Phase 2a of the HS2 programme peaks in 2021/22 at around 25,200 workers, and is then forecast to fall to just over 500 workers by 2026. After 2026, demand increases again with a secondary peak of around 1,800 workers between 2029/30 and 2030/31. Almost half of the workforce is forecast to be construction operatives, with just over a third involved in management of construction. The remaining 15% are design services occupations.
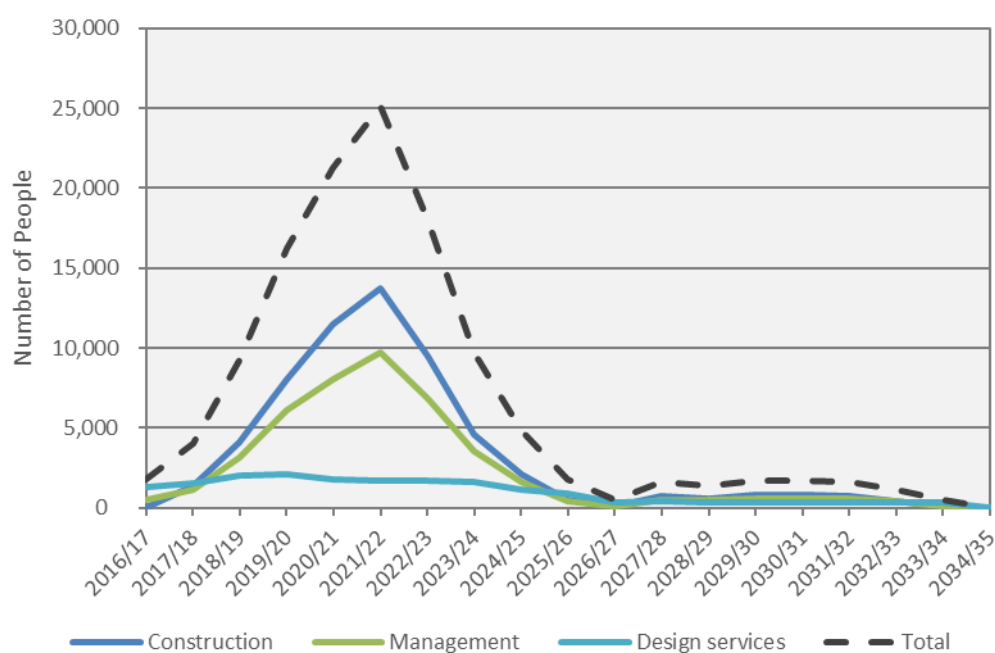
Figure 21: HS2 Construction labour demand by type of work – Phase One and Phase 2a

Stage of work	Person-years	Peak workforce	Timing of peak
Construction	59,600	13,700	2021/22
Management	44,200	9,700	2021/22
Design services	18,200	2,100	2018/19
Total[17]	**121,900**	**25,200**	**2021/22**

Table 6: HS2 Construction labour demand by type of work – Phase One and Phase 2a

Figure 22 and Table 7 show that the vast majority of the demand for workers in Phase One and Phase 2a occurs in London, the South East, and the West Midlands, together comprising over 93% of the total demand across these Phases. It should be noted that the regional analysis refers to the region in which labour demand is generated. It may not necessarily be the case that this work is delivered by workers based in the same region. Some occupations, (especially those in the professions) do not need to be based on site and can deliver work remotely. There may also be opportunities to deliver some work through offsite manufacturing.
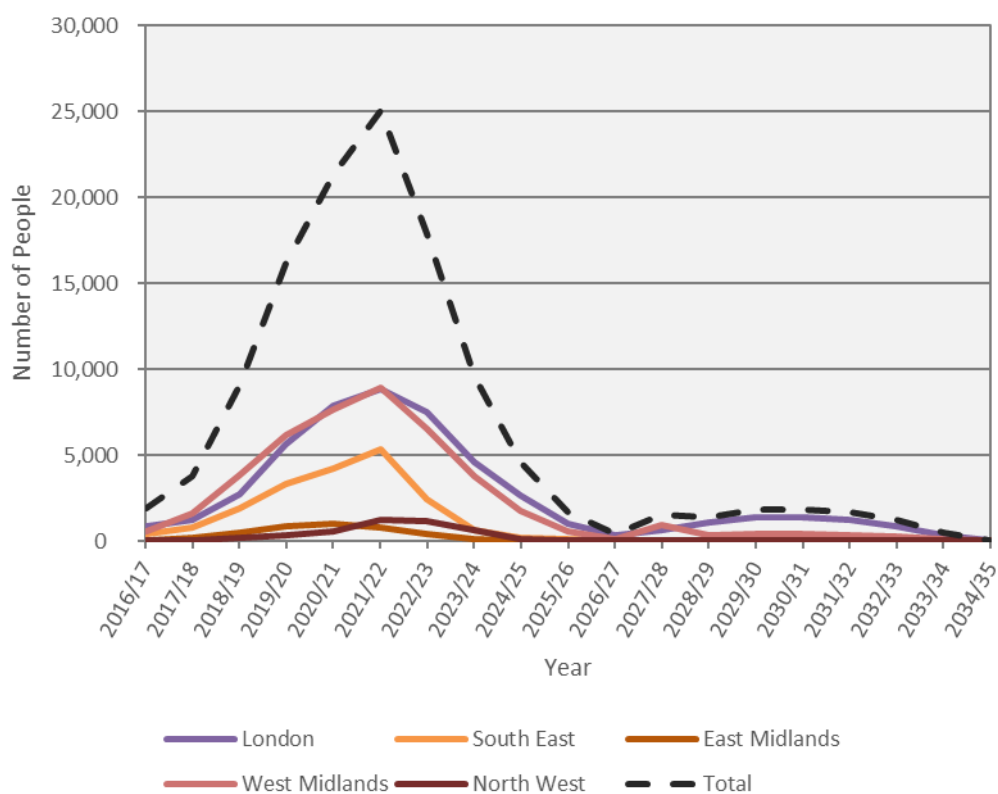
Figure 22: HS2 Construction labour demand by region – Phase One and Phase 2a

Region	Person-years	Peak workforce	Timing of peak
London	50,100	8,800	2021/22
South East	19,300	5,300	2021/22
East Midlands	4,000	1,000	2020/21
North West	4,200	1,200	2021/22
West Midlands	44,300	9,000	2021/22
Total[18]	**121,900**	**25,200**	**2021/22**

Table 7: HS2 Construction labour demand by region – Phase One and Phase 2a

Figure 23 and Table 8 present a breakdown of the labour demand by broad occupational group. Around a fifth of the workforce is concerned with senior management & other office based staff, with a similar proportion within designers. Civil engineering operatives and labourers are the largest of the trades and operative groups, peaking at 3,700 people.
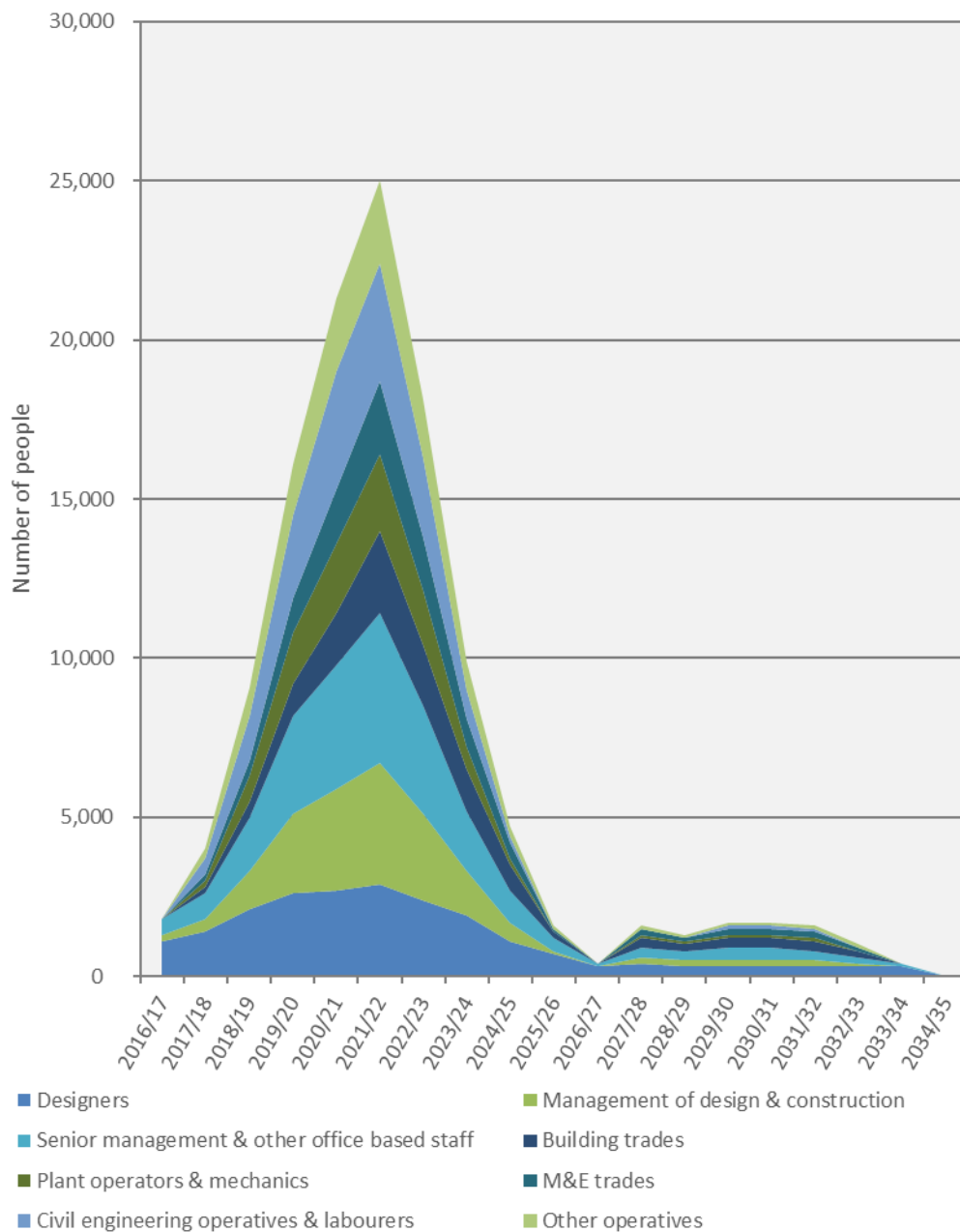
Figure 23: HS2 Construction labour demand by occupational group – Phase One and Phase 2a

Occupational group	Person-years	Peak workforce	Timing of peak
Designers/professionals	21,500	2,900	2021/22
Management of design & construction	17,200	3,800	2021/22
Senior management & other office based staff	23,500	4,700	2021/22
Building trades	11,800	2,600	2021/22
Plant operators & mechanics	10,200	2,400	2021/22
Mechanical & electrical (M&E) trades	10,200	2,300	2021/22
Civil engineering operatives & labourers	16,000	3,700	2021/22
Other operatives	11,500	2,600	2021/22
Total[19]	**121,900**	**25,200**	**2021/22**

Table 8: HS2 Construction labour demand by broad occupational group – Phase One and Phase 2a

Figure 24 and Table 9 provide a breakdown of the labour demand for Phase One and Phase 2a by skill level. The various skill levels are introduced and outlined in section 3.6.2.
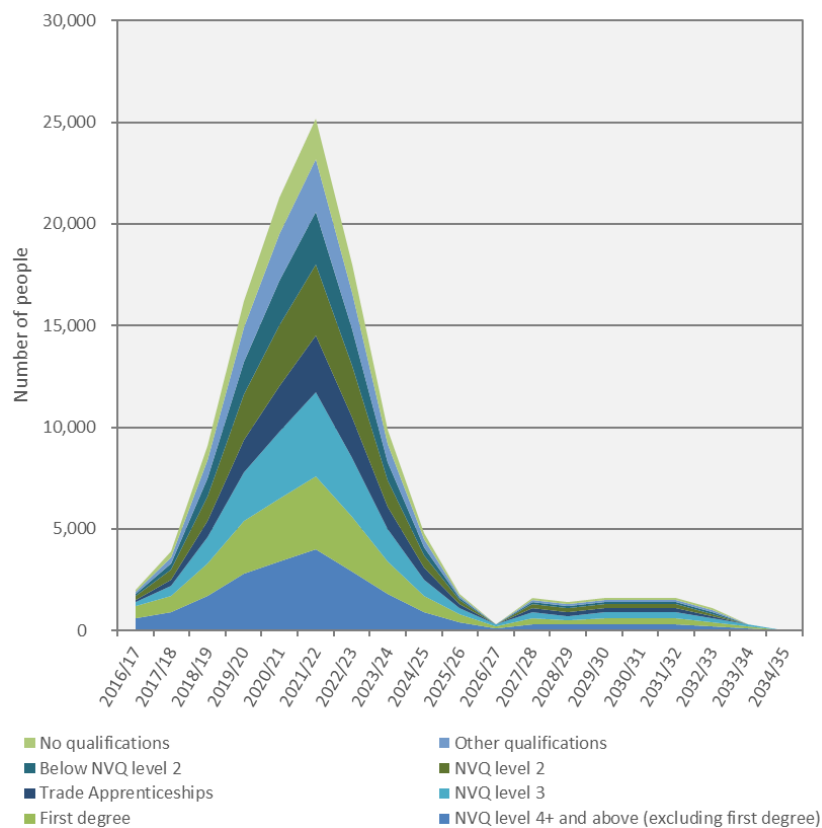
Figure 24: HS2 Construction labour demand by skill level – Phase One and Phase 2a

Skill level	Person-years	Peak workforce	Timing of peak
NVQ level 4+ and above (excluding first degree)	21,400	4,000	2021/22
First degree	19,600	3,600	2021/22
NVQ level 3	19,300	4,100	2021/22
Trade apprenticeships	12,800	2,800	2021/22
NVQ level 2	16,300	3,500	2021/22
Below NVQ level 2	11,800	2,600	2021/22
Other qualifications	11,700	2,600	2021/22
No qualifications	9,200	2,000	2021/22
Total[20]	**121,900**	**25,200**	**2021/22**

Table 9: HS2 Construction labour demand by qualification – Phase One and Phase 2a

4.2   Mismatch analysis

4.2.1   Overall mismatch analysis

This section explores the construction occupations that may face a potential mismatch between sector-wide requirements for labour and skills and their available supply.

The analysis in this section can be interpreted as a volume mismatch. It does not provide any insights into the criticality of specific occupations to the successful delivery of the HS2 programme. There may be occupations and skillsets that are critical to HS2 delivery but for whom the requirements are small in number.

The mismatch analysis is a preliminary, top down analytical approach. The intention is to identify occupations that merit more in-depth analysis to understand potential challenges to recruitment and retention of workers. It does not provide a definitive analysis.

The potential mismatches have been estimated using demand and supply forecasts are previously detailed in sections 3 and 4.1. The metrics have been designed to highlight three reasons why a mismatch might be of concern and potentially relevant to the HS2 construction programme:

1. The presence of an overall construction sector mismatch. This is measured using the following metrics.

- The **average demand for labour by occupation in the construction sector**. This is averaged over the period from 2017 to 2021 (the peak year for HS2 labour demand during Phase One and Phase 2a).

- The **average annual gross recruitment requirement (GRR) for each occupation in the construction sector** from 2017 to 2021. The GRR in each year is calculated as sector-wide labour demand minus available supply. The average annual GRR is then calculated as the sum of the annual GRRs over the period from the first year of the analysis to the year under consideration divided by the number of years under consideration. This is calculated for the three main regions of Phase One and 2a – London, South East and West Midlands.

- The **annual average inflow** is calculated by applying the historical inflow rate from 2006-2016 to the forecast for sector-wide demand to produce a forecast of potential inflows. Inflow rates are calculated in the same way as the outflows, using data from the ONS Labour Force Survey. The inflow data do not include those entering the sector from training.

2. The size of the wider pool of labour in other sectors that employers in the construction sector might draw on. This uses the **share of each occupation employed in the construction sector**. A low share according to this metric suggests a large potential pool of labour and skills available in other sectors. This is based on an analysis of the standard occupational classification and standard industrial classification Labour Force Survey Data from 2015[21].

3. The relative importance of the occupation in volume terms to the HS2 construction programme. This is assessed using the following metrics:

- The average annual labour requirement for HS2 from 2017 until the peak of that occupation.

- The size of HS2's requirement relative to the total size of the occupation in the construction sector.

- The importance of each occupation required by HS2, in volume terms, compared to the total HS2 demand across all construction occupations.

The mismatch analysis for construction in Phase One and Phase 2a is summarised in a scorecard in Table 10. The assessment of each occupation using the above criteria has produced a shortlist of priority construction occupations that warrant further investigation to understand whether we might anticipate recruitment challenges:

- Construction trades supervisors;
- Scaffolders;
- Plant operatives;
- Steel erectors/structural fabrication;
- Labourers not elsewhere classified (nec);
- Civil engineering operatives not elsewhere classified (nec); and
- Civil engineers.

In addition, the following occupations are identified as being at lower priority but may nonetheless warrant further investigation to understand whether we might anticipate recruitment challenges:

- Senior, executive, and business process managers;
- Construction project managers;
- Plant mechanics/fitters; and
- Logistics.

Each of the occupations listed above are considered in more detail in the following section.

Occupational group	Average total construction demand (2017-2021)	Average gross recruitment requirement (GRR) (2017-2021)	GRR as a share of total construction sector demand (2017-2021)	Average HS2 demand (2017-2021)	Average HS2 demand as a share of total construction sector demand (2017-2021)	HS2 demand in each occupation as a share of total HS2 labour demand (2017-2021)	Anticipated inflows as a share of average construction demand (2017-2021)	Construction employment as a share of employment in all sectors (2015)
Senior, executive, and business process	76,300	4,900	6%	700	1%	5%	4%	8%
Construction project managers	24,000	1,500	6%	300	1%	3%	3%	75%
Other construction process managers	88,500	3,400	4%	1,200	1%	9%	3%	31%
Non-construction professional, technical, IT, and other office-based staff	150,900	12,500	8%	1,700	1%	13%	8%	5%
Construction trades supervisors	21,000	2,500	12%	400	2%	3%	5%	47%
Wood trades and interior fit-out	97,200	7,500	8%	500	1%	4%	6%	69%
Bricklayers	20,600	1,400	7%	100	0%	1%	3%	96%
Building envelope specialists	49,900	600	1%	200	0%	1%	1%	84%
Painters and decorators	46,600	3,800	8%	<100	0%	0%	6%	81%
Plasterers	11,900	800	6%	<100	0%	0%	6%	96%
Roofers	14,500	900	6%	<100	0%	0%	6%	100%
Floorers	8,800	700	9%	<100	0%	0%	6%	80%
Glaziers	11,900	600	5%	<100	0%	0%	6%	53%
Specialist building operatives (nec)	22,400	1,000	4%	300	1%	2%	5%	35%
Scaffolders	6,700	600	9%	100	2%	1%	5%	76%
Plant operatives	12,800	1,500	12%	600	5%	5%	7%	21%
Plant mechanics/fitters	15,200	1,200	8%	600	4%	5%	10%	7%
Steel erectors/structural fabrication	9,000	800	9%	200	2%	2%	5%	16%
Labourers (nec)	48,100	8,600	18%	800	2%	6%	15%	78%
Electrical trades and installation	66,600	1,600	2%	800	1%	6%	3%	50%
Plumbing and HVAC[22] trades	59,300	2,000	3%	200	0%	2%	4%	78%

Occupational group	Average total construction demand (2017-2021)	Average gross recruitment requirement (GRR) (2017-2021)	GRR as a share of total construction sector demand (2017-2021)	Average HS2 demand (2017-2021)	Average HS2 demand as a share of total construction sector demand (2017-2021)	HS2 demand in each occupation as a share of total HS2 labour demand (2017-2021)	Anticipated inflows as a share of average construction demand (2017-2021)	Construction employment as a share of employment in all sectors (2015)
Logistics	9,400	1,600	17%	200	2%	1%	10%	2%
Civil engineering operatives (nec)	5,900	700	12%	1,200	21%	10%	11%	51%
Non-construction ops (nec)	12,700	900	7%	500	4%	4%	9%	3%
Civil engineers	19,900	1,100	5%	600	3%	5%	3%	76%
Other construction professionals and	79,600	5,400	7%	1,000	1%	8%	5%	24%
Architects	24,000	1,200	5%	100	0%	1%	6%	90%
Surveyors	31,000	900	3%	300	1%	2%	4%	66%
Total	**1,044,800**	**70,300**	**7%**	**13,000**	**1%**	**100%**	**5%**	**-**

Table 10: Construction mismatch scorecard – Phase One and Phase 2a

4.2.2   Priority occupations for further analysis

4.2.2.1.   Construction trades supervisors

The construction trades supervisors occupation includes both construction and building supervisors, and skilled metal, electrical and electronic trades supervisors. Table 11 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase One and Phase 2a regions	
Average total construction sector demand (2017-2021)	21,000
Average gross recruitment requirement (GRR) (2017-2021)	2,500
GRR as a share of total construction sector demand	12%
Average HS2 demand (2017-2021)	400
HS2 demand as a share of total construction sector demand	2%
Inflows – Phase One and Phase 2a regions	
Average anticipated inflows into the construction sector (2017-2021)	1,100
Anticipated inflows as a share of average construction sector demand	5%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	47%
Training – Phase One and Phase 2a regions	
Further Education achievements (2015/16)	1,460
Apprenticeship starts (2015/16)	240
Higher Education achievements – all of UK (2014/15)	4,380

Table 11: Mismatch analysis criteria for construction trades supervisors: Phase One and Phase 2a

The analysis suggests that, before accounting for inflows into the occupation, 2,500 construction trades supervisors per annum will need to be recruited across the construction sector operating in the Phase One and 2a regions between 2017 and 2021. This represents around 12% of sector-wide requirements for construction trades supervisors, with the remaining 88% expected to be met from the existing available supply of these workers. If historic inflow rates of 5% of construction sector demand were to be sustained into the future, then these inflows would be sufficient to satisfy less than half of this recruitment requirement.

Although historic inflows would be insufficient to satisfy the gross recruitment requirement, the training provision for construction trades supervisors in the Phase One and 2a regions is strong. Training for construction trades supervisors increasingly occurs at both Further Education and Higher Education level. At Higher Education level, the subject area of building includes many achievements in the combined relevant occupational areas of both construction trades supervisors and construction managers, which numbered 4,380 nationally in 2014/15.

It is also worth noting that there is also a large body of construction trades supervisors currently working outside of construction. Just over half (53%) of construction trades supervisors work in other industries, most notably the manufacturing sector (21%). This suggests a potentially large pool of available skills that could be drawn into construction.

The potential for retirement rates to increase in future is of concern. 28% of construction trades supervisors are aged 55 or over, against a sector average of 18%. Whilst the proportion of workers in this age category has fluctuated since 2012, the trend has been an increase from 23% in 2012 to 28% in 2016, indicating the possibility of retirement rates accelerating in future years. This should however be balanced against the less physically demanding nature of a construction trades supervisor role compared to manual roles, which may allow for later retirement ages.

4.2.2.2. Scaffolders

The mismatch analysis suggests that the occupation of scaffolders may warrant close attention. Table 12 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase One and 2a regions	
Average total construction sector demand (2017-2021)	6,700
Average gross recruitment requirement (GRR) (2017-2021)	600
GRR as a share of total construction sector demand	9%
Average HS2 demand (2017-2021)	100
HS2 demand as a share of total construction sector demand	2%
Inflows – Phase One and 2a regions	
Average anticipated inflows into the construction sector (2017-2021)	300
Anticipated inflows as a share of average construction sector demand	5%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	76%
Training – Phase One and 2a regions	
Further Education achievements (2015/16)	50
Apprenticeship starts (2015/16)	300

Table 12: Mismatch analysis criteria for scaffolders: Phase One and Phase 2a

The analysis suggests that, before accounting for inflows into the occupation, 600 scaffolders per annum will need to be recruited on average across the construction sector operating in the Phase One and 2a regions between 2017 and 2021. This represents around 9% of sector-wide requirements for scaffolders. If historic inflow rates of 5% of construction sector demand were to be sustained into the future, then these inflows would be sufficient to satisfy just over half of this recruitment requirement.

This potential shortfall could be mitigated by the strong apprenticeship provision for scaffolders in the Phase One and 2a regions, with 300 apprentice starts per annum.

Although the majority of scaffolders work inside the construction sector, there is a relatively small proportion (24%) working outside of construction, most notably in the mining (9%) and manufacturing (7%) sectors. This suggests another potential pool of available skills that could be drawn into construction to help fill this demand.

Assessing the level of unemployment in the scaffolding occupation by looking at the number of scaffolders currently claiming Jobseeker's Allowance (JSA) suggests there is limited scope for recruitment from this source. In the UK in 2017, 140 scaffolders

were out of work and claiming JSA, only 20 of whom reside in the Phase One and 2a regions.

Retirements in the scaffolding occupation are of less concern than in other occupations. Just 4% of scaffolders are aged 55 or over, against a sector average of 18% for all skilled trades occupations. The overall trend for this figure has been downwards over recent years, reducing from 9% in 2012 to 4% from 2014 onwards, indicating the possibility of less workers being lost to retirement than the historical trend in future years. Supporting this point, when asked the likelihood that in five years' time they will still want to be working in construction, just 2% of scaffolders stated that they hope to be retired (against a sector average of 4%).[23]

4.2.2.3. Plant operatives

The plant operative occupation includes roles such as crane drivers, plant and machine operatives, fork-lift truck drivers, and mobile machine drivers and operatives. Table 13 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase One and 2a regions	
Average total construction sector demand (2017-2021)	12,800
Average gross recruitment requirement (GRR) (2017-2021)	1,500
GRR as a share of total construction sector demand	12%
Average HS2 demand (2017-2021)	600
HS2 demand as a share of total construction sector demand	5%
Inflows – Phase One and 2a regions	
Average anticipated inflows into the construction sector (2017-2021)	600
Anticipated inflows as a share of average construction sector demand	7%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	21%
Training – Phase One and 2a regions	
Further Education achievements (2015/16)	4,230
Apprenticeship starts (2015/16)	110

Table 13: Mismatch analysis criteria for plant operatives: Phase One and Phase 2a

The analysis suggests that, before accounting for inflows to the sector, 1,500 plant operatives per annum on average will need to be recruited across the construction sector operating in the Phase One and 2a regions between 2017 and 2021. This represents around 12% of sector-wide requirements for plant operatives. If historic inflow rates of 7% of construction sector demand were to be sustained into the future, then these inflows would be sufficient to satisfy just over half of this recruitment requirement.

It appears likely that this potential shortfall can be made up through training. The training provision for plant operatives in the Phase One and 2a regions is very strong, with Further Education competence achievements currently numbering 4,230 per annum, the second highest in volume terms of all occupations. However, the adequacy of existing training will be dependent upon the type or category of machinery to be operated, and it cannot be expected that every Further Education achievement in this area will qualify the holder to operate every type of machinery required for HS2.

It is also worth noting that a large number of plant operatives currently work outside construction. There are 79% of plant operatives working in other industries, most notably manufacturing (33%), wholesale and retail (15%) and transport and storage (15%) sectors. This suggests a very large pool of available skills that could be drawn into construction. In some instances, however, there may be a requirement for these workers to be trained in skills specific to the types of plant operated in construction.

Assessing the level of unemployment in the plant operative occupation suggests there may be also be some scope to recruit from this source. In the UK in 2017, 1,390 plant operatives were out of work and claiming Jobseeker's Allowance, 380 of which currently reside in the Phase One and 2a regions.

Looking at the potential for an increase in retirement rates within this occupation, 12% of plant operatives are currently aged 55 or over, against a sector average of 18% for all skilled trades occupations. This figure for plant operatives has been on a downward trend from 21% in 2012 to 12% in 2016, indicating a potential reduction in the numbers being lost to retirement in future.

4.2.2.4. Steel erectors/structural fabrication

The steel erectors/structural fabrication occupation includes roles such as steel erectors, welding trades, metal plate workers, smiths and forge workers, and metal machining setters. Table 14 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase One and 2a regions	
Average total construction sector demand (2017-2021)	9,000
Average gross recruitment requirement (GRR) (2017-2021)	800
GRR as a share of total construction sector demand	9%
Average HS2 demand (2017-2021)	200
HS2 demand as a share of total construction sector demand	2%
Inflows – Phase One and 2a regions	
Average anticipated inflows into the construction sector (2017-2021)	500
Anticipated inflows as a share of average construction sector demand	5%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	16%
Training – Phase One and 2a regions	
Further Education achievements (2015/16)	180
Apprenticeship starts (2015/16)	0

Table 14: Mismatch analysis criteria for steel erectors/structure fabrication: Phase One and Phase 2a

The analysis suggests that, before accounting for inflows to the sector, 800 steel erectors per annum will need to be recruited across the construction sector operating in the Phase One and 2a regions between 2017 and 2021. This represents around 9% of sector-wide requirements for steel erectors. If historic inflow rates of 5% of construction sector demand were to be sustained into the future, then these inflows would be sufficient to satisfy just over half of this recruitment requirement.

If the volume of training continues at the current level of 180 competence achievements per annum in the Phase One and 2a regions, it will help to address some but not all of the potential shortfall, especially as this has not typically been an occupation where apprenticeships have been extensively used in the past.

However, 84% of the total workforce of steel erectors currently work outside of construction. The vast majority work in the manufacturing sector (77%), which suggests there may be considerable scope to recruit into construction from other sectors.

Assessing the level of unemployment in the steel erectors/structural fabrication occupation suggests there may be also be some scope to recruit from this source. In

the UK in 2017, 820 steel erectors were out of work and claiming Jobseeker's Allowance, 210 of which currently reside in the Phase One and 2a regions.

4.2.2.5. Labourers not elsewhere classified (nec)

The labourers (nec) occupation includes all workers classified as being in elementary construction occupations. Table 15 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase One and 2a regions	
Average total construction sector demand (2017-2021)	48,100
Average gross recruitment requirement (GRR) (2017-2021)	8,600
GRR as a share of total construction sector demand	18%
Average HS2 demand (2017-2021)	800
HS2 demand as a share of total construction sector demand	2%
Inflows – Phase One and 2a regions	
Average anticipated inflows into the construction sector (2017-2021)	7,100
Anticipated inflows as a share of average construction sector demand	15%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	78%
Training – Phase One and 2a regions	
Further Education achievements (2015/16)	0
Apprenticeship starts (2015/16)	0

Table 15: Mismatch analysis criteria for labourers (nec): Phase One and Phase 2a

The analysis suggests that, before accounting for inflows to the sector, 8,600 labourers (nec) per annum will need to be recruited on average across the construction sector operating in the Phase One and 2a regions between 2017 and 2021. This represents around 18% of sector-wide requirements for labourers (nec), the highest of any of the occupations analysed in Phase One and Phase 2a. If historic inflow rates of 15% of construction sector demand were to be sustained into the future, then these inflows would be sufficient to largely satisfy the recruitment requirement. The low barriers to entry in this occupation related to the relatively low skill levels explain the fluidity with which workers enter and exit.

There are no Further Education achievements or apprenticeship starts directly linked to this occupation. The pool of workers available to recruit is not therefore restricted to those people possessing particular qualifications. Labourers (nec) can be recruited from a far wider segment of the unemployed than workers in other occupations. For this reason, the labourer occupation also attracts low skilled migrant labour.

The majority of workers classified as labourers (nec) currently operate in the construction sector, although 22% of all labourers (nec) do operate outside of construction – most notably in the professional and other private services sector (9%). This suggests that there exist a pool of people currently working in this occupation who could be drawn into construction from other sectors.

Currently 10% of labourers (nec) are aged 55 or over, compared with a sector average of 18% for all skilled trades occupations. This figure has remained relatively static over recent years, fluctuating between 8% and 10% from 2012 to 2016, and indicating that retirement rates may remain relatively constant in future.

4.2.2.6.   Civil engineering operatives not elsewhere classified (nec)

Civil engineering operatives (nec) include a number of construction and maintenance operatives who experience high demand for their services during large scale infrastructure projects. HS2 is no different in this regard, and the analysis suggests that civil engineering operatives (nec) is an occupation that warrants further analysis. Table 16 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase One and 2a regions	
Average total construction sector demand (2017-2021)	5,900
Average gross recruitment requirement (GRR) (2017-2021)	700
GRR as a share of total construction sector demand	12%
Average HS2 demand (2017-2021)	1,200
HS2 demand as a share of total construction sector demand	21%
Inflows – Phase One and 2a regions	
Average anticipated inflows into the construction sector (2017-2021)	600
Anticipated inflows as a share of average construction sector demand	11%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	51%
Training – Phase One and 2a regions	
Further Education achievements (2015/16)	2,270
Apprenticeship starts (2015/16)	470

Table 16: Mismatch analysis criteria for civil engineering operatives (nec): Phase One and Phase 2a

The analysis suggests that, before accounting for inflows to the sector, 700 civil engineering operatives (nec) per annum will need to be recruited across the construction sector operating on average in the Phase One and 2a regions between 2017 and 2021. This represents around 12% of sector-wide requirements for civil engineering operatives (nec). If historic inflow rates of 11% of construction sector demand were to be sustained into the future, then these inflows would be sufficient to satisfy the large majority of this recruitment requirement.

Furthermore, it may be possible to sustain inflow rates in future that exceed those observed in the recent past. The training provision for civil engineering operatives (nec) in the Phase One and 2a regions is relatively strong. Further Education competence achievements currently number 2,270 per annum in these regions, the third highest in volume terms of all occupations, whilst apprenticeship starts per annum total 470. Training for civil engineering operatives (nec) will cover qualifications in subjects as varied as general construction operations, highways maintenance, road building, demolition and tunnelling. A more detailed analysis of the specific skills required within the civil engineering operative role by HS2

construction would be required to confirm whether the pipeline of training and apprenticeships will meet the needs of HS2 construction.

There is also a large body of civil engineering operatives (nec) working outside of construction (49%), most notably in the mining (18%), manufacturing (14%) and transport and storage (11%) sectors, which is a potentially large pool of available skills that could be drawn into construction.

4.2.2.7. Civil engineers

The mismatch analysis suggests that civil engineers is an occupation that may warrant further analysis. Table 17 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase One and 2a regions	
Average total construction sector demand (2017-2021)	19,900
Average gross recruitment requirement (GRR) (2017-2021)	1,100
GRR as a share of total construction sector demand	5%
Average HS2 demand (2017-2021)	600
HS2 demand as a share of total construction sector demand	3%
Inflows – Phase One and 2a regions	
Average anticipated inflows into the construction sector (2017-2021)	600
Anticipated inflows as a share of average construction sector demand	3%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	76%
Training	
Higher Education achievements – all of UK (2014/15)	4,650

Table 17: Mismatch analysis criteria for civil engineers: Phase One and Phase 2a

The analysis suggests that, before accounting for inflows to the sector, 1,100 civil engineers per annum will need to be recruited on average across the construction sector operating in the Phase One and 2a regions between 2017 and 2021. This represents around 5% of sector-wide requirements for steel erectors. If historic inflow rates of 3% of construction sector demand were to be sustained into the future, then these inflows would go some way to satisfying this recruitment requirement.

Furthermore, it may be possible to increase inflow rates in future above those observed in the recent past as the training provision for civil engineers at UK universities is strong. Higher Education competence achievements currently number 4,650 per annum in the UK, although the challenge here will be ensuring these graduates enter the construction sector.

There is a small share of all civil engineers working outside of construction (24%), most notably in the extraction and mining (6%) and manufacturing (5%) sectors. This suggests an additional, albeit fairly small, pool of available skills that could be drawn into construction.

Assessing the level of unemployment suggests there is very limited scope to draw from this resource. In the UK in 2017, just 100 civil engineers were out of work and claiming Jobseeker's Allowance, only 20 of whom currently reside in the Phase One and 2a regions.

12% of civil engineers currently are aged 55 or over, compared with an average of 22% for all managerial and professional occupations within construction. This figure for civil engineers was on an upward trend from 18% in 2012 to 22% in 2015, before reducing to 12% in 2016. This volatility make it difficult to assess whether future retirement rates will diverge from historic trends.

4.2.3   Other occupations

As outlined in section 4.2.1 there are four occupations identified as being at lower risk of facing recruitment challenges but might nonetheless benefit from more detailed analysis. The first three under consideration are plant mechanics/fitters; logistics; and senior, executive and business process managers. The overall construction sector operating in the Phase One and 2a regions will need to recruit an annual average of around 1,200, 1,600, and 4,900 respectively into each of these occupations between 2017 and 2021. This requirement for recruitment represents around 8% of sector-wide requirements for plant mechanics/fitters, 17% for logistics, and 6% for senior, executive and business process managers.

However, these three occupations are all characterised by a significant number of workers currently working outside of construction. Just 7% of all plant mechanics/fitters currently work in construction. In logistics, the figure is even lower at just 2%. For senior, executive and business process managers, just 8% work in construction

The fourth occupation in this group warranting further consideration is construction project managers. The gross recruitment requirement for the overall construction sector operating in the Phase One and 2a regions is 1,500 per annum on average between 2017 and 2021, representing around 6% of construction sector-wide requirements for construction project managers. However, unlike the three occupations above, there is smaller pool of workers in this occupation working outside of construction, with just 25% operating outside of the sector. Despite this, reassurance can be gained from large volumes of achievements occurring in both further and higher education for this occupation.

5 Construction demand and mismatch analysis: Phase 2b

5.1 Construction demand

Figure 25 and Table 18 show that labour and skills demand generated by the construction of HS2 Phase 2b is forecast to be concentrated in the period from 2024 to 2033, peaking in 2031/32 at around 16,000 people.
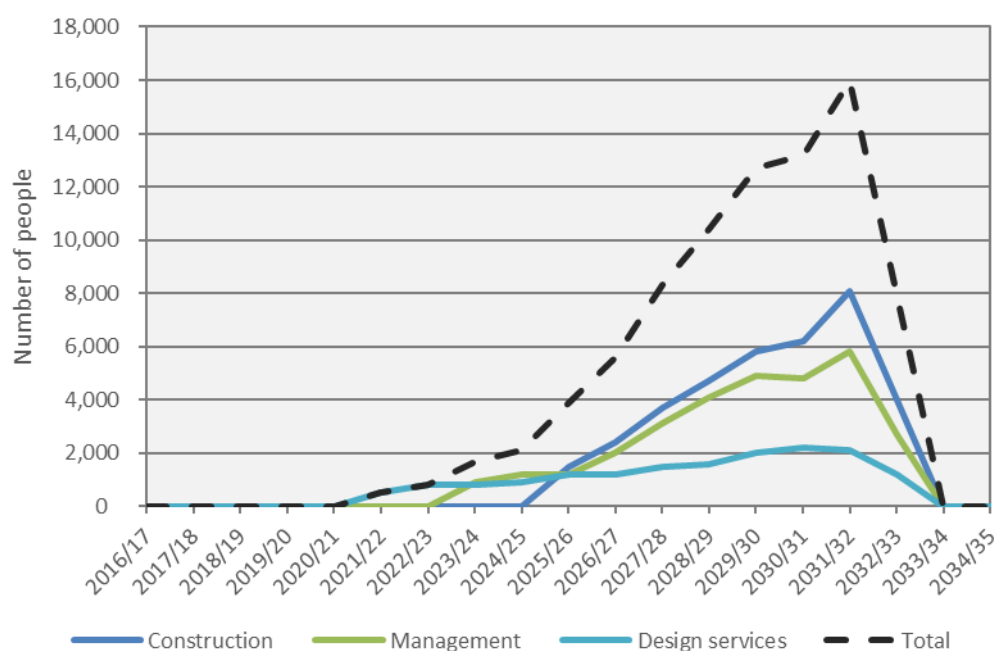
Figure 25: HS2 construction labour demand by type of work – Phase 2b

Stage of work	Person-years	Peak workforce	Timing of peak
Construction	36,300	8,100	2031/32
Management	30,700	5,800	2031/32
Design services	15,900	2,200	2030/31
Total[24]	**82,800**	**16,000**	**2031/32**

Table 18: HS2 construction labour demand by type of work – Phase 2b

Figure 26 and Table 19 provide a breakdown of the Phase 2b labour demand by the broad occupational groups used previously in the forecasts for Phase One and Phase 2a.
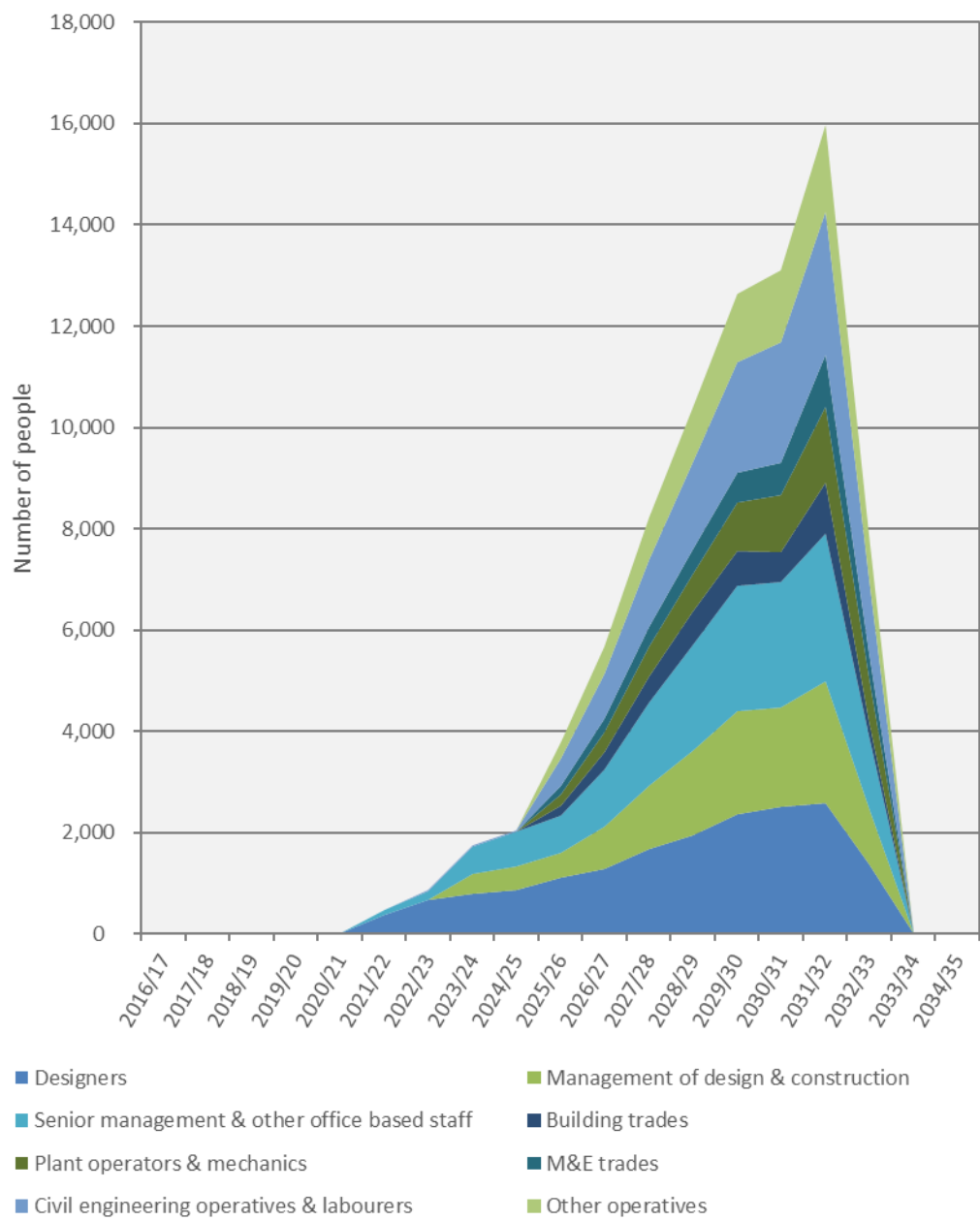
Figure 26: HS2 construction labour demand by occupational group – Phase 2b

Broad occupational group	Person-years	Peak workforce	Timing of peak
Designers	17,600	2,600	2031/32
Management of design & construction	12,600	2,400	2031/32
Senior management & other office based staff	16,400	2,900	2031/32
Building trades	4,300	1,000	2031/32
Plant operators & mechanics	6,400	1,500	2031/32
M&E trades	4,100	1,000	2031/32
Civil engineering operatives & labourers	13,300	2,800	2031/23
Other operatives	8,200	1,700	2031/32
Total[25]	**82,800**	**16,000**	**2031/32**

Table 19: HS2 Construction labour demand by broad occupational group – Phase 2b

Figure 27 and Table 20 presented a breakdown by skill level of the HS2 workforce in Phase 2b. Almost a fifth of the workforce are forecast to require skills at NVQ level 4 and above.
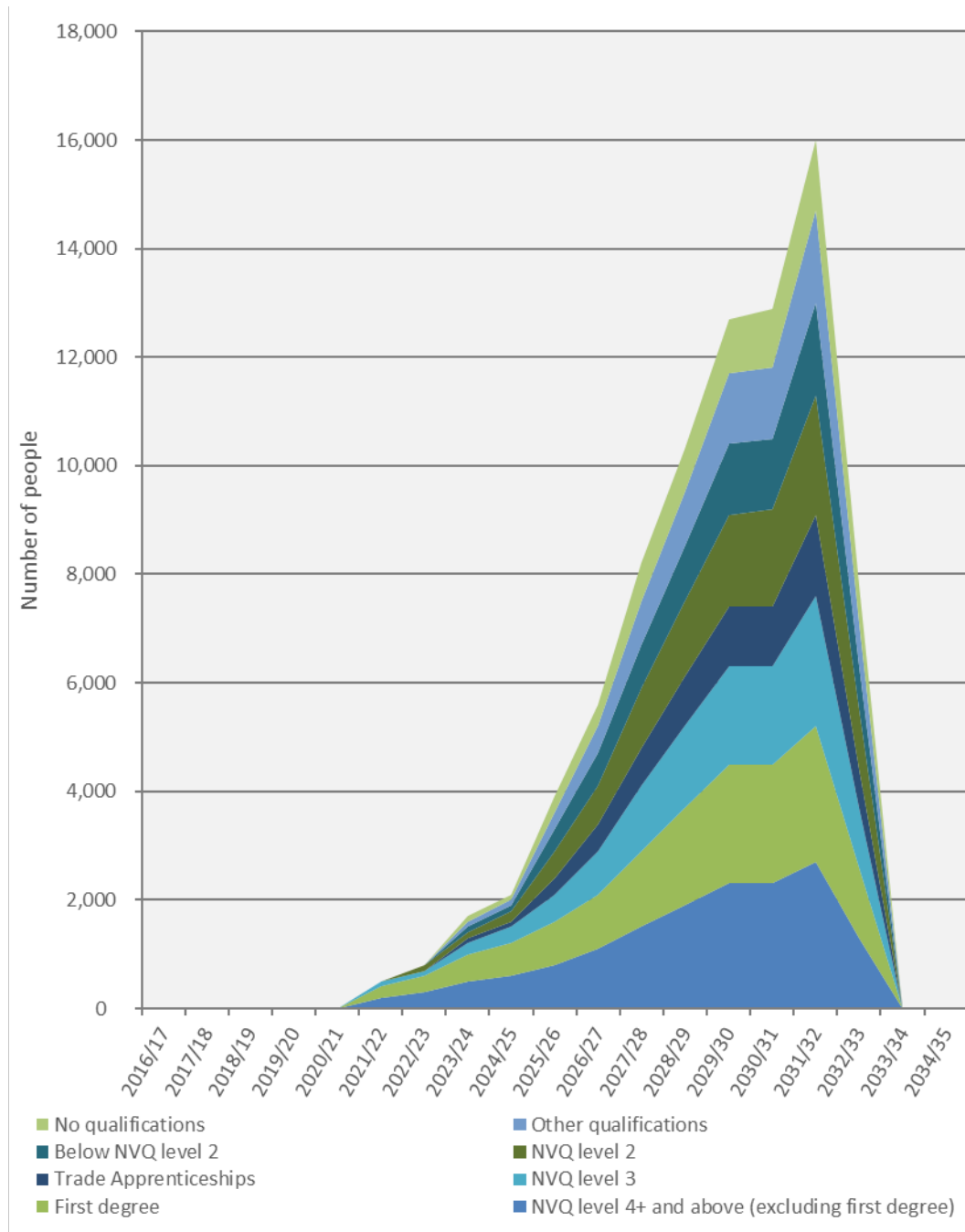
Figure 27: HS2 construction labour demand by qualification – Phase 2b

Skill level	Total person-years	Peak workforce	Timing of peak
NVQ level 4+ and above (excl. first degree)	15,500	2,700	2031/32
First degree	14,700	2,500	2031/32
NVQ level 3	11,800	2,400	2031/32
Trade apprenticeships	7,200	1,500	2031/32
NVQ level 2	10,900	2,200	2031/32
Below NVQ level 2	8,100	1,700	2031/32
Other qualifications	8,100	1,700	2031/32
No qualifications	6,600	1,300	2031/32
Total[26]	**82,800**	**16,000**	**2031/32**

Table 20: HS2 Construction labour demand by qualification – Phase 2b

5.2   Mismatch analysis

5.2.1   Overall mismatch analysis

The mismatch analysis for Phase 2b follows the same methodology used for Phase One and Phase 2a and outlined in section 4.2.1. It focuses on the three main regions along the Phase 2b line of route – the North West, the East Midlands, and Yorkshire & the Humber as a combined area. These are referred to as the Phase 2b regions in the remainder of this section. The occupations which are identified in the mismatch analysis in Phase 2b as facing potential recruitment challenges and meriting further analysis are different from those identified for Phase One and Phase 2a. This is principally due to regional differences in the existing workforce and the forecast change in sector-wide demand.

The mismatch analysis for Phase 2b construction is summarised in a scorecard in Table 21. The following occupations have been identified as a shortlist of priority construction occupations that warrant further investigation to understand whether we might anticipate recruitment challenges:

• Plant operatives;
• Labourers not elsewhere classified (nec); and
• Civil engineering operatives not elsewhere classified (nec).

In addition, the following occupations are identified as being of lower priority, given the prevalence of workers employed outside the construction sector in these occupations, but may nonetheless warrant further investigation to understand whether we might anticipate recruitment challenges:

- Logistics;
- Plant mechanics/fitters; and
- Non-construction professional, technical, IT, and other office-based staff.

This mismatch analysis should be interpreted in the context of lower levels of mobility of workers in the Phase 2b regions compared to other regions of the UK, as detailed in Section 3.5.2.

Occupational group	Average total construction demand (2017-2031)	Average gross recruitment requirement (GRR) (2017-2031)	GRR as a share of total construction sector demand (2017-2031)	Average HS2 demand (2017-2031)	Average HS2 demand as a share of total construction sector demand (2017-2031)	HS2 demand in each occupation as a share of total HS2 labour demand (2017-2031)	Anticipated inflows as a share of average construction demand (2017-2031)	Construction employment as a share of employment in all sectors (2015)
Senior, executive, and business process	48,000	2,800	6%	300	1%	6%	4%	8%
Construction project managers	10,900	600	5%	100	1%	3%	3%	75%
Other construction process managers	51,900	2,200	4%	400	1%	9%	3%	31%
Non-construction professional, technical, IT, and other office-based staff	97,700	8,200	8%	700	1%	14%	8%	5%
Construction trades supervisors	11,400	900	8%	200	1%	3%	6%	47%
Wood trades and interior fit-out	62,700	4,500	7%	100	0%	3%	6%	69%
Bricklayers	17,500	1,100	6%	<100	0%	1%	3%	96%
Building envelope specialists	24,000	100	1%	<100	0%	1%	1%	84%
Painters and decorators	21,600	1,600	7%	<100	0%	0%	6%	81%
Plasterers	14,400	1,000	7%	<100	0%	0%	6%	96%
Roofers	12,600	800	6%	<100	0%	0%	6%	100%
Floorers	7,500	500	7%	<100	0%	0%	6%	80%
Glaziers	8,600	400	4%	<100	0%	0%	6%	53%
Specialist building operatives (nec)	14,600	600	4%	100	1%	3%	5%	35%
Scaffolders	6,900	500	7%	<100	1%	1%	5%	76%
Plant operatives	10,200	1,000	9%	200	2%	4%	7%	21%
Plant mechanics/fitters	12,100	900	8%	100	1%	3%	10%	7%
Steel erectors/structural fabrication	6,900	500	7%	100	1%	2%	5%	16%
Labourers (nec)	33,200	5,800	18%	400	1%	8%	15%	78%
Electrical trades and installation	47,300	900	2%	200	0%	4%	3%	50%

Occupational group	Average total construction demand (2017-2031)	Average gross recruitment requirement (GRR) (2017-2031)	GRR as a share of total construction sector demand (2017-2031)	Average HS2 demand (2017-2031)	Average HS2 demand as a share of total construction sector demand (2017-2031)	HS2 demand in each occupation as a share of total HS2 labour demand (2017-2031)	Anticipated inflows as a share of average construction demand (2017-2031)	Construction employment as a share of employment in all sectors (2015)
Plumbing and HVAC trades	42,800	1,900	5%	100	0%	1%	4%	78%
Logistics	5,000	800	16%	100	2%	2%	10%	2%
Civil engineering operatives (nec)	7,500	800	11%	400	5%	8%	11%	51%
Non-construction ops (nec)	11,300	700	6%	100	1%	3%	9%	3%
Civil engineers	13,600	800	6%	400	3%	8%	3%	76%
Other construction professionals and	49,100	2,900	6%	500	1%	11%	5%	24%
Architects	5,500	200	4%	<100	0%	1%	6%	90%
Surveyors	18,300	800	4%	100	1%	3%	4%	66%
Total	**673,200**	**43,900**	**7%**	**4,700**	**1%**	**100%**	**6%**	

Table 21: Construction mismatch scorecard – Phase 2b

5.2.2 Priority occupations for further analysis

5.2.2.1. Plant operatives

The plant operative occupation includes roles such as crane drivers, plant and machine operatives, fork-lift truck drivers, and mobile machine drivers and operatives. Table 22 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase 2b regions	
Average total construction sector demand (2017-2031)	10,200
Average gross recruitment requirement (GRR) (2017-2031)	1,000
GRR as a share of total construction sector demand	9%
Average HS2 demand (2017-2031)	200
HS2 demand as a share of total construction sector demand	2%
Inflows – Phase 2b regions	
Average anticipated inflows into the construction sector (2017-2031)	700
Anticipated inflows as a share of average construction sector demand	7%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	21%
Training – Phase 2b regions	
Further Education achievements (2015/16)	3,710
Apprenticeship starts (2015/16)	80

Table 22: Mismatch analysis criteria for plant operatives: Phase 2b

The analysis suggests that, before accounting for inflows to the sector, 1,000 plant operatives per annum will need to be recruited in the overall construction sector operating in the Phase 2b regions between 2017 and 2031. This represents around 9% of sector-wide requirements for plant operatives. If historic inflow rates of 7% of construction sector demand were to be sustained into the future, then these inflows would be sufficient to satisfy most of this recruitment requirement.

It appears likely that this slight potential shortfall can be made up through training. The training provision for plant operatives in the Phase 2b regions is strong, with the second highest volume of Further Education competence achievements of all construction occupations. However, the adequacy of existing training will be

dependent upon the type or category of machinery to be operated, and it cannot be expected that every Further Education achievement in this area will qualify the holder to operate every type of machinery required for HS2.

Assessing the level of unemployment in the plant operative occupation suggests there may be also be some scope to recruit from this potential source. In the UK in 2017, 1,390 plant operatives were out of work and claiming Jobseeker's Allowance, 350 of which currently reside in the Phase 2b regions.

There is also a large body of plant operatives currently work outside of construction (79%).

5.2.2.2. Labourers not elsewhere classified (nec)

The labourers (nec) occupation includes all workers classified as being in elementary construction occupations. Table 23 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase 2b regions	
Average total construction sector demand (2017-2031)	33,200
Average gross recruitment requirement (GRR) (2017-2031)	5,800
GRR as a share of total construction sector demand	18%
Average HS2 demand (2017-2031)	400
HS2 demand as a share of total construction sector demand	1%
Inflows – Phase 2b regions	
Average anticipated inflows into the construction sector (2017-2031)	4,900
Anticipated inflows as a share of average construction sector demand	15%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	78%
Training – Phase 2b regions	
Further Education achievements (2015/16)	0
Apprenticeship starts (2015/16)	0

Table 23: Mismatch analysis criteria for labourers (nec): Phase 2b

The analysis suggests that, before accounting for inflows to the sector, 5,800 labourers (nec) per annum will need to be recruited into the overall construction sector operating in the Phase 2b regions between 2017 and 2031. This represents

around 18% of sector-wide requirements for labourers (nec), the highest of any of the occupations analysed in Phase 2b. If historic inflow rates of 15% of construction sector demand were to be sustained into the future, then these inflows would be sufficient to satisfy most of this recruitment requirement.

Assessing the level of unemployment in the labourer occupation suggests there is scope to draw from this source. In the UK in 2017, 6,130 labourers (nec) were out of work and claiming Jobseeker's Allowance, 1,630 of which currently reside in the Phase 2b regions. In addition, the potential pool of unemployed people who could be recruited into this occupation extends far beyond those classifying themselves as labourers (nec).

There are no Further Education achievements or apprenticeship starts directly linked to this occupation. The majority of workers classified as labourers (nec) (78%) currently operate in the construction sector. Currently, 10% of labourers (nec) are aged 55 or over compared with a sector average of 18% for all skilled trades occupations but there have been high levels of volatility in this age bracket over the last five years suggesting that future retirement rates are difficult to forecast.

5.2.2.3. Civil engineering operatives not elsewhere classified (nec)

This occupational group includes a number of construction and maintenance operatives who experience high demand for their services during large scale infrastructure projects. Table 24 summarises the mismatch analysis criteria.

Criteria	Value
Demand, supply and mismatch – Phase 2b regions	
Average total construction sector demand (2017-2031)	7,500
Average gross recruitment requirement (GRR) (2017-2031)	800
GRR as a share of total construction sector demand	11%
Average HS2 demand (2017-2031)	400
HS2 demand as a share of total construction sector demand	5%
Inflows – Phase 2b regions	
Average anticipated inflows into the construction sector (2017-2031)	800
Anticipated inflows as a share of average construction sector demand	11%
Share of the occupation within the construction sector (UK wide)	
Construction employment as a share of employment in all sectors (2015)	51%
Training – Phase 2b regions	
Further Education achievements (2015/16)	1,250
Apprenticeship starts (2015/16)	850

Table 24: Mismatch analysis criteria for civil engineering operatives (nec): Phase 2b

The analysis suggests that, before accounting for inflows to the sector, 800 civil engineering operatives (nec) per annum will need to be recruited into the overall construction sector operating in the Phase 2b regions between 2017 and 2031. This represents around 11% of sector-wide requirements for civil engineering operatives (nec). If historic inflow rates of 11% of construction sector demand were to be sustained into the future, then these inflows would be sufficient to satisfy this recruitment requirement.

Furthermore, it may be possible to sustain inflow rates in future that exceed those observed in the recent past. The training provision for civil engineering operatives (nec) in the Phase 2b regions is relatively strong. It is worth noting that this training for civil engineering operatives (nec) will cover qualifications in subjects as varied as general construction operations, highways maintenance, road building, demolition and tunnelling. While many of these qualifications may be relevant, a more detailed analysis of the specific skills required within the civil engineering operative role by HS2 construction would be required to confirm whether the pipeline of training and apprenticeships will meet the needs of HS2 construction.

There also exists a large body of civil engineering operatives (nec) working outside of construction (49%) who could be drawn into construction.

5.2.3   Other occupations

Three further occupational groups are identified as being at lower risk of facing recruitment challenges during but might nonetheless benefit from more detailed analysis - plant mechanics/fitters; logistics; and non-construction professional, technical, IT and other office-based staff. The overall construction sector operating in the Phase 2b regions will need to recruit an annual average of around 900, 800, and 8,200 people respectively between 2017 and 2031 for these three occupational groups. This recruitment requirement represents around 8% of sector-wide requirements for plant mechanics/fitters, 16% for logistics, and 8% for non-construction professional, technical, IT and other office-based staff.

However, it is notable that a significant number of workers in these occupations currently work outside construction. Just 7% of plant mechanics/fitters currently work in construction. In logistics, the figure is even lower at just 2%. In non-construction professional, technical, IT and other office-based staff, 5% of the total number of workers in this occupation are in construction.

In all three of these cases, there exists a large additional pool of potential workers currently working outside of the construction sector which could potentially be drawn into construction in times of high demand.

6 Rail engineering sector analysis

6.1 The rail engineering sector today

The rail engineering sector differs from construction in that it does not exist as a specific industrial category within the Standard Industrial Classifications. As such, it is not possible to determine the characteristics of the sector and its workforce in the same way as for construction. Over the course of 2017, National Skills Academy for Rail (NSAR) have gathered survey information from the rail engineering sector regarding its current workforce. Information has been taken from a mixture of employer provided survey data and data provided from the Sentinel[27] database of safety critical workers. These data provide the basis to assess the capacity of the rail engineering sector to meet future workforce requirements.

These data provide information on nearly 224,000 members of the UK rail engineering workforce. NSAR believe that data has been secured from all of the major rail employers and therefore a working assumption that the data is approximately 85% to 90% complete has been used. Accordingly, it is not unreasonable to assume that the sector has a total workforce of closer to 250,000.

Table 25 shows how the workforce is split into the construction, maintenance and operation of different asset types. The asset "operations" means those staff involved in activities such as business management or operations such as customer service activities on board trains and is therefore not relevant to this commission. The number of workers involved in track assets constitutes nearly 30% of the workforce. The traction & rolling stock, electrification & power and signalling, systems & telecommunications asset types are all highly relevant to HS2.

Asset type	Workforce
Operations	93,800
Track	80,400
Traction & rolling stock	19,800
Electrification	15,900
Signalling & telecommunications	6,900
Civils & structures	1,600
Property, stations & depots	3,800
Systems engineering	1,700
Total	**223,900**

Table 25: UK rail engineering distribution of workforce by asset types

Table 26 shows the distribution of the 224,000 workforce, as derived from survey data, by type of work. Investment projects are the largest type category, employing forty-three per cent (some 97,000) of the rail engineering workforce, whilst less than 1% are employed in manufacturing.

Work type	Split
Investment projects	43%
Operations	29%
Maintenance	16%
Business management	11%
Manufacturing	<1%
Total	**100%**

Table 26: UK rail engineering split of rail workforce by work type

6.2   Future sector-wide rail engineering labour and skills demand

As is the case for construction, a forecast of future sector-wide demand for rail engineering labour and skills has been used to determine future recruitment requirements in the sector, alongside estimates of available supply for the relevant occupations. Forecasts of future sector demand have been estimated by translating forecast volumes of rail sector investment into the number of workers required to deliver that investment. The number of people required to deliver a given level of investment are determined by an analysis of data gathered in relation to the numbers working in the industry and the type of work they are carrying out. A constant number of people at current skill levels per unit invested is assumed; no allowance is made for productivity growth due to a lack of historic data.

Forecasts for the level of investment in the UK rail engineering sector are taken from published sources in the short to medium run where investments plans exist, with extrapolation based on reasonable assumptions for funding levels beyond the published periods. For example, it has been assumed that investment in maintenance, renewals and operations activities will continue at a relatively constant rate until 2033, while funding levels for enhancement projects is assumed to vary. This is in line with funding parameters set by Government for Network Rail's Control Period 6 (CP6 - 2019 to 2024), which provides core funding for renewal, maintenance and operations activities but funds enhancement projects only where a business case is justifiable and demonstrable.

In addition, the forecast investment levels account for other enhancement schemes that may affect the rail engineering sector's demand for labour and skills during the delivery of HS2. Notably, these are schemes such as Crossrail, Four Line Modernisation by TfL, East West Rail, Crossrail 2, works undertaken on behalf of Transport for West Midlands, Trans Pennine and North West Electrification schemes, South Wales Metro, New Tube for London and other enhancement or improvement schemes. The sector investment data becomes less reliable beyond the mid-2020s when there is less certainty around secured funding levels. The levels of investment for enhancement schemes for the mid-2020s onwards are often unknown and therefore the projections are based upon a continuing level of renewals and maintenance activities. No additional enhancement schemes are included, except where known and predictable.

The forecast of future labour demand is shown in Figure 28 for investment projects in rail systems. This is presented for the six regions combined through which HS2 will pass[28]. The rail systems demand profile fluctuates considerably over the period with a distinct reduction in the workforce over the period to 2033. The fluctuations reflect historic year-on-year changes in the rail systems investment profile with the work in the early to mid-2020s and early 2030s featuring a large contribution from HS2. In addition, investment in other assumed and significant schemes such as Crossrail 2 starts to decrease from 2030 onwards, leading to a compound effect from that period onwards on the demand for labour and skills. Finally, the overall downward trend in the demand profile is a function of greater certainty about projects which are due to occur in the immediate future and less knowledge about future investment decisions.
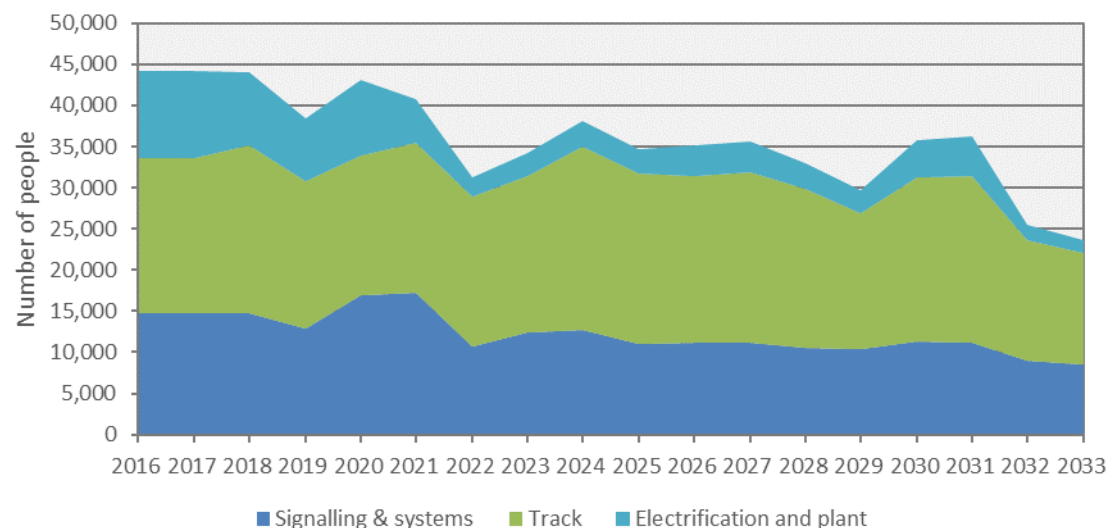
Figure 28: Labour demand forecasts for rail systems in six regions along HS2 line of route

Figure 29 presents the forecast future labour demand for traction and rolling stock manufacture. As for rail systems the investment profile produces a fluctuating demand profile. The peaks in the mid-2020s and early 2030s feature a substantial contribution from HS2. Overall there is a downward trend in labour demand which, like rail systems, is driven partly by an absence of any future investment plans in traction and rolling stock manufacture.
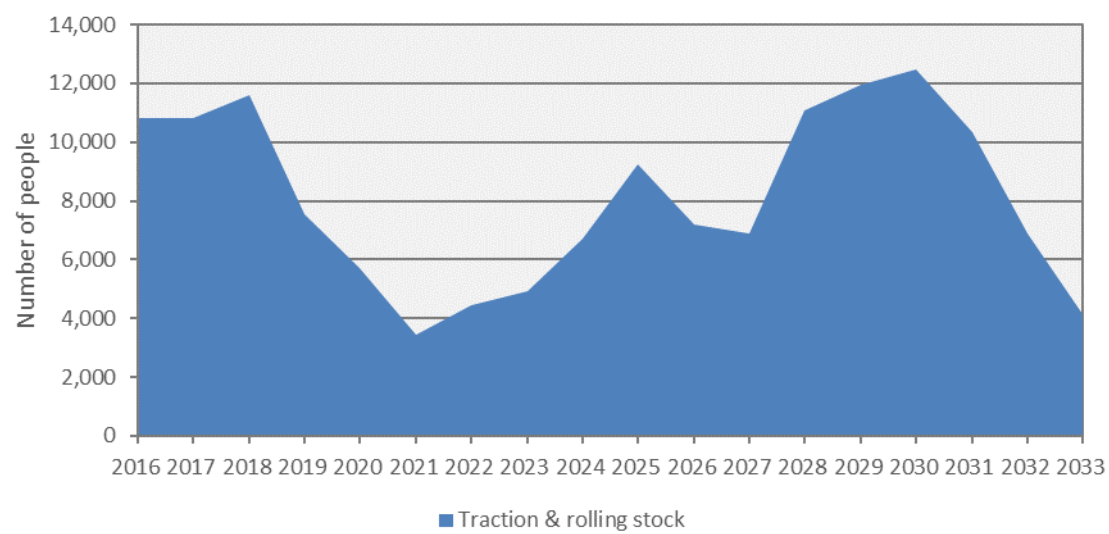
Figure 29: Labour demand forecast for traction & rolling stock manufacture, all regions of UK

6.3   Forecasting the future rail engineering available supply

A key purpose of this commission is to estimate any potential mismatches between the demand for labour and skills involved in rail engineering investment projects and their available supply.

Forecasting the future available supply of rail engineering labour and skills presents the same challenges as for the construction sector, as described in section 3. In addition, there are particular characteristics of railway systems and rolling stock design and manufacture that need to be taken into account:

- Rail systems activities such as signalling design and manufacture do not take place at the site of the railway line. With the move towards digital rail systems, the trend towards a higher proportion of the work taking place off-site is likely to accelerate. As a result, the mismatch analysis between skills requirements and their availability at the level of individual regions for these activities is not as meaningful as the aggregated regional picture.
- Rolling stock design and manufacture could in principle be based anywhere geographically.

The method of calculating the available supply for rail engineering is the same as that for construction outlined in section 4.2. For each occupational group, the current workforce (as measured by the NSAR survey in 2016) decreases each year according to an assumed outflow rate from the sector. Since the National Statistics data do not separately identify rail engineering as a sector, it is not possible to precisely follow the approach used for the construction sector where data on historic outflow rates have been used to proxy for future outflows. Instead, occupations in the Office for National Statistics LFS data have been carefully inspected and mapped to the most similar rail engineering job roles. This then allows historic outflow rates (over the period 2006-2016[29]) from the LFS data to be used to proxy for future outflows in the forecast. As is the case for the analysis of available supply in the construction sector, this approach implicitly assumes that factors such as the age structure of the workforce, technologies and ways of working in the rail engineering sector remain relatively unchanged in future.

6.4   Factors affecting available supply

6.4.1   Age analysis

Figure 30 shows that the median age of the rail investment projects workforce is 38. For maintenance and operations activities the median age is 45, and for the rail sector as a whole, the median age is 42.
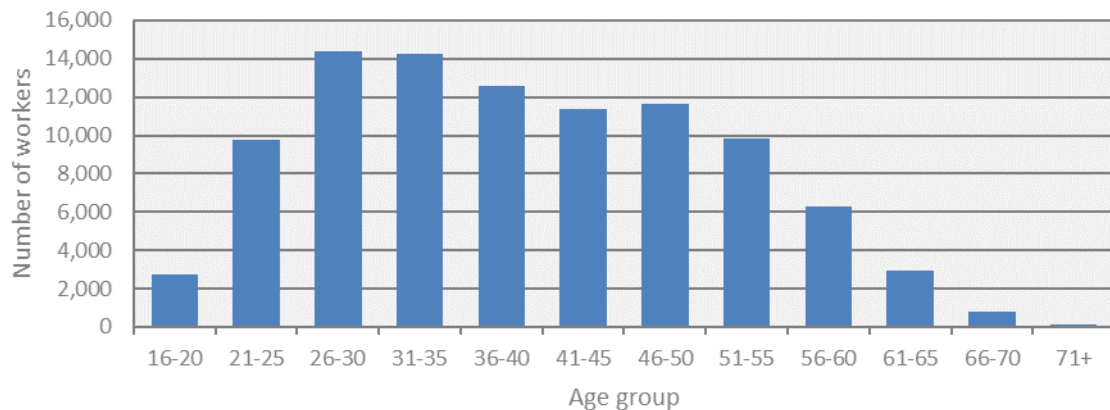
Figure 30: UK rail engineering age ranges for investment projects workforce, 2016

Between 2017 and 2033, nearly 24,000 workers currently working in rail investment projects will reach the age of 65. It is reasonable to assume that on average, this will reasonably reflect the age at which most of these workers will retire, as this is the current state pension age.

6.4.2   Location of current workforce

6.4.3   Table 27 shows that the workforce working on rail investment projects is split roughly evenly between workers based in London and the South East (52%) and other regions of the UK (48%).

Region	Percentage
South East	31%
London	21%
North West	12%
Yorkshire & the Humber	10%
West Midlands	7%
East Midlands	6%
South West	5%
Scotland	4%
Wales	3%
North East	<1%
East of England	<1%
Northern Ireland	<1%

Table 27: UK rail engineering split of rail workforce by region in investment projects, 2016

There is no firm evidence of patterns of geographic mobility across the UK in rail engineering disciplines. By the very nature of the work and asset cycles, the workforce will need to some degree to follow the work around the country.

6.5 Quantitative assessment of recruitment requirement in the rail engineering sector

The recruitment requirement of rail engineering labour and skills is used in later sections of this report, along with its components; labour and skills demand and future available supply to determine.

Figure 31 shows the assessment of the future sector-wide recruitment requirement for rail systems. This is calculated for the six regions combined through which HS2 passes. The increase in demand over time reflects the expectation of a completion of Crossrail 2 and HS2 Phase 2b, leading to a sharp drop off from 2031 onwards. Also, a conservative approach in the analysis to the unknown level of investment in enhancement schemes beyond the mid-2020s (HS2 and other major schemes excepted).

The increase in 2020 to 2021 is largely as a result of ramping up the HS2 Phase One works, and the dip to 2022 is a result of the tailing off from other schemes in London Underground and Network Rail while HS2 works continue.
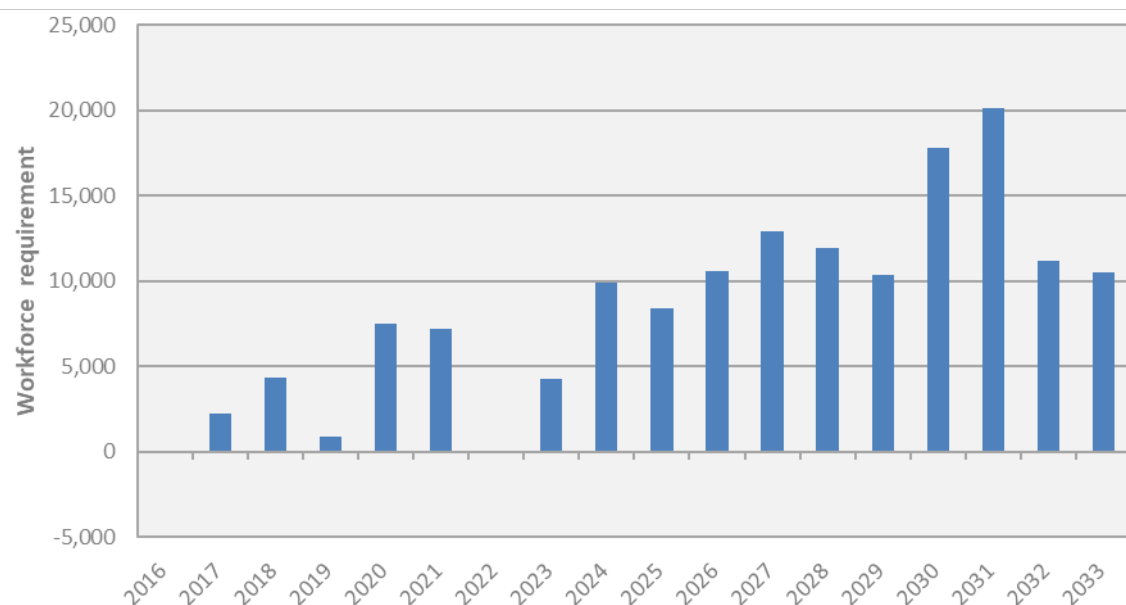
Figure 31: Rail systems sector-wide cumulative gross recruitment requirement in six regions along HS2 line of route

Figure 32 provides a similar assessment of sector-wide recruitment requirement labour for traction and rolling stock manufacture.

The decrease between 2018 and 2021 is largely as a result of the gradual introduction of new fleets onto the network for Crossrail and the new fleet for Great Western and East Coast Mainline before the HS2 Phase One fleets start to increase the workforce levels from 2022 onwards. The peak in 2030 is a direct result of the Crossrail 2 and HS2 Phase 2b fleets being developed in parallel.

A similarly conservative approach as in the rail systems analysis of not forecasting unknown levels of traction & rolling stock investment has been taken. As a result of this approach, and completion of a number of fleets such as New Tube for London, Crossrail 2 and Merseyrail's new fleet in the early 2030's leads to a sharp decrease in the recruitment requirement thereafter.
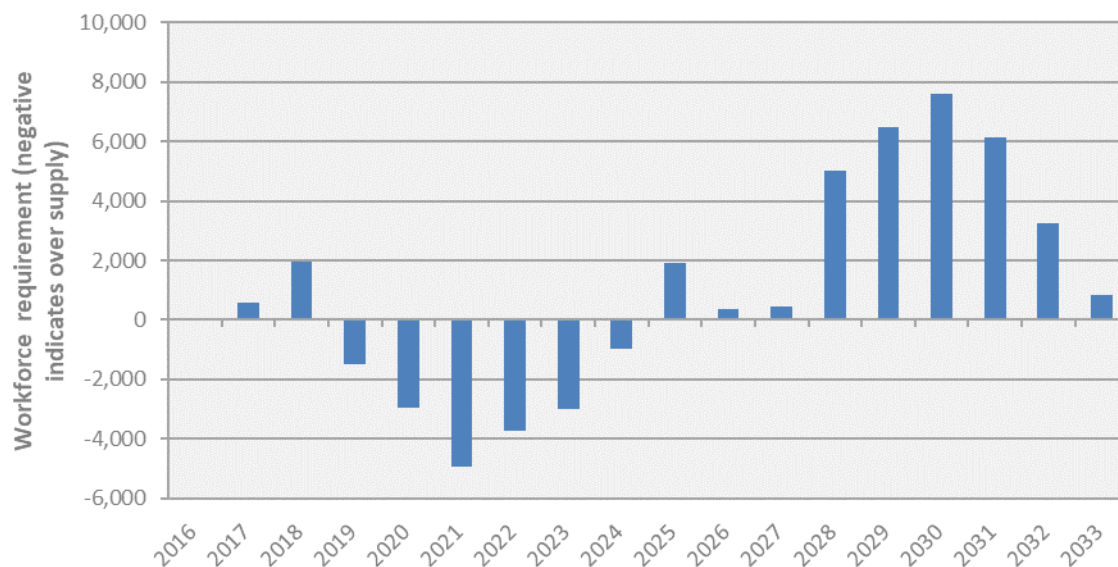
Figure 32: Rolling stock manufacture cumulative gross recruitment requirement sector-wide, UK-wide

6.6   Workforce education and training

In Further Education colleges 1% of students study engineering and science subjects. A breakdown of post-16 provision is shown in Table 28.

Type	Number in 6 regions on HS2 route	Number of engineering courses	Average class size	Max number of students per annum
Sixth Form Colleges	71	65	30	1,950
University Technical Colleges	36	34	20	680
General Further Education College	160	150	70	10,500
Total	**267**	**249**		**13,130**

Table 28: Provision of post-16 engineering qualifications in regions along HS2 line of route
(Source: Ofsted Annual Report 2015/16[30])

When fully operational, the National College for High Speed Rail will offer up to 2,000 places for Level 4+ provision. Across all UK Higher Education, over 140,000 students study engineering (all years, full and part time, undergraduate and post graduate), of whom 55,000 are first years (full and part time, undergraduate (37,000) and post graduate (18,000).

Across the UK there are approximately 50,000 engineering starts at Levels 2-6, the great majority of which are offered in Higher Education Institutions. For rail the National College for High Speed Rail now offers its own diploma (starting in 2017) and Rail Engineering Apprenticeship Trailblazer standards have been approved for use at Levels 4 to 7. Figure 33 outlines the available apprenticeship standard requirements and those under development for rail engineering, operations, and the general requirements of the rail sector.

	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
Rail & Rail Systems Engineering	Rail engineering operative	Rail Engineering Technician / Rail Engineering Design Technician	Rail Engineering Advanced Technician / Rail Engineering Design Advanced	Rail & Rail Systems Service Engineer	Rail & Rail Systems Service Engineer	Rail & Rail Systems Principal Engineer
Rail Operations	Vehicle Operations / Infrastructure Operations / Stations & Onboard Team Member / Network Operations	Transport Planning Technician / Safety & Onboard Team Member / Network Operations / Infrastructure Operations	Operations Manager / Infrastructure Operations / Network			
General (delivered in a rail context)	Business Administration	Infrastructure Operations	Supply Chain Logistics / Safety & Environment / Digital Industries / Project Manager		Chartered Management Design Apprenticeship / Digital Industries Design Apprenticeship	Leadership Masters Degree Apprenticeship

Each level is coded in a different colour; lighter colour boxes indicate standards that are under development; darker boxes represent standards which are available now.

Figure 33: Expected apprenticeship standard requirements for rail sector as at November 2017

Table 29 suggests that applications for apprenticeships across all industries (not just rail) exceeds available apprenticeships. On average there are nine applications for every Level 3 apprentice vacancy and eight applications for every Level 2 apprenticeship vacancy.

Level	Vacancies	Applications
Level2	170,000	1,240,000
Level3	30,000	380,000
Level4	10,000	12,000
Total	**210,000**	**1,632,000**

Table 29: Number of apprenticeship applications and vacancies by level, all industries, 2015/16[31]

7 Rail engineering demand & mismatch analysis: Phase One and Phase 2a

7.1 Rail engineering demand

7.1.1 Methodology

The demand for rail engineering labour and skills generated by the delivery of Phase One and Phase 2a of HS2 has been forecast using the spend profile in each of the following HS2 Ltd cost pillars:

- railway systems[32];
- on network costs (works relating to existing infrastructure);
- operations & maintenance (O&M) set up; and
- traction & rolling stock

Asset types have been allocated to cost pillars as follows:

- track – included within railway systems and on network costs cost pillars;
- signalling, systems & telecommunications (SS&T) – included within railway systems cost pillar;
- electrification & power (E&P) – included within railway systems cost pillar;
- rail heads (civil engineering) – included within depots & stabling cost pillar[33];
- operations & maintenance set up; and
- traction & rolling stock.

The following general assumptions have been made in modelling the data:

- all analysis uses data on point estimate costs;
- no differentiation has been made between design, management or construction/delivery activities;
- where a spend is given for a specific year this is the start of the financial year (e.g. 2016 is 2016/17);
- the price ruling date is 2015Q1;
- no future productivity growth in the rail engineering sector has been assumed; and
- costs exclude VAT.

For most asset types, work has been allocated to a particular geographical region. It should be noted that the regional analysis refers to the region in which labour demand is generated. It may not necessarily be the case that this work is delivered by workers based in the same region. Some occupations, (especially those in the professions) do not need to be based on site and can deliver work remotely. For the purposes of this analysis, demand across all the regions along the line of route for HS2 Phase One and Phase 2a (London, South East West Midlands, East Midlands & North West) has been combined. However, traction & rolling stock and O&M setup work has not been assigned to a specific region.

The rail engineering occupational aggregates have been derived from roles identified by a NSAR survey of the rail engineering sector. This survey was carried out in 2016/2017 and obtained over 220,000 responses from individuals working in the rail sector. Respondents were asked to provide details of job role, age, gender location and the type of work that they deliver. This data was then used to assess the numbers employed in each skill level and occupation in each asset type.

There are nine occupations for each of the six asset types (track, electrification & power, signalling, systems, telecommunications, traction & rolling stock) split into four skill levels (Levels A-D). Forecasting is undertaken at asset level (in accordance with investment levels) and then disaggregated in to four skill levels (Levels A to D) and then to individual occupations.

The rail engineering labour demand is presented in two broad groups.

1. Rail systems: those involved in track, signalling, systems & telecommunications, electrification & power.

2. Rolling stock manufacture: those involved in the design and manufacture of the rolling stock.

Details of these rail engineering skills levels and occupations are provided in Appendix E and Appendix F.

7.1.2   Rail systems demand

The total forecast labour demand for rail systems (which excludes traction & rolling stock) during Phase One and Phase 2a of HS2 is shown in Figure 34 and Table 30, broken down by skill level. The total number of person-years required to deliver rail systems in Phase One and Phase 2a is forecast to be 34,000, peaking at 6,800 in 2025/26. Delivery of rail systems in Phase One and Phase 2a is currently forecast to be concentrated in two peaks: the first in 2022/23 and the second in 2025/26.
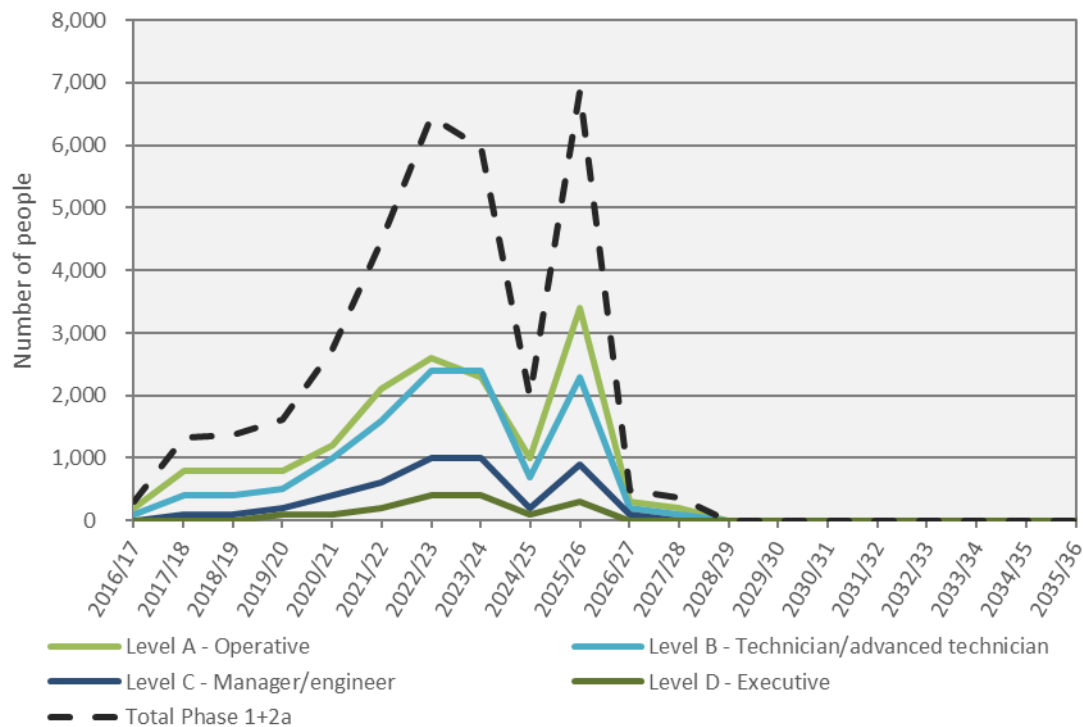
Figure 34: HS2 labour demand arising from rail systems by skill level – Phase One and Phase 2a, all Phase One and Phase 2a regions

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	15,600	3,400	2025/26
Level B – Technician/advanced technician	12,100	2,400	2022/23
Level C – Manager/engineer	4,600	1,000	2022/23
Level D – Executive	1,700	400	2023/24
Total[34]	**34,000**	**6,800**	**2025/26**

Table 30: HS2 rail systems labour demand by skill level – Phase One and Phase 2a, all Phase One and 2a regions

7.1.3   Rail systems by asset type

This section contains a breakdown of the rail systems labour demand by asset type during Phase One and Phase 2a. This covers signalling, systems & telecommunications, track and electrification & power. Due to the relatively low level of labour demand in rail systems civil engineering, the labour demand is not shown separately for that asset type.

7.1.3.1. Signalling, systems & telecommunications

Figure 35 and Table 31 show forecast total labour demand for the signalling, systems & telecommunications asset within rail systems by skill level. Delivery of signalling, systems & telecommunications during Phase One and Phase 2a is currently forecast to be concentrated in two peaks. The first in 2023/24 and then a second smaller peak in 2025/26.
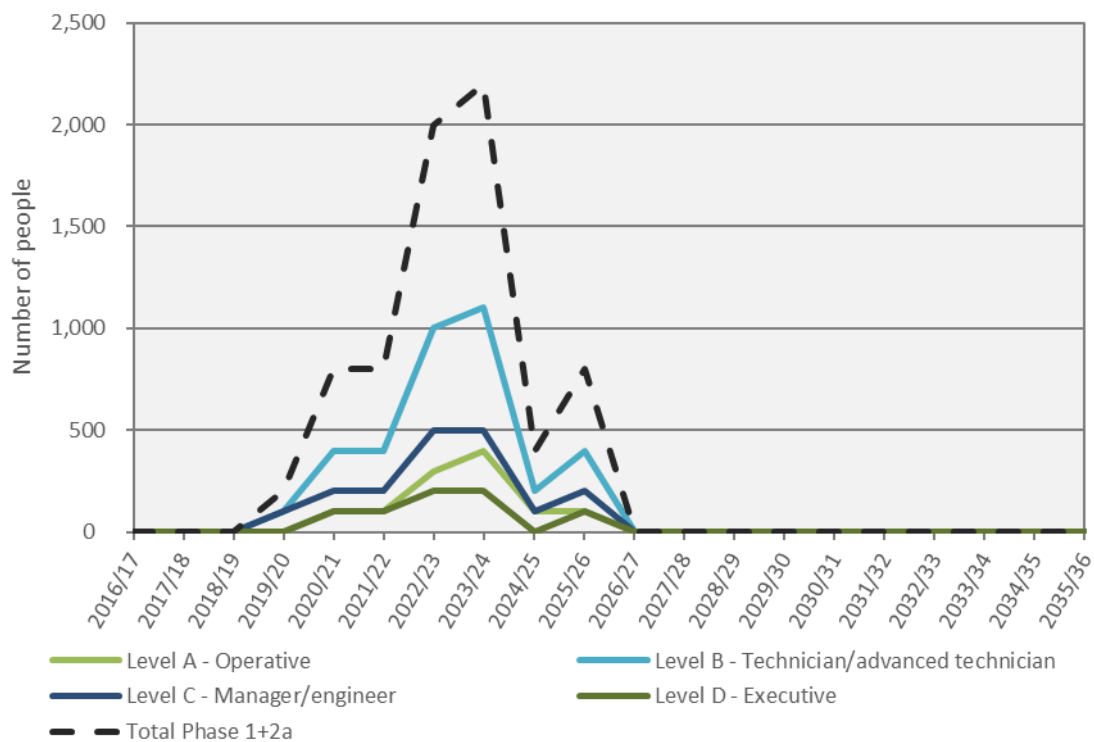
Figure 35: HS2 labour demand arising from signalling, systems & telecommunications by skill level – Phase One and Phase 2a, all Phase One and 2a regions

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	1,200	400	2023/24
Level B – Technician/advanced technician	3,500	1,100	2023/24
Level C – Manager/engineer	1,800	500	2023/24
Level D – Executive	600	200	2023/24
Total[35]	**7,000**	**2,100**	**2023/24**

Table 31: HS2 signalling, systems & telecommunications labour demand by skill level – Phase One and Phase 2a, all Phase One and 2a regions

7.1.3.2. Track

Figure 36 and Table 32 show forecast total labour demand for the track asset within rail systems by skill level. Delivery of the track asset during Phase One and Phase 2a is currently forecast to be concentrated in two peaks, the first in 2022/23 and the second in 2025/26. The second peak is driven by O&M set up. In the regional breakdown and the mismatch analysis which follows later in this section the track roles have been omitted because they could not be allocated to one of the three main regions of Phase One and Phase 2a.
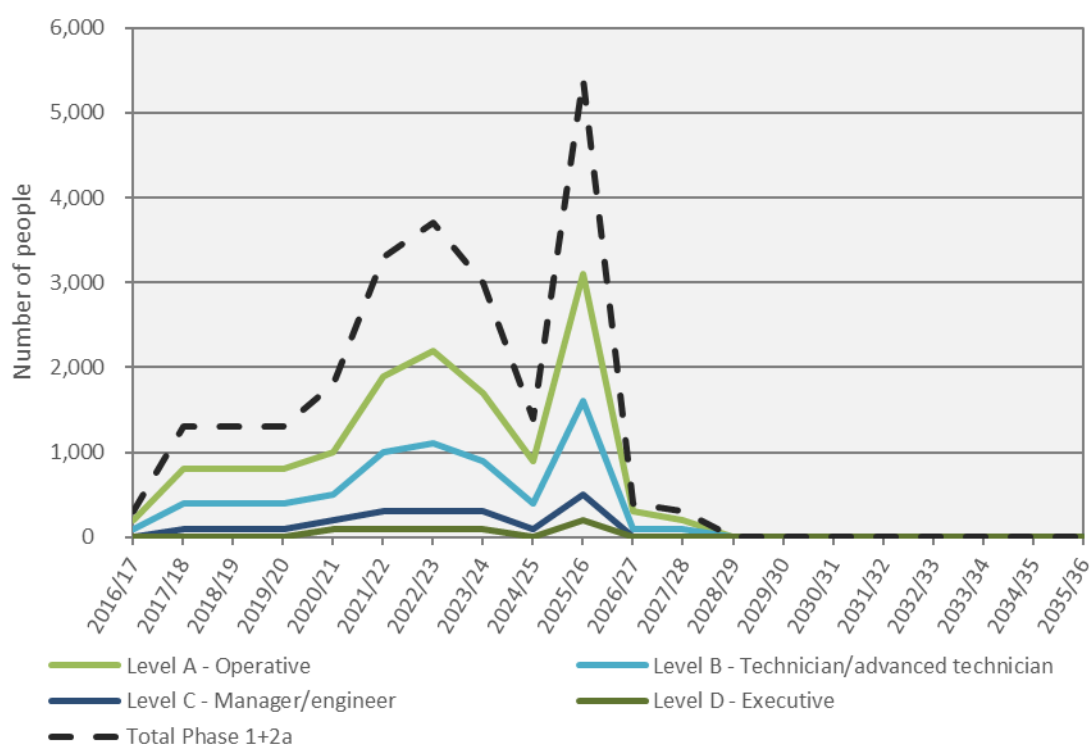
Figure 36: HS2 labour demand arising from track by skill level – Phase One and Phase 2a, all Phase One and 2a regions

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	13,800	3,100	2025/26
Level B – Technician/advanced technician	6,900	1,600	2025/26
Level C – Manager/engineer	2,100	500	2025/26
Level D – Executive	700	200	2025/26
Total[36]	**23,500**	**5,300**	**2025/26**

Table 32: HS2 track labour demand by skill level – Phase One and Phase 2a, all Phase One and 2a regions

7.1.3.3. Electrification & power

Figure 37 and Table 33 show forecast total labour demand for the electrification & power asset within rail systems by skill level. Delivery of the electrification & power asset during Phase One and Phase 2a is currently forecast to be concentrated in two peaks. The first between 2022/23 and 2023/24 and the second in 2025/26.
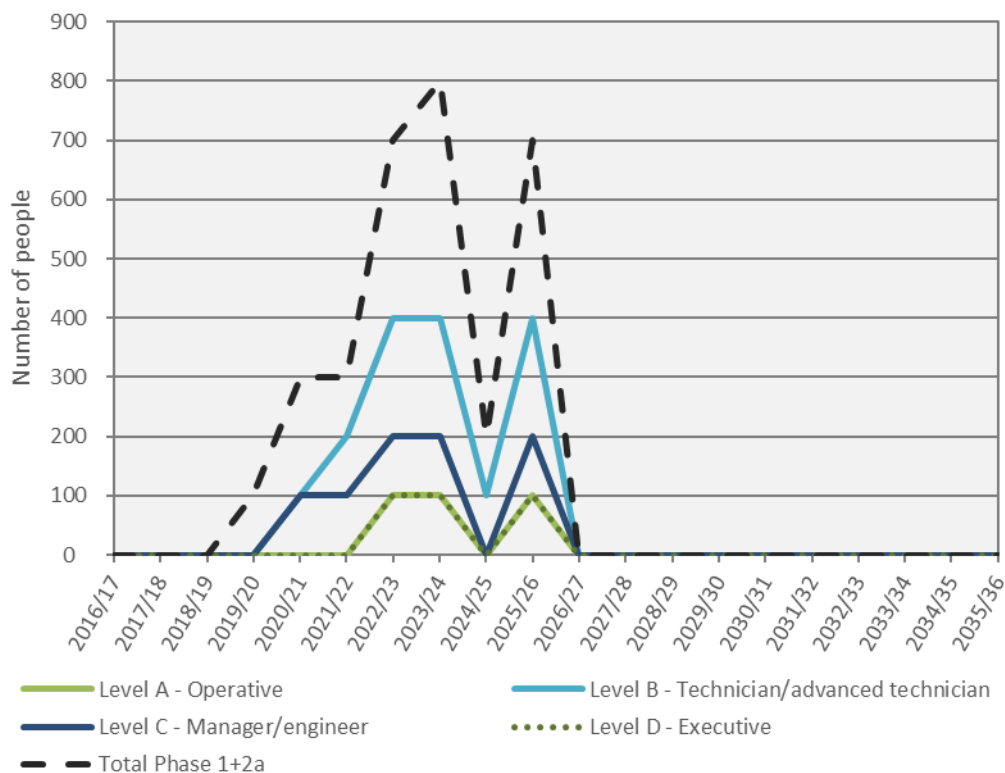
Figure 37: HS2 labour demand arising from electrification & power by skill level – Phase One and 2a, all Phase One and 2a regions[37]

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	400	100	2023/24
Level B – Technician/advanced technician	1,500	400	2023/24
Level C – Manager/engineer	800	200	2023/24
Level D – Executive	400	100	2023/24
Total[38]	**3,000**	**800**	**2023/24**

Table 33: HS2 electrification & power labour demand by skill level – Phase One and Phase 2a, all Phase One and 2a regions

7.1.4   Traction & rolling stock

Traction & rolling stock is only included in Phase One, as Phase 2a of HS2 will be operated using the Phase One traction and rolling stock fleet. Figure 38 and Table 34 present the forecast labour demand for the manufacture of traction and rolling stock, which includes design, construction, assembly and testing of traction and rolling stock. For Phase One, these activities are forecast to require 8,700 person-years over the period from 2019 to 2026. Fifty percent of the roles are forecast to be at Skill Level B and a further 35% at Skill Level C with just 5% at Skill Level D. Labour demand is currently forecast to peak between 2023/4 and 2025/6. Note that this labour demand has not been assigned to specific regions within the UK.
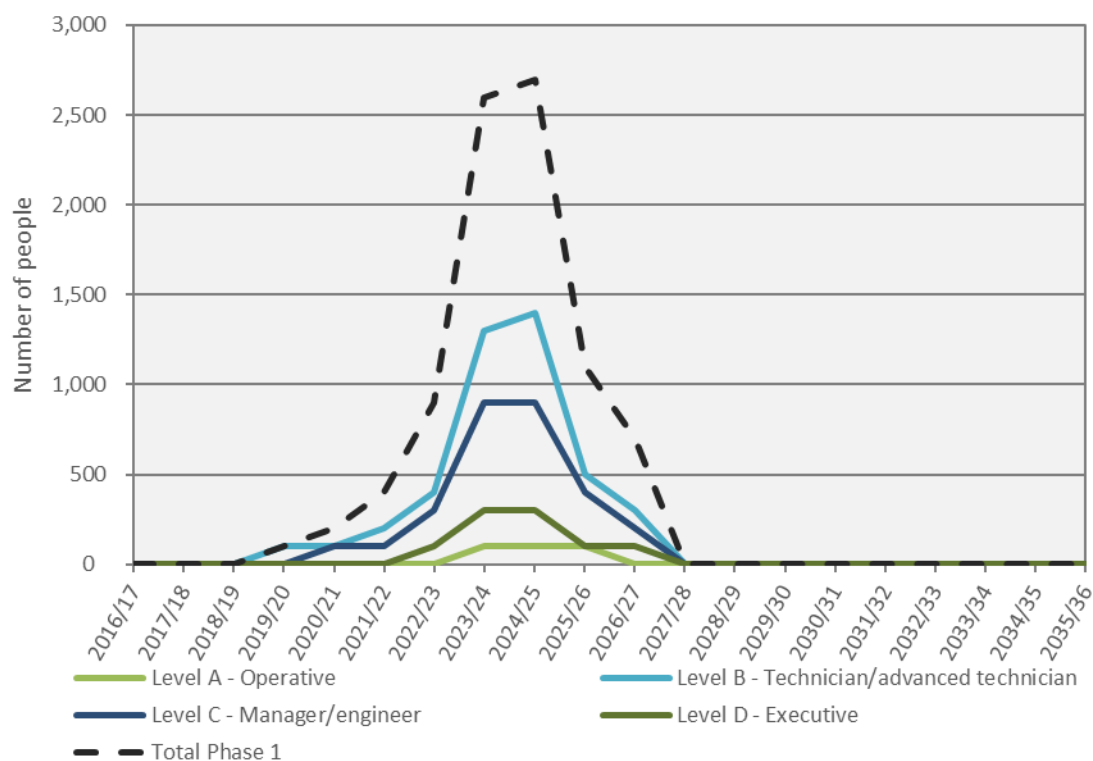
Figure 38: HS2 labour demand arising from traction & rolling stock manufacture by skill level – Phase One, all UK regions

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	400	100	2024/25
Level B – Technician/advanced technician	4,400	1,400	2024/25
Level C – Manager/engineer	3,000	900	2024/25
Level D – Executive	900	300	2024/25
Total[39]	**8,700**	**2,700**	**2024/25**

Table 34: HS2 labour demand arising from traction & rolling stock manufacture by skills level - Phase One, all UK regions

7.1.5   Rail engineering by region

Figure 39 and Table 35 show the regional breakdown of forecast rail engineering labour demand (rail systems and traction & rolling stock) during Phase One and Phase 2a. The forecasts suggest that the largest demand for labour and skills may occur in the West Midlands (33% of the total), with London accounting for around a quarter of total demand. Just over another quarter of total demand has not been allocated to a specific region and is made up of traction & rolling stock and O&M setup. The forecast peaks around 2025 and 2026 in the West Midlands are driven by the investment expenditure on track and on network works.
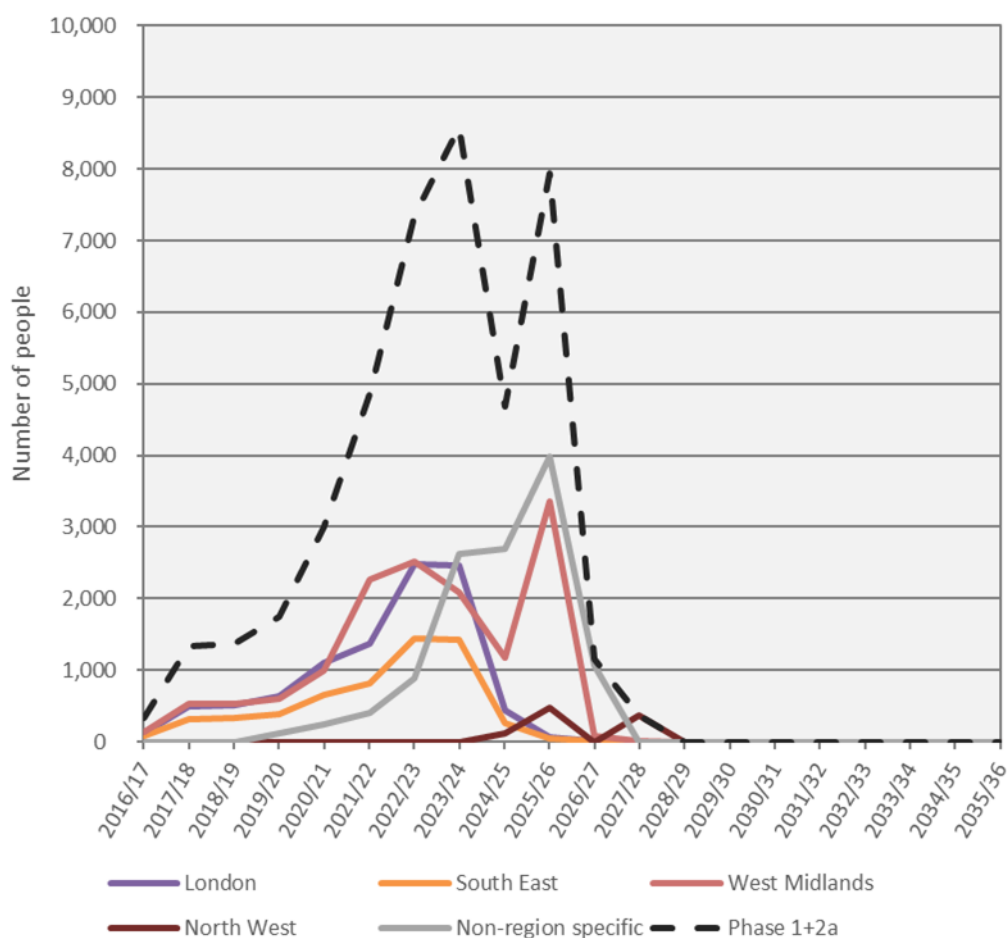
Figure 39: HS2 labour demand arising from rail systems by region – Phase One and Phase 2a

Region	Person-years	Peak workforce	Timing of peak
London	9,700	2,500	2022/23
South East	5,800	1,400	2022/23
West Midlands	14,200	3,300	2025/26
North West	1,000	500	2025/26
Non-region specific	12,000	4,000	2025/26
Total[40]	**42,700**	**8,600**	**2023/24**

Table 35: HS2 rail systems labour demand by type of region – Phase One and Phase 2a

7.2 Mismatch analysis

7.2.1 Overall mismatch analysis

The mismatch analysis follows the same methodology as for construction (see section 4.2.1). The same metrics calculated for construction have also been calculated for rail engineering and have been collated in a scorecard (Table 36). The only difference is that the percentage of workers who are working in other sectors beyond rail engineering is not shown, as the relevant data are not available for rail engineering occupations. An asterisk (*) in the table indicates that the numbers forecast are too small to provide meaningful results when presented as a percentage.

For the purposes of this analysis, demand across the entirety of Phase One and Phase 2a has been combined. The exception to this is traction and rolling stock, which is for the whole of the UK. As for construction, each of the occupations has been assessed in turn using the following criteria:

- the overall sector mismatch;
- the relevance to the HS2 programme; and
- the likelihood of the historic inflows being capable of meeting the recruitment requirement should they remain at historic rates.

The assessment of each occupation using the above criteria has produced a shortlist of priority construction occupations that warrant further investigation to understand whether we might anticipate recruitment challenges:

- signalling, systems & telecommunications: advanced technicians, engineers and managers; and
- track technicians.

Each of the occupations listed above are considered in more detail in the following section. Due to the similarity of the types of work on signalling, systems & telecommunications (SS&T) and the occupations within it, these occupations have been treated as a single group using the sum of the averages for more detailed analysis. For SS&T engineers and managers, both the job role and the assistants' job role have been analysed together.

Asset type	Role	Average total rail engineering demand (2017/18-peak)	Average gross recruitment requirement (2017/18-peak)	GRR as a share of total rail engineering demand (2017/18-peak)	Average HS2 demand (2017/18-peak)	Average HS2 demand as a share of total rail engineering demand (2017/18-peak)	HS2 demand in each occupation as a share of total HS2 labour demand (2017/18-peak)	Anticipated inflows as a share of average rail engineering demand (2017/18-peak)
Electrification (peak 2023/24)	Head	450	10	2%	40	9%	1%	5%
	Advanced technician	1,180	20	2%	100	8%	2%	6%
	Apprentice	10	<10	*	<10	*	0%	6%
	Asst engineer	360	<10	*	30	8%	1%	6%
	Asst manager	230	<10	*	20	9%	0%	7%
	Engineer	450	10	2%	40	9%	1%	6%
	Higher apprentice	50	<10	*	<10	*	0%	6%
	Manager	450	10	2%	40	9%	1%	3%
	Technician	440	10	2%	40	9%	1%	6%
Signalling (peak 2023/24)	Head	720	70	10%	50	7%	1%	4%
	Advanced technician	2,820	260	9%	200	7%	5%	6%
	Apprentice	40	<10	*	<10	*	0%	6%
	Asst engineer	870	90	10%	60	7%	2%	6%
	Asst manager	540	50	9%	40	7%	1%	3%
	Engineer	1,090	100	9%	80	7%	2%	6%
	Higher apprentice	110	10	9%	10	9%	0%	6%
	Manager	1,090	100	9%	80	7%	2%	3%
	Technician	1,410	130	9%	100	7%	2%	6%
Systems (peak 2023/24)	Head	220	10	5%	<10	*	0%	4%
	Advanced technician	850	40	5%	10	1%	0%	5%
	Apprentice	10	<10	*	<10	*	0%	5%
	Asst engineer	260	10	4%	<10	*	0%	5%
	Asst manager	160	10	6%	<10	*	0%	3%

Category	Role							
	Engineer	330	20	6%	10	3%	0%	5%
	Higher apprentice	30	<10	*	<10	*	0%	5%
	Manager	330	20	6%	10	3%	0%	3%
	Technician	420	20	5%	10	2%	0%	5%
Telecommunications (peak 2025/26)	Head	70	10	14%	20	29%	0%	4%
	Advanced technician	270	40	15%	60	22%	2%	5%
	Apprentice	<10	<10	*	<10	*	0%	5%
	Asst engineer	80	10	13%	20	25%	0%	5%
	Asst manager	50	10	20%	10	20%	0%	3%
	Engineer	110	10	9%	20	18%	1%	5%
	Higher apprentice	10	<10	*	<10	*	0%	5%
	Manager	110	10	9%	20	18%	1%	3%
	Technician	140	20	14%	30	21%	1%	5%
Track41 (peak 2022/23)	Head	330	10	3%	60	18%	1%	4%
	Advanced technician	2,120	90	4%	400	19%	10%	5%
	Apprentice	160	10	6%	30	19%	1%	5%
	Asst engineer	650	40	6%	120	18%	3%	6%
	Asst manager	410	20	5%	80	20%	2%	3%
	Engineer	490	20	4%	90	18%	2%	5%
	Higher apprentice	80	<10	*	20	25%	0%	5%
	Manager	490	20	4%	90	18%	2%	3%
	Technician	6,370	270	4%	1,210	19%	29%	5%
Traction & rolling stock (peak 2024/25)	Head	690	20	3%	90	13%	2%	4%
	Advanced technician	2,160	70	3%	270	13%	7%	6%
	Apprentice	20	<10	*	<10	*	0%	11%
	Asst engineer	690	20	3%	90	13%	2%	6%
	Asst manager	520	20	4%	70	13%	2%	11%
	Engineer	1,210	40	3%	150	12%	4%	6%

	Higher apprentice	90	<10	*	10	11%	0%	11%
	Manager	1,210	40	3%	150	12%	4%	3%
	Technician	330	20	6%	40	12%	1%	11%
Total		**33,820**	**2,000**	**6%**	**3,980**	**12%**	**100%**	**5%**

Table 36: Rail engineering mismatch scorecard – Phase One and Phase 2a[42]

7.2.2 Priority occupations for further analysis

7.2.2.1. Signalling, systems & telecommunications (SS&T)

The analysis suggests that the availability of the occupations of advanced technicians, engineers and managers in SS&T during the construction and delivery of HS2 Phase One and Phase 2a may warrant further investigation. HS2 demand for these occupations during Phase One and Phase 2a accounts for nearly 7% of total rail engineering sector requirements on average between 2017/18 and 2023/24 & 2025/26[43]. Table 37 summarises the mismatch analysis criteria.

Criteria	SS&T advanced technicians	SS&T engineers	SS&T managers
Demand, supply & mismatch			
Average total rail engineering demand (2017/18-2023/24 & 2025/26)	3,950	2,730	2,280
Average gross recruitment requirement (2017/18-2023/24 & 2025/26)	340	250	190
GRR as a share of total rail engineering demand	9%	9%	89%
Average HS2 demand (2017/18-2023/24 & 2025/26)	280	190	160
HS2 demand as a share of total rail engineering demand	7%	7%	7%
Inflows			
Average anticipated inflows into rail engineering (2017/18-2023/24 & 2025/26))	220	150	70
Anticipated inflows as a share of average rail engineering demand	5%	6%	3%

Table 37: Mismatch analysis criteria for signalling, systems & telecommunications: Phase One and Phase 2a

The analysis suggests that, before accounting for inflows to the sector, the overall rail engineering sector operating in the Phase One and 2a regions will need to recruit on average around 780 people per annum in total across the SS&T priority occupations between 2017/18 and 2023/24 & 2025/26.

This projected gross recruitment requirement is driven by an expectation that sector-wide investment levels in the relevant HS2 Phase One and 2a regions for SS&T projects will remain relatively constant at between £2.4bn and £3bn per annum for the next fifteen years. In addition to HS2, this investment pipeline includes notable investments for Network Rail SS&T Renewals, potential Digital Railway schemes, Four Line Modernisation for Transport for London, other London Underground and Docklands Light Railway renewal schemes, Thameslink ERTMS and Traffic Management, South Wales Metro, East West Rail and other Light Rail investments in Birmingham, Manchester and Newcastle.

If average historic inflows labour and skills into these SS&T occupations were to be sustained in future, then these inflows would be sufficient to satisfy some but not all of the projected gross recruitment requirement.

Typically the advanced technician roles would be recruited from an apprenticeship scheme or a vocational education scheme, whereas the engineers and graduates would typically come from an academic, university background requiring science, technology, engineering, and mathematics (STEM) qualifications. There may also be inflows of recruits from other sectors, such as software and telecommunications, but many will still require training and 'conversion' to rail. The National College for High Speed Rail will provide training provision for these priority occupations at advanced technician level, with approximately 2,000 students completing training every year.

7.2.2.2. Track technicians

The mismatch analysis suggests that the availability of the occupations of track technicians during the construction and delivery of HS2 Phase One and Phase 2a may warrant further investigation. HS2 demand for this occupation during Phase One and Phase 2a accounts for nearly 19% of sector-wide requirements on average between 2017/18 and 2022/23. Table 38 summarises the mismatch analysis criteria.

Criteria	Track technicians
Demand, supply & mismatch	
Average total rail engineering demand (2017/18-2022/23)	6,370
Average gross recruitment requirement (2017/18-2022/23)	270
GRR as a share of total rail engineering demand	4%
Average HS2 demand (2017/18-2022/23)	1,210
HS2 demand as a share of total rail engineering demand	19%
Inflows	
Average anticipated inflows into rail engineering (2017/18-2022/23)	340
Anticipated inflows as a share of average rail engineering demand	5%

Table 38: Mismatch analysis criteria for track technicians: Phase One and Phase 2a

The analysis suggests that, before accounting for inflows, the overall rail engineering sector operating in the Phase One and 2a regions will need to recruit on average around 270 people per annum into the track technician occupation between 2017/18 and 2022/23 to fill vacancies.

This projected gross recruitment requirement is driven by an expectation that sector investment levels for track projects remain relatively constant at approximately £2bn per annum for the next fifteen years. In addition to HS2, this anticipated investment pipeline includes notable investments in Network Rail Track Renewals, Transport for London renewals programmes, Thameslink, South Wales Metro, East West Rail and other Light Rail investments in Birmingham, Manchester and Newcastle.

If average historic inflow rates of 5% of rail engineering sector demand into the category were to be sustained, then these inflows would likely be sufficient to satisfy the large majority of this recruitment requirement.

Typically, the track technician roles would come from an apprenticeship scheme or a vocational education scheme. There may be inflows from other sectors, such as highways or other construction sectors, but many will still require some amount of training and 'conversion' to rail, albeit to a lesser extent than for the SS&T occupations. The National College for High Speed Rail will provide training provision for these priority occupations at advanced technician level, with approximately 2,000 students completing training every year.

8 Rail engineering demand and mismatch analysis: Phase 2b

8.1 Rail engineering demand

8.1.1 Methodology

The approach to forecasting the demand for rail engineering labour and skills generated by HS2 Phase 2b follows the approach used for HS2 Phase One and Phase 2a in Section 7 of this report.

8.1.2 Rail systems

Figure 40 and Table 39 show the forecast labour demand for rail systems (which excludes traction & rolling stock) generated by Phase 2b of HS2 in the regions along the Phase 2b line of route (East Midlands, North West and Yorkshire & the Humber). The number of person years required to deliver Phase 2b rail systems is 18,500. The peak demand is forecast to be 6,700 people in 2032/33, which is similar to the magnitude of the forecast peak demand for rail systems during Phase One and Phase 2a.
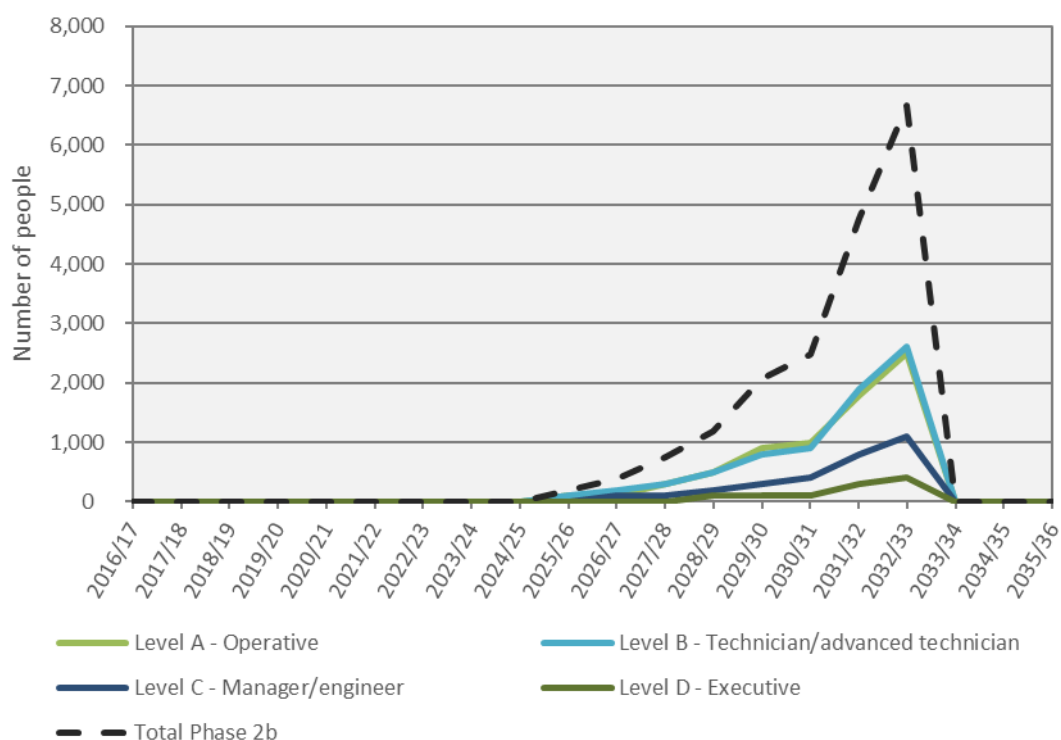
Figure 40: HS2 labour demand arising from rail systems by skill level – Phase 2b, Phase 2b regions

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	7,100	2,500	2032/33
Level B – Technician/advanced technician	7,200	2,600	2032/33
Level C – Manager/engineer	3,000	1,100	2032/33
Level D – Executive	1,200	400	2032/33
Total[44]	**18,500**	**6,700**	**2032/33**

Table 39: HS2 rail systems labour demand by skill level – Phase 2b, Phase 2b regions

8.1.3   Rail systems by asset type

This section contains a breakdown of the rail systems labour demand by asset type. This covers signalling, systems & telecommunications, track and electrification & power.

8.1.3.1.   Signalling, systems & telecommunications

Figure 41 and Table 40 show the forecast labour demand for signalling, systems & telecommunications within rail systems in Phase 2b. The forecast peak demand in Phase 2b is around 1,400 people in 2032/33.
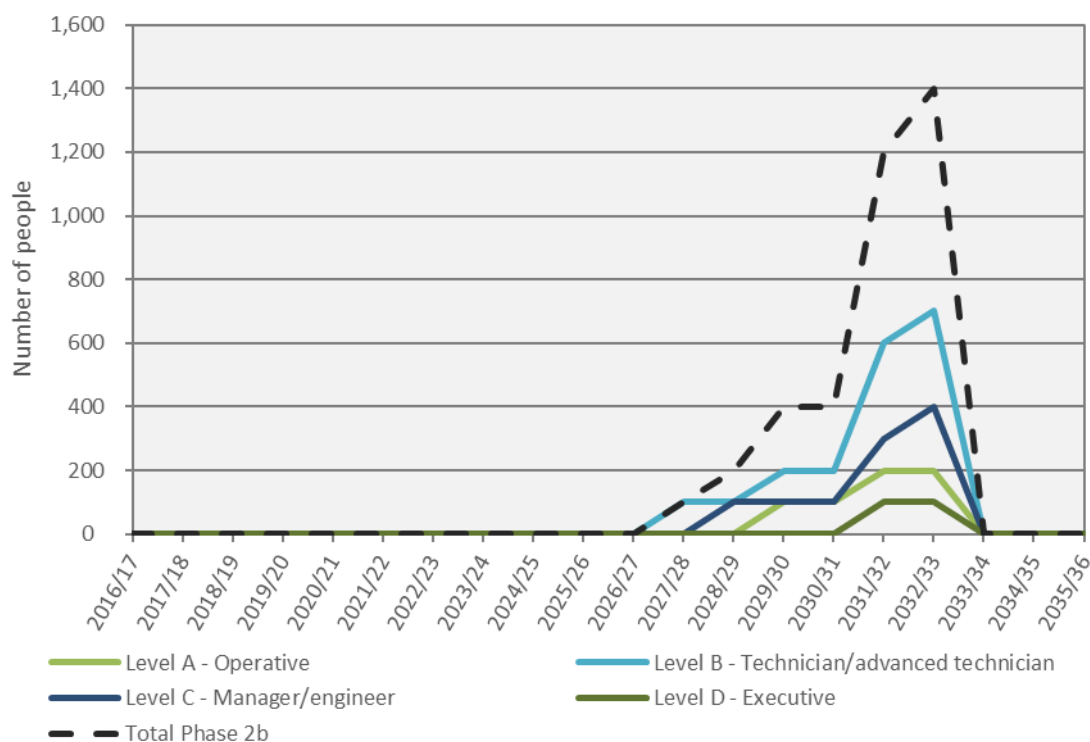
Figure 41: HS2 labour demand arising from signalling, systems & telecommunications by skill level – Phase 2b, Phase 2b regions

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	700	200	2032/33
Level B – Technician/advanced technician	2,000	700	2032/33
Level C – Manager/engineer	1,000	400	2032/33
Level D – Executive	300	100	2032/33
Total[45]	**4,000**	**1,400**	**2032/33**

Table 40: HS2 signalling, systems & telecommunications labour demand by skill level – Phase 2b, Phase 2b regions

8.1.3.2.   Track

Figure 42 and Table 41 show the forecast labour demand for track works within rail systems in Phase 2b. The forecast peak demand in Phase 2b is around 3,400 people in 2032/33.
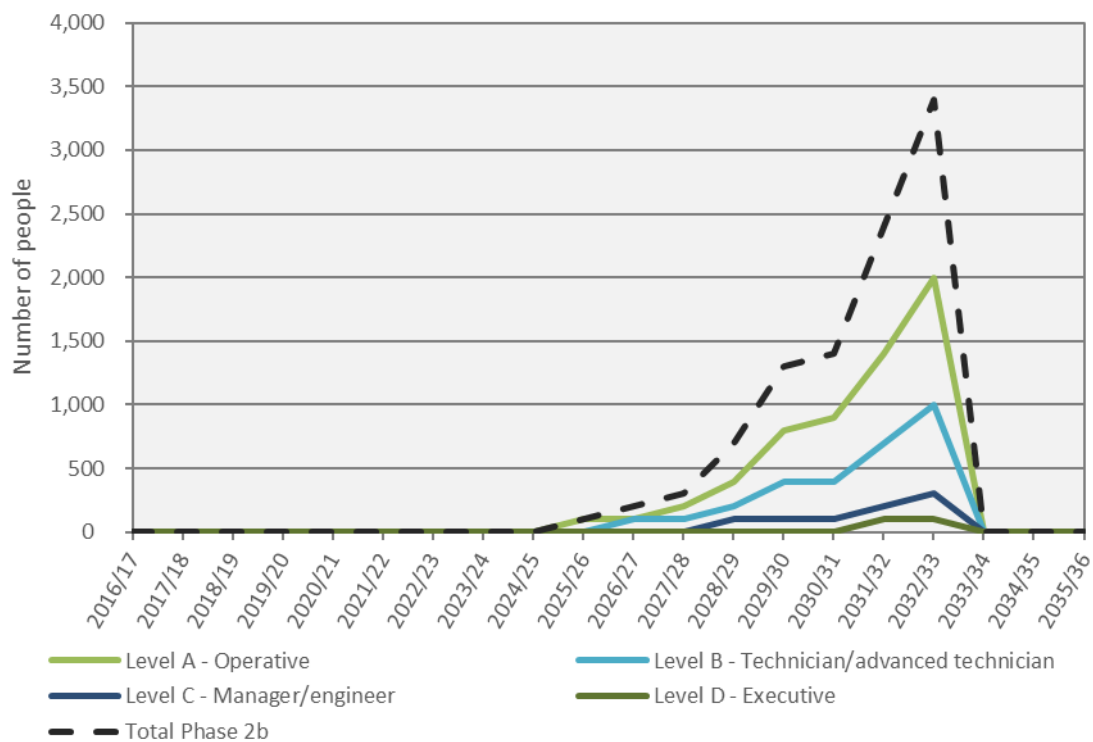
Figure 42: HS2 labour demand arising from track by skill level – Phase 2b, Phase 2b regions

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	5,900	2,000	2032/33
Level B – Technician/advanced technician	2,900	1,000	2032/33
Level C – Manager/engineer	900	300	2032/33
Level D – Executive	300	100	2032/33
Total[46]	**10,000**	**3,400**	**2032/33**

Table 41: HS2 track labour demand by skill level – Phase 2b, Phase 2b regions

8.1.3.3. Electrification & power

Figure 43 and Table 42 show the forecast labour demand for electrification & power within rail systems in Phase 2b. The forecast peak demand in Phase 2b is around 1,800 people in 2032/33.
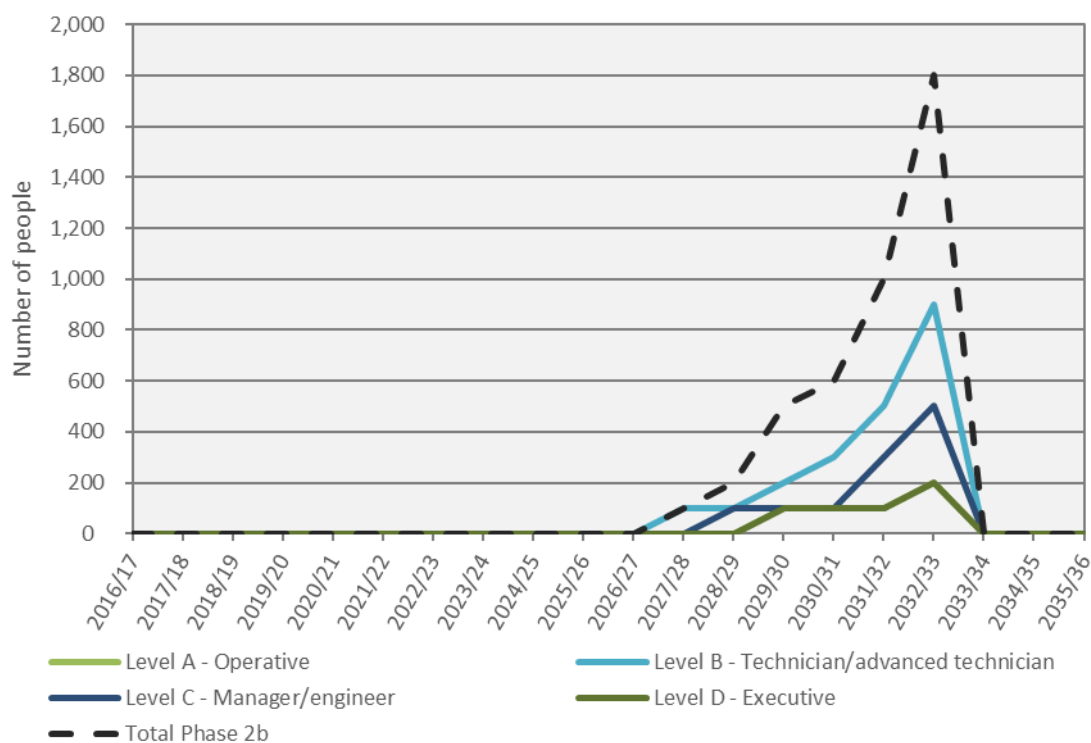
Figure 43: HS2 labour demand arising from electrification & power by skill level – Phase 2b, Phase 2b regions

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	600	200	2032/33
Level B – Technician/advanced technician	2,200	900	2032/33
Level C – Manager/engineer	1,100	500	2032/33
Level D – Executive	600	200	2032/33
Total[47]	**4,500**	**1,800**	**2032/33**

Table 42: HS2 electrification & power labour demand by skill level – Phase 2b, Phase 2b regions

8.1.4 Traction & rolling stock

Figure 44 and Table 43 show the demand for labour and skills arising from the delivery of rolling stock for Phase 2b across all regions of the UK. Delivering the traction & rolling stock for Phase 2b is forecast to require around 13,600 person-years, of which 10% are forecast to require Level D skills, 35% are Level C, 50% are Level B and 5% are Level A. The demand is forecast to be concentrated between 2029/30 and 2033/34, with those years accounting for around 85% of the total person-years. Labour demand for Phase 2b traction & rolling stock is forecast to peak at around 2,900 people in 2032/2033. Traction & rolling stock is forecast to account for around 40% of the total labour required to deliver rail engineering for Phase 2b.
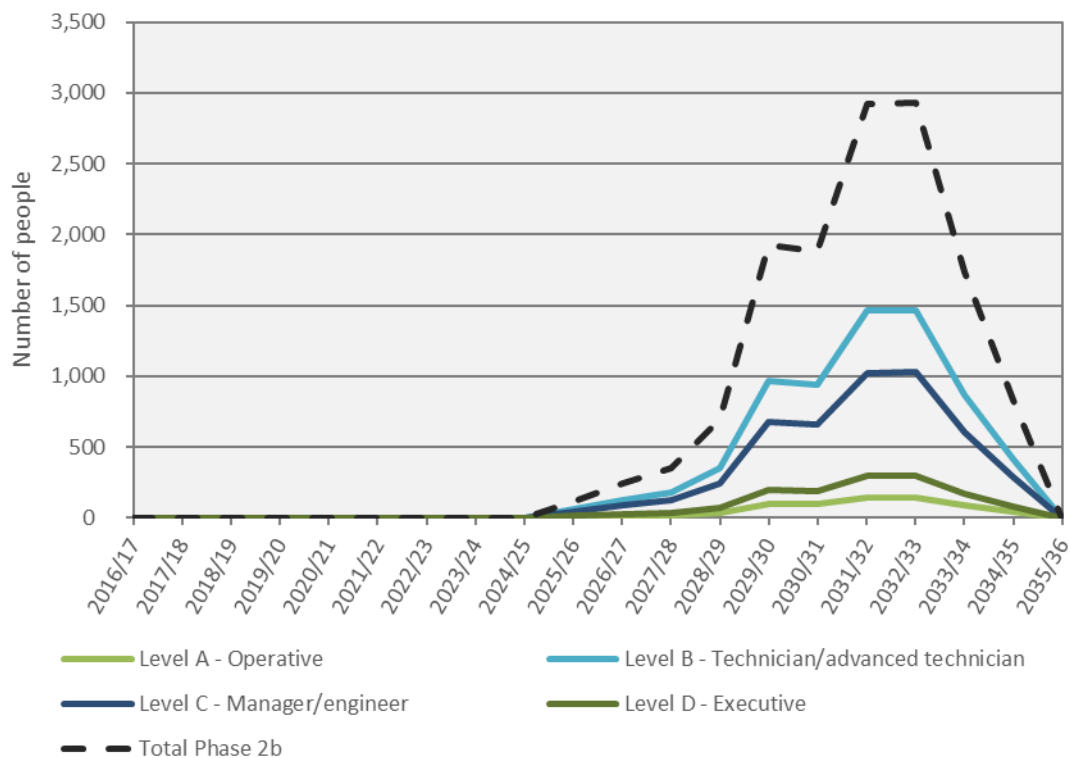
Figure 44: HS2 labour demand arising from traction & rolling stock by skill level - Phase 2b, all UK regions

Skill level	Person-years	Peak workforce	Timing of peak
Level A – Operative	700	100	2032/33
Level B – Technician/advanced technician	6,800	1,500	2032/33
Level C – Manager/engineer	4,800	1,000	2032/33
Level D – Executive	1,400	300	2032/33
Total[48]	**13,600**	**2,900**	**2032/33**

Table 43: HS2 labour demand arising from traction & rolling stock by skill level – Phase 2b, all UK regions

8.2 Mismatch analysis

8.2.1 Overall mismatch analysis

The mismatch analysis for Phase 2b follows the same method as for Phase One and Phase 2a in Section 7. For the purposes of this analysis, demand across the entirety of Phase 2b has been combined. Available supply is combined across the three main regions along the Phase 2b line of route – the North West, the East Midlands, and Yorkshire & the Humber. These are referred to as the Phase 2b regions in the remainder of this section.

The scorecard for the rail engineering occupations for Phase 2b is shown in Table 44. An asterisk (*) in the table indicates that the numbers forecast are too small to provide meaningful results when presented as a percentage. Using the same assessment criteria as for Phase One and Phase 2a, the following occupations have been identified as shortlist of priority construction occupations that warrant further investigation to understand whether we might anticipate recruitment challenges:

- Signalling, systems & telecommunications: advanced technicians, engineers and managers;
- track technicians; and
- electrification advanced technicians.

Each of the occupations listed above are considered in more detail in the following section. Due to the similarity of the types of work on signalling, systems & telecommunications and the occupations within it these have been treated in one detailed analysis. For SS&T engineers and managers, both the job role and the assistants have been analysed together.

Asset type	Role	Average total rail engineering demand (2017/18-2032/33)	Average gross recruitment requirement (2017/18-2032/33)	GRR as a share of total rail engineering demand (2017/18-2032/33)	Average HS2 demand (2017/18-2032/33)	Average HS2 demand as a share of total rail engineering sector demand (2017/18-2032/33)	HS2 demand in each occupation as a share of total HS2 labour demand (2017/18-2032/33)	Anticipated inflows as a share of average rail engineering demand (2017/18-2032/33)
Electrification	Head	220	30	14%	30	14%	2%	4%
	Advanced technician	570	70	12%	90	16%	5%	6%
	Apprentice	10	<10	*	<10	*	0%	6%
	Asst engineer	180	20	11%	30	17%	2%	6%
	Asst manager	110	10	9%	20	18%	1%	6%
	Engineer	220	30	14%	30	14%	2%	6%
	Higher apprentice	20	<10	*	<10	*	0%	6%
	Manager	220	30	14%	30	14%	2%	3%
	Technician	220	30	14%	30	14%	2%	6%
Signalling, systems & telecommunications	Head	190	10	5%	20	11%	1%	4%
	Advanced technician	760	50	7%	70	9%	4%	5%
	Apprentice	10	<10	*	<10	*	0%	5%
	Asst engineer	230	20	9%	20	9%	1%	6%
	Asst manager	150	10	7%	10	7%	1%	3%
	Engineer	290	20	7%	30	10%	1%	5%
	Higher apprentice	30	<10	*	<10	*	0%	5%
	Manager	290	20	7%	30	10%	1%	3%
	Technician	380	30	8%	30	8%	2%	5%
Track	Head	220	10	5%	20	9%	1%	4%
	Advanced technician	1,460	80	5%	120	8%	7%	5%
	Apprentice	110	10	9%	10	9%	1%	5%

	Asst engineer	450	30	7%	40	9%	2%	6%
	Asst manager	280	20	7%	20	7%	1%	3%
	Engineer	340	20	6%	30	9%	2%	5%
	Higher apprentice	60	<10	*	<10	*	0%	5%
	Manager	340	20	6%	30	9%	2%	3%
	Technician	4,390	240	5%	360	8%	20%	5%
Traction & rolling stock	Head	820	40	5%	70	9%	4%	4%
	Advanced technician	2,560	140	5%	220	9%	12%	6%
	Apprentice	20	<10	*	<10	*	0%	10%
	Asst engineer	820	40	5%	70	9%	4%	6%
	Asst manager	620	50	8%	50	8%	3%	10%
	Engineer	1,440	80	6%	120	8%	7%	6%
	Higher apprentice	100	10	10%	10	10%	0%	10%
	Manager	1,440	80	6%	120	8%	7%	3%
	Technician	390	30	8%	30	8%	2%	10%
Total		**19,950**	**1,280**	**6%**	**1,850**	**9%**	**100%**	**5%**

Table 44: Rail engineering mismatch scorecard – Phase 2b[49]

8.2.2 Priority occupations for further analysis

8.2.2.1. Signalling, systems & telecommunications (SS&T)

The analysis suggests that the availability of the occupations of advanced technicians, engineers and managers in SS&T during the delivery of HS2 Phase 2b may warrant further investigation. HS2 demand for these occupations during Phase 2b accounts for nearly 9% of total rail engineering sector requirements on average between 2017/18 and 2032/33. Table 45 summarises the mismatch analysis criteria.

Criteria	SS&T advanced technicians	SS&T engineers	SS&T managers
Demand, supply & mismatch			
Average total rail engineering demand (2017/18-2032/33)	760	520	440
Average gross recruitment requirement (2017/18-2032/33)	50	40	30
GRR as a share of total rail engineering demand	7%	8%	7%
Average HS2 demand (2017/18-2032/33)	70	50	40
HS2 demand as a share of total rail engineering demand	9%	9%	9%
Inflows			
Average anticipated inflows into rail engineering (2017-2032)	40	30	10
Anticipated inflows as a share of average rail engineering demand	5%	5%	3%

Table 45: Mismatch analysis criteria for signalling, systems & telecommunications: Phase 2b

The analysis suggests that, before accounting for inflows to the sector, the overall rail engineering sector operating in the Phase 2b regions will need to recruit on average around 120 people per annum in total across the SS&T priority occupations between 2017/18 and 2032/33.

This projected gross recruitment requirement is driven by an expectation that sector investment levels remain relatively constant at between £2.5bn and £3bn per annum for the next fifteen years.

If average historic inflow rates of 3% to 5% were to be sustained in future, then these inflows would likely be sufficient to satisfy over half of this gross recruitment requirement.

Typically the advanced technician roles would come from an apprenticeship scheme or a vocational education scheme, whereas the engineers and graduates would come from an academic, university background requiring STEM qualifications. There may be inflows from other sectors, such as software or telecommunications, but many may still require training and 'conversion' to rail.

8.2.2.2.   Track technicians

The analysis suggests that, before accounting for inflows, the availability of the occupations of track technicians during the construction and delivery of HS2 Phase 2b may warrant further investigation. HS2 demand for this occupation accounts for nearly 8% of total rail engineering sector requirements on average between 2017 and 2032. Table 46 summarises the mismatch analysis.

Criteria	Track technicians
Demand, supply & mismatch	
Average total rail engineering demand (2017/18-2032/33)	4,390
Average gross recruitment requirement (2017/18-2032/33)	240
GRR as a share of total rail engineering demand	5%
Average HS2 demand (2017/18-2032/33)	360
HS2 demand as a share of total rail engineering demand	8%
Inflows	
Average anticipated inflows into rail engineering (2017/18-2032/33)	240
Anticipated inflows as a share of average rail engineering demand	5%

Table 46: Mismatch analysis criteria for track technicians: Phase 2b

The analysis suggests that, before accounting for inflows to the sector, the overall rail engineering sector operating in the Phase 2b regions will need to recruit around 240 people per annum into the track technician occupation between 2017/18 and 2032/33.

If average historic inflow rates of 5% were to be sustained in future, then they would potentially be sufficient to satisfy this gross recruitment requirement.

In terms of their route into the workforce, typically, the track technician roles would come from an Apprenticeship scheme or a vocational education scheme. There may be inflows from other sectors, such as highways or other construction, but many will still require training and 'conversion' to rail, albeit to a lesser extent than for the SS&T occupations.

8.2.2.3. Electrification advanced technicians

The analysis suggests that the availability of the occupations of electrification advanced technicians during the construction and delivery of HS2 Phase 2b may warrant further investigation. HS2 demand for this occupation accounts for 16% of total rail engineering sector requirements on average between 2017/18 and 2032/33. Table 47 summarises the mismatch analysis criteria.

Criteria	Electrification advanced technicians
Demand, supply & mismatch	
Average total rail engineering demand (2017/18-2032/33)	570
Average gross recruitment requirement (2017/18-2032/33)	70
GRR as a share of total rail engineering demand	12%
Average HS2 demand (2017/18-2032/33)	90
HS2 demand as a share of total rail engineering demand	16%
Inflows	
Average anticipated inflows into rail engineering (2017/18-2032/33)	30
Anticipated inflows as a share of average rail engineering demand	5%

Table 47: Mismatch analysis criteria for electrification advanced technicians: Phase 2b

The analysis suggests that, before accounting for inflows to the sector, the overall rail engineering sector operating in the Phase 2b regions will need to recruit around 70 people per annum into the electrification advanced technician occupation between 2017/18 and 2032/33.

If average historic inflow rates were to be sustained into the future, then these inflows would potentially be sufficient to satisfy almost half of this gross recruitment requirement.

Typically, electrification advanced technicians would come from an apprenticeship scheme or a vocational education scheme. There may be inflows from other sectors, such as energy, utilities or other construction sectors, but many will still require training and 'conversion' to rail, albeit to a lesser extent than for the SS&T occupations.

Appendix A – forecasting parameters

Forecasting model variables (baseline forecast)
Note: where prices are used those prices are chain linked.

Model variables	Annual percentage change																		
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
GDP market prices	2.2	1.8	1.8	1.4	1.8	2.0	2.2	2.7	2.9	2.7	2.4	2.2	2.2	2.1	2.0	2.1	2.1	2.1	2.0
Final consumption expenditure by households and NPISH[50]	2.4	2.8	1.9	0.9	1.6	2.2	2.3	2.2	2.2	2.2	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2
Gross fixed capital formation (investment)	3.4	0.5	0.1	0.6	1.4	2.0	2.5	3.6	5.2	3.3	2.8	2.3	2.1	2.0	1.9	1.8	1.8	1.9	1.9
Total workforce jobs (job count measure)	1.5	1.6	0.3	0.4	0.5	0.5	0.5	0.8	0.8	0.7	0.6	0.6	0.7	0.7	0.7	0.6	0.5	0.5	0.5
Bank base rate (level)	0.5	0.4	0.3	0.3	0.7	1.2	1.7	2.3	3.0	3.0	3.0	3.2	3.7	4.0	4.0	4.0	4.0	4.0	4.0
Final consumption expenditure by government	1.3	0.8	0.5	0.5	0.2	0.7	1.6	3.0	3.1	3.2	2.8	2.5	2.3	2.2	2.1	2.1	2.0	2.0	2.0
Gross fixed capital formation (investment)	3.4	0.5	0.1	0.6	1.4	2.0	2.5	3.6	5.2	3.3	2.8	2.3	2.1	2.0	1.9	1.8	1.8	1.9	1.9
Domestic demand	1.9	1.5	0.3	0.7	1.3	1.9	2.2	2.6	2.9	2.6	2.4	2.3	2.2	2.1	2.1	2.1	2.1	2.1	2.1
Exports of goods and services	6.1	1.8	4.5	2.4	2.5	2.4	2.9	3.8	3.6	3.1	2.8	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Total final expenditure	2.9	1.6	1.2	1.1	1.6	2.0	2.4	2.9	3.1	2.7	2.5	2.3	2.3	2.3	2.2	2.2	2.2	2.2	2.2
Imports of goods and services	5.5	2.8	-0.2	0.1	0.8	2.2	2.7	3.5	3.5	2.7	2.7	2.6	2.6	2.6	2.7	2.7	2.7	2.8	2.8
Total population	0.8	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5
Working age population	1.4	1.0	0.6	0.5	0.8	1.2	0.5	0.3	0.3	0.3	0.2	0.5	1.1	0.9	0.2	0.0	0.0	0.0	0.0
Real household disposable income	3.6	1.5	-0.1	1.3	1.5	2.1	1.8	2.2	2.4	3.2	2.8	2.1	1.8	2.2	2.8	2.8	2.9	2.9	2.8
Average weekly earnings	2.4	2.4	2.2	2.5	3.2	3.5	3.5	3.7	4.1	4.4	4.3	4.1	3.8	3.6	3.5	3.7	3.8	3.8	3.8
Consumer prices	0.1	0.7	2.6	2.5	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Bank base rate (level)	0.5	0.4	0.3	0.3	0.7	1.2	1.7	2.3	3.0	3.0	3.0	3.2	3.7	4.0	4.0	4.0	4.0	4.0	4.0

Major sector gross value added growth rates (baseline forecast)

Major sector gross value added growth rates	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Construction	4.8	1.6	1.3	1.2	1.9	2.3	2.5	2.6	2.8	2.6	2.4	2.1	1.9	1.8	1.7	1.6	1.6	1.5	1.5
Agriculture, forestry & fishing	1.1	-4.1	1.8	1.5	1.0	0.3	0.3	0.9	1.1	0.7	0.5	0.5	0.5	0.3	0.2	0.2	0.2	0.2	0.1
Mining and quarrying	8.3	-0.2	-1.0	0.9	0.7	-0.3	0.1	-0.1	0.0	-0.2	-0.1	-0.2	-0.2	-0.1	-0.2	-0.3	-0.3	-0.4	-0.4
Manufacturing	-0.3	0.0	1.5	1.2	1.5	1.1	1.2	1.5	1.6	1.3	1.1	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.8
Utilities	1.6	2.6	2.7	1.4	1.8	1.6	1.7	1.8	1.9	1.6	1.8	1.8	1.8	1.8	1.7	1.7	1.7	1.6	1.5
Construction	4.8	1.6	1.3	1.2	1.9	2.3	2.5	2.6	2.8	2.6	2.4	2.1	1.9	1.8	1.7	1.6	1.6	1.5	1.5
Wholesale & retail	4.4	4.3	2.6	1.5	2.1	2.1	2.6	3.1	3.1	2.9	2.7	2.5	2.3	2.2	2.0	2.0	1.9	1.9	1.8
Transport & storage	0.8	-0.8	2.3	1.9	2.2	2.0	2.5	3.4	3.5	3.0	2.6	2.3	2.2	2.2	2.2	2.2	2.2	2.1	2.1
Accommodation, food services & recreation	2.7	3.4	3.3	1.6	2.1	1.9	2.1	2.7	3.0	2.7	2.3	2.2	2.1	1.9	1.8	1.9	1.9	1.9	1.8
Information & communication	5.7	5.6	3.3	2.2	2.4	2.4	2.7	3.5	4.0	3.5	2.9	2.7	2.6	2.6	2.6	2.6	2.6	2.5	2.5
Finance & insurance	1.7	1.5	0.8	1.3	1.8	2.6	3.0	3.6	3.9	3.6	3.3	2.9	2.8	2.8	2.9	3.1	3.2	3.3	3.3
Professional & other private services	3.0	2.2	2.0	1.7	2.0	2.1	2.4	2.9	3.1	3.0	2.7	2.5	2.5	2.4	2.3	2.3	2.4	2.3	2.3
Public services	0.1	0.1	0.9	0.9	1.6	2.0	2.2	2.6	2.8	2.6	2.4	2.2	2.2	2.1	2.0	2.0	2.0	2.0	1.9

Appendix B: Sector-wide forecast demand in construction in HS2 regions, broken down by occupation, for 2017

Occupational group	London	South East	West Mids.	East Mids.	North West	York. & Humber	Total for six HS2 regions
Managerial and professional	157,500	123,900	70,100	47,700	84,800	56,900	**540,900**
Other construction process managers	38,500	30,100	20,300	13,400	21,400	13,400	**137,100**
Other construction prof/tech. staff	26,800	34,200	13,900	9,900	21,600	12,400	**118,800**
Senior, exec. & business managers	27,700	26,200	19,000	12,100	16,900	13,900	**115,800**
Surveyors	16,700	8,700	6,600	4,500	6,600	5,500	**48,500**
Construction project managers	13,400	7,300	2,300	2,200	5,000	3,000	**33,200**
Civil engineers	10,300	6,300	3,000	3,200	4,900	3,900	**31,500**
Construction trades supervisors	7,800	5,900	3,700	1,800	4,900	4,200	**28,300**
Architects	16,200	5,100	1,400	800	3,600	600	**27,700**
Skilled trades	189,500	204,400	112,800	99,700	147,900	115,600	**869,900**
Wood trades and interior fit-out	38,200	37,500	17,600	19,300	26,400	18,300	**157,200**
Electrical trades and installation	22,400	27,700	18,300	15,000	22,500	18,000	**123,800**
Plumbing and HVAC trades	20,900	25,600	13,400	10,600	17,200	14,300	**101,900**
Labourers (nec)	16,700	20,500	10,500	8,700	16,000	8,100	**80,400**
Building envelope specialists	23,000	18,600	7,900	7,800	7,900	8,100	**73,200**
Painters and decorators	20,600	17,100	6,400	5,600	9,900	6,000	**65,600**
Specialist building operatives (nec)	7,000	8,100	4,700	4,100	7,800	5,700	**37,400**
Bricklayers	10,100	8,300	3,900	5,000	5,600	4,400	**37,200**
Plasterers	4,300	5,500	2,600	5,100	4,600	6,000	**28,100**
Plant mechanics/fitters	3,100	5,000	7,100	3,400	4,700	4,100	**27,400**
Roofers	2,700	7,700	3,700	1,900	5,800	4,700	**26,500**
Plant operatives	4,500	4,900	2,300	3,700	4,600	1,700	**21,700**
Glaziers	4,400	4,300	3,000	2,800	2,700	3,200	**20,300**
Floorers	2,700	3,800	1,600	1,500	3,500	2,800	**15,900**
Steel erectors/structural fabrication	2,500	2,900	3,000	1,500	2,400	3,100	**15,200**
Logistics	3,100	2,900	3,100	1,500	2,200	1,300	**14,000**
Civil engineering operatives (nec)	1,900	1,700	2,100	2,000	1,200	3,600	**12,400**
Scaffolders	1,500	2,400	2,000	500	3,100	2,300	**11,700**
Office-based staff	70,700	56,400	35,400	27,100	42,800	32,400	**264,900**
Non-construction prof/tech/IT/other	64,000	53,700	32,400	24,300	39,100	27,800	**241,300**

Occupational group	London	South East	West Mids.	East Mids.	North West	York. & Humber	Total for six HS2 regions
Non–construction operatives	6,700	2,700	3,000	2,800	3,800	4,700	**23,600**
All occupations	**417.700**	**384.700**	**218.300**	**174.600**	**275.500**	**204.900**	**1.675.700**

Source: CITB/Experian (2017)

Appendix C – Construction qualifications by occupation, 2015/16

Occupation	NVQ level 2 and above	Below NVQ level 2	Other qualifications	No qualifications
All occupations	**74%**	**10%**	**8%**	**7%**
Total - Design and construction management	**88%**	**7%**	**3%**	**2%**
Total - Construction operatives	**62%**	**13%**	**14%**	**11%**
Labourers (nec)	42%	19%	19%	20%
Roofers	55%	18%	8%	19%
Painters and decorators	64%	9%	12%	14%
Floorers	52%	22%	15%	12%
Plasterers	53%	18%	18%	11%
Plant operatives	38%	25%	28%	10%
Bricklayers	77%	5%	9%	9%
Glaziers	69%	16%	7%	9%
Construction trades supervisors	74%	11%	8%	6%
Scaffolders	54%	21%	18%	6%
Wood trades and interior fit-out	76%	9%	9%	5%
Plumbing and HVAC trades	80%	9%	9%	2%
Electrical trades and installation	94%	2%	4%	0%

Source: ONS Labour Force Survey (2017)

Appendix D - Construction occupations

This appendix contains details of the 28 occupational aggregates that are used for construction forecasts and the 166 individual occupations which are aggregated to form these 28 occupational aggregates.

Construction occupations[51] The construction stages during which occupational group is employed is denoted by an "X"	Design services	Management	Construction	Broad occupational grouping (overleaf)
Senior, executive, and business process managers	X	X		C
Construction project managers		X		B
Other construction process managers		X		B
Non-construction professional, technical, IT, & other office–based staff (excl. managers)	X	X		C
Construction trades supervisors		X		B
Wood trades and interior fit-out			X	D
Bricklayers			X	D
Building envelope specialists			X	D
Painters and decorators			X	D
Plasterers			X	D
Roofers			X	D
Floorers			X	D
Glaziers			X	D
Specialist building operatives (nec))			X	H
Scaffolders			X	H
Plant operatives			X	E
Plant mechanics/fitters			X	E
Steel erectors/structural fabrication			X	H
Labourers (nec)			X	G

Construction occupations[51] The construction stages during which occupational group is employed is denoted by an "X"	Design services	Management	Construction	Broad occupational grouping (overleaf)
Electrical trades and installation			X	F
Plumbing and heating, ventilation, and air conditioning trades			X	F
Logistics			X	H
Civil engineering operatives (nec)			X	G
Non–construction operatives			X	H
Civil engineers	X	X		A
Other construction professionals and technical staff	X	X		A
Architects	X	X		A
Surveyors	X	X		A

In sections 4.1 and 5.1 of this report these occupations have been grouped into seven broad occupational groups as shown on the table below. The code letter refer back to the table on the previous page.

Broad occupational group	Reference code
Designers/professionals	A
Management of design & construction	B
Senior management & other office based staff	C
Building trades	D
Plant operators & mechanics	E
Mechanical and electrical trades	F
Civil engineering operatives & labourers	G
Other operatives	H

The 28 occupational aggregates represent 166 occupations within the construction sector. A full set of the 166 occupations is given below.

Occupations included within construction occupational aggregates (Four-digit codes refer to Office for National Statistics Standard Occupational Classification Codes).	
Senior, executive, and business process managers	
(1115) Chief executives and senior officials	(1162) Managers and directors in storage and warehousing
(1131) Financial managers and directors	(1259) Managers and proprietors in other services(nec)
(1132) Marketing and sales directors	(1139) Functional managers and directors(nec)
(1133) Purchasing managers and directors	(2133) IT specialist managers
(1135) Human resource managers and directors	(2134) IT project and programme managers
(1251) Property, housing and estate managers	(3538) Financial accounts managers
(1136) Information technology and telecommunications directors	(3545) Sales accounts and business development managers
(2150) Research and development managers	
Construction project managers	
(2436) Construction project managers and related professionals	
Other construction process managers	
(1121) Production managers and directors in manufacturing	(3567) Health and safety officers
(1122) Production managers and directors in construction	(3550) Conservation and environmental associate professionals
(1161) Managers and directors in transport and distribution	
(1255) Waste disposal and environmental services managers	
Non-construction professional, technical, IT, and other office–based staff (excl. managers)	
(3131) IT operations technicians	(3541) Buyers and procurement officers[52]
(3132) IT user support technicians	(3562) Human resources and industrial relations officers
(3534) Finance and investment analysts and advisers	(4121) Credit controllers
(3535) Taxation experts	(4214) Company secretaries
(3537) Financial and accounting technicians	(7129) Sales related occupations(nec)
(3563) Vocational and industrial trainers and instructors	(7211) Call and contact centre occupations
(3539) Business and related associate professionals(nec)	(7219) Customer service occupations(nec)
(3520) Legal associate professionals	(9219) Elementary administration occupations(nec)
(3565) Inspectors of standards and regulations	(2111) Chemical scientists
(2136) Programmers and software development professionals	(2112) Biological scientists and biochemists
(2139) Information technology and telecommunications professionals(nec)	(2113) Physical scientists
(3544) Estate agents and auctioneers	(3111) Laboratory technicians
(2413) Solicitors	(3421) Graphic designers
(2419) Legal professionals(nec)	(2463) Environmental health professionals
(2421) Chartered and certified accountants	(2135) IT business analysts, architects and systems designers
(2424) Business and financial project management professionals	(2141) Conservation professionals
(2423) Management consultants and business analysts	(2142) Environment professionals
(4216) Receptionists	(2425) Actuaries, economists and statisticians
(4217) Typists and related keyboard occupations	(2426) Business and related research professionals
(3542) Business sales executives	(4124) Finance officers
(4122) Book-keepers, payroll managers and wages clerks	(4129) Financial administrative occupations(nec)
(4131) Records clerks and assistants	(4138) Human resources administrative occupations
(4133) Stock control clerks and assistants	(4151) Sales administrators
(7213) Telephonists	(4159) Other administrative occupations(nec)
(7214) Communication operators	(4162) Office supervisors
(4215) Personal assistants and other secretaries	(7130) Sales supervisors
(7111) Sales and retail assistants	(7220) Customer service managers and supervisors
(7113) Telephone salespersons	(4161) Office managers
Construction trades supervisors	

Occupations included within construction occupational aggregates (Four-digit codes refer to Office for National Statistics Standard Occupational Classification Codes).	
(5250) Skilled metal, electrical and electronic trades supervisors (5330) Construction and building trades supervisors	
Wood trades and interior fit-out	
(5315) Carpenters and joiners (8121) Paper and wood machine operatives	(5442) Furniture makers and other craft woodworkers (5319) Construction and building trades (nec)[53]
Bricklayers	
(5312) Bricklayers and masons	
Building envelope specialists	
(5319) Construction and building trades(nec)(see footnote 53)	
Painters and decorators	
(5323) Painters and decorators	(5319) Construction and building trades(nec)(see footnote 53)
Plasterers	
(5321) Plasterers	
Roofers	
(5313) Roofers, roof tilers and slaters	
Floorers	
(5322) Floorers and wall tillers	
Glaziers	
(5316) Glaziers, window fabricators and fitters	(5319) Construction and building trades(nec)(see footnote 53)
Specialist building operatives not elsewhere classified (nec)	
(8149) Construction operatives(nec) (5319) Construction and building trades(nec)(see footnote 53)	(9132) Industrial cleaning process occupations (5449) Other skilled trades (nec)
Scaffolders	
(8141) Scaffolders, stagers and riggers	
Plant operatives	
(8221) Crane drivers (8129) Plant and machine operatives (nec)	(8222) Fork-lift truck drivers (8229) Mobile machine drivers and operatives (nec)
Plant mechanics/fitters	
(5223) Metal working production and maintenance fitters (5224) Precision instrument makers and repairers (5231) Vehicle technicians, mechanics and electricians	(9139) Elementary process plant occupations(nec) (5222) Tool makers, tool fitters and markers-out (5232) Vehicle body builders and repairers
Steel erectors/structural fabrication	
(5311) Steel erectors (5215) Welding trades (5214) Metal plate workers, and riveters	(5319) Construction and building trades(nec)(see footnote 53) (5211) Smiths and forge workers (5221) Metal machining setters and setter-operators
Labourers (nec)	
(9120) Elementary construction occupations	

Occupations included within construction occupational aggregates (Four-digit codes refer to Office for National Statistics Standard Occupational Classification Codes).	
Electrical trades and installation	
(5241) Electricians and electrical fitters (5249) Electrical and electronic trades (nec)	(5242) Telecommunications engineers
Plumbing and heating, ventilation, and air conditioning trades	
(5314) Plumbers and heating and ventilating engineers (5216) Pipe fitters	(5319) Construction and building trades(nec)(see footnote 53) (5225) Air-conditioning and refrigeration engineers
Logistics	
(8211) Large goods vehicle drivers (8212) Van drivers (9260) Elementary storage occupations	(3541) Buyers and purchasing officers (see footnote **Error! Bookmark not defined.**) (4134) Transport and distribution clerks and assistants
Civil engineering operatives not elsewhere classified (nec)	
(8142) Road construction operatives (8143) Rail construction and maintenance operatives	(8123) Quarry workers and related operatives
Non–construction operatives	
(8117) Metal making and treating process operatives (8119) Process operatives(nec) (8125) Metal working machine operatives (8126) Water and sewerage plant operatives (8132) Assemblers (vehicles and metal goods) (8133) Routine inspectors and testers (8139) Assemblers and routine operatives (nec)	(9249) Elementary security occupations(nec) (9233) Cleaners and domestics (9232) Street cleaners (5113) Gardeners and landscape gardeners (6232) Caretakers (9241) Security guards and related occupations (3319) Protective service associate professionals (nec)
Civil engineers	
(2121) Civil engineers	
Other construction professionals and technical staff	
(2122) Mechanical engineers (2123) Electrical engineers (2126) Design and development engineers (2127) Production and process engineers (2461) Quality control and planning engineers (2129) Engineering professionals(nec) (3112) Electrical and electronics technicians (3113) Engineering technicians (3114) Building and civil engineering technicians	(3119) Science, engineering and production technicians(nec) (3121) Architectural and town planning technicians (3122) Draughtspersons (3115) Quality assurance technicians (2432) Town planning officers (2124) Electronics engineers (2435) Chartered architectural technologists (3531) Estimators, valuers and assessors (3116) Planning, process and production technicians
Architects	
(2431) Architects	
Surveyors	
(2433) Quantity surveyors (2434) Chartered surveyors	

Appendix E – rail engineering occupations

Occupation name
Electrification advanced technician
Electrification apprentice
Electrification assistant engineer
Electrification assistant manager
Electrification engineer
Electrification higher apprentice
Electrification manager
Electrification technician
Head of civils
Head of electrification
Head of signalling
Head of systems
Head of telecommunications
Head of track
Head of traction & rolling stock
Signalling advanced technician
Signalling apprentice
Signalling assistant engineer
Signalling assistant manager
Signalling engineer
Signalling higher apprentice
Signalling manager
Signalling technician
Systems advanced technician
Systems apprentice
Systems assistant engineer
Systems assistant manager
Systems engineer
Systems higher apprentice
Systems manager
Systems technician

Occupation name (continued)
Traction & rolling stock advanced technician
Traction & rolling stock apprentice
Traction & rolling stock assistant engineer
Traction & rolling stock assistant manager
Traction & rolling stock engineer
Traction & rolling stock higher apprentice
Traction & rolling stock manager
Traction & rolling stock technician
Telecommunications advanced technician
Telecommunications apprentice
Telecommunications assistant engineer
Telecommunications assistant manager
Telecommunications engineer
Telecommunications higher apprentice
Telecommunications manager
Telecommunications technician
Track advanced technician
Track apprentice
Track assistant engineer
Track assistant manager
Track engineer
Track higher apprentice
Track manager
Track technician

Appendix F – rail engineering qualifications

Rail engineering – qualification breakdown	Skill level
Level A – Operative	Level 1/2
Level B – Technician/advanced technician	Level 3
Level C – Manager/engineer	Level 4/5
Level D – Executive	Level 6/7/8

Endnotes

[1] The total does not equal the sum of the column for peak workforce because of differences in the timing of the peaks

[2] The total does not equal the sum of the column for peak workforce because of differences in the timing of the peaks

[3] Construction employment is defined by standard industrial classifications (SIC) 41-43, 71.1, and 74.9 – that is contracting and professional services.

[4] Prices are chain linked 2013 prices

[5] Prices are chain linked 2013 prices

[6] Northern Ireland Statistics and Research Agency

[7] Prices are chain linked 2013 prices

[8] NIGEM is a general equilibrium model of the UK and world economy which forecasts, amongst other things, aggregate output, expenditure, income and employment based on the UK National Accounts published by the Office of National Statistics.

[9] 'Economic and Fiscal Outlook', Office for Budget Responsibility, November 2017.

[10] 2014-based ONS population projections, published in May 2016, available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections.

[11] Due to a discontinuity in the data in the change from the use of Standard Occupational Classifications 2000 to Standard Occupational Classifications 2010 it has not been possible to determine a long term flow rate for construction trades supervisors. A weighted average flow rate using data from 2006-2016 has been used for this occupation from the trade occupations who are likely to become construction trades supervisors.

[12] Workforce Mobility and Skills in the UK Construction Sector 2015 (CITB). This research was conducted using almost 5,000 face-to-face interviews with construction workers.

[13] The above data is provided as indicative guidance and should be treated with caution in the light of the difficulty in measuring international migration accurately.

[14] Higher Education Statistics Agency

[15] Workforce Mobility and Skills in the UK Construction Sector 2015 (CITB)

[16] https://www.citb.co.uk/documents/research/productivity%20report%20final%2011_03_16.pdf

[17] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[18] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[19] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[20] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[21] It should be noted that occupations will differ in the ease with which they can transition between sectors. Roles whose skills are not sector specific, such as catering and security, will be able to move between sectors more easily than occupations such as civil engineers who develop sector-specific skills

[22] Heating, ventilation and air conditioning

[23] Workforce Mobility and Skills in the UK Construction Sector 2015 (CITB).

[24] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[25] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks; additionally, the total person years and peak differs from the other breakdowns in this section due to rounding

[26] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks. It is slightly different from the occupation breakdown due to rounding

[27] Sentinel is a safety system in use across the rail Industry. It provides rail workers with a passport to work on the rail infrastructure across the United Kingdom and permits workers to access the infrastructure in a controlled manner

[28] London, South East, West Midlands, East Midlands, North West and Yorkshire & the Humber.

[29] As for the construction analysis data does not exists for construction trades supervisors from 2006 and so a weighted average of relevant occupations has been used.

[30] https://www.gov.uk/government/publications/ofsted-annual-report-201516-education-early-years-and-skills

[31] The Annual Report of Her Majesty's Chief Inspector of Education, Children's Services and Skills 2015/16

[32] There is also a small amount of rail systems work included within the depots and stabling which for the purposes of this report has been excluded from construction and included within rail engineering.

[33] This is the only element of civil engineering that is modelled under rail engineering and is very low in comparison to other expenditure levels within rail engineering.

[34] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[35] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[36] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[37] The Level A and Level D labour demand co-include exactly and for clarity the Level D line has been shown as dots rather than a solid line

[38] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[39] The total does not equal the sum of the columns because of rounding for each skill level and differences in the timing of the peaks

[40] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[41] The track roles have a second peak in 2025/26 driven by O&M set up by these have been omitted from the mismatch due to these roles not being assigned to a specific region.

[42] The data included in the analysis is for the Phase One and 2a regions with the exception of traction and rolling stock which is presented for the whole of the UK.

[43] Telecommunications peaks later (2025/26) than signalling and systems which both peak in 2023/24.

[44] The total does not equal the sum of the columns because of rounding for each asset type and differences in the timing of the peaks

[45] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[46] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[47] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[48] The total does not equal the sum of the columns because of rounding and differences in the timing of the peaks

[49] The data included in the analysis is for the Phase 2b regions with the exception of traction and rolling stock which is presented for the whole of the UK.

[50] Non-profit institutions serving households

[51] These occupational aggregates represent 166 occupations within the construction industry. A full set of the 166 occupations is given later in this appendix.

[52] This occupational group is split across i) non-construction professional, technical, IT, and other office–based staff (excl. managers) and ii) logistics.

[53] This occupational group is split across i) wood trades and interior fit-out; ii) building envelope specialists; iii) painters and decorators; iv) glaziers; v) specialist building operatives not elsewhere classified nec; vi) steel erectors/structural fabrication and viii) plumbing and heating, ventilation, and air conditioning trades

HS2