Understanding current and future skills needs

Technical report

Skills and Productivity Board

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3. Introduction

This technical report is the Skills and Productivity Board's (SPB) analytical accompaniment to the main report, which is a response to the below two questions posed by the previous Secretary of State:

1. Which areas of the economy face the most significant skills mismatches or present growing areas of skills need?

2. Can the SPB identify the changing skills needs of several priority areas within the economy over the next 5-10 years?

It is split into two main sections – the demand for skills and the supply of skills. Each section outlines the approach and methodology adopted by the SPB, its findings, and limitations identified with the analysis.

4. Demand for skills

4.1 Approach and methodology

In this report, we focus on measuring skills and skills mismatches by mapping skills to occupations at the UK Standard Occupation Classification (SOC) 4-digit, unit group level. We infer the demand for particular skills from the relative demand for employment in occupations in which those skills are used intensively and/or at high levels. This decision is pragmatic, as a mapping between skills and occupations for the US already exists (US Occupational Information Network (O*NET)) and can be adapted for the purpose of our UK-specific analysis.[1] Consequently, the types of skills we consider will be limited to what is included in the mapping; there is still a need to explore the best way to group different skills via an appropriate skills taxonomy.[2]

Skills are rarely assessed directly, and not across multiple factors or at scale. This is a limitation of the data available. Instead, they are typically assessed indirectly using occupations (as we do here), qualifications, or educational attainment. Inferences about skills demand and supply can then be made from examining changes in occupational employment or qualification attainment.

4.1.1 O*NET structure

The O*NET framework describes 1,100 occupations at 8-digit level (for example, 11-9199.04 refers to Supply Chain Managers), including information on associated skills, abilities, and knowledge as well as other worker and occupation-specific information. The O*NET information used by the SPB focuses on four sets of occupation-specific descriptors: skills, abilities, knowledge, and work activities. There are 35 skills, 52 abilities, 33 knowledge, and 41 work activities in O*NET, a total of 161 different 'elements'.

Several of these relate to personal attributes that cannot be changed by education and training, for example physical and sensory attributes. We therefore drop the physical, psychomotor, and sensory abilities from further analysis and focus only on those skills which can be influenced by education or training (the only abilities considered are cognitive abilities) – 130 in total. **Throughout this report, these O*NET elements are collectively referred to as 'skills' unless explicitly stated otherwise.**

[1] Our analysis uses the mapping between O*NET job classifications and the UK occupational coding system (SOC) that underpins the Department for Education's LMI for All data portal.

[2] Frontier Economics was commissioned by the SPB to review various existing taxonomies and provide recommendations on how they might be used to address the questions that the SPB has been tasked with answering. Relatedly, the ONS Taxonomy Oversight Group is examining different taxonomies, including one on skills.

For each O*NET occupation, an importance rating (on a Likert scale from 1 (not important) to 5 (extremely important)) and a level rating (ranked 0-7, with explicit scale anchors for some levels to provide reference points) is assigned to each skill.[3] If the importance of a skill is recorded as 'not important' (= 1), then the level assessment is skipped and is automatically recorded as 0. So, level = 0 does not necessarily mean a low level of the skill but rather that it is unimportant in the job (relative to other skills).

For this analysis, the SPB defined its own classification which groups the 130 O*NET skills being considered into 8 skill categories and 23 subcategories. These categories and associated subcategories are presented in **Table 1** below (see the associated spreadsheet for the full list of skills and description of the subcategories).

Table 1: Skills categories and subcategories as defined by the SPB

Skill category	Count	Proportion of all skills	Skill subcategory	Count	Proportion of all skills
Application of knowledge	14	11%	Logic and reasoning	6	5%
			Utilisation	8	6%
Communication	11	8%	Theory	3	2%
			Verbal	4	3%
			Written	4	3%
Digital and data	14	11%	Information	8	6%
			IT	6	5%
Management	10	8%	Admin	3	2%
			Planning	3	2%
			Resources	4	3%
Mental processes	18	14%	Capability	6	5%
			Perception	12	9%
People	23	18%	Interaction	7	5%
			Organisational	5	4%
			Relationships	7	5%
			Service	4	3%
Subject specific	20	15%	LEM	3	2%
			SHAPE	7	5%
			STEM	6	5%
			Vocational	4	3%
Technical and physical	20	15%	Maintenance	6	5%
			Operation	11	8%
			Production	3	2%

[3] The 41 work activities are only assigned importance ratings. O*NET level anchors are available to download from the O*NET website here – Level Scale Anchors - O*NET 25.1 Data Dictionary at O*NET Resource Center (onetcenter.org)

4.1.2 Current skills demand

Combining the LMI for All[4] mapping of O*NET occupations to UK SOC – a many-to-one match, with several O*NET occupations matching to each UK SOC occupation – and the O*NET mapping of occupations to skills provides a list of skills and an accompanying importance score for each UK SOC occupation. This creates a matrix which looks like **Table 2** below.

Table 2: A 6x6 sample of skill by UK SOC matrix for O*NET importance scores

Skill	UK SOC						
	1115	**1121**	**1122**	**1123**	**1131**	**1132**	**…n [365]**
Oral Comprehension	4.25	4.06	3.96	4.10	4	4	
Written Comprehension	4.13	4.03	3.92	3.92	4.06	4	
Oral Expression	4.19	4	3.92	4.05	4.06	4	
Written Expression	4.06	3.75	3.79	3.67	3.94	3.88	
Fluency of Ideas	3.44	3.34	3.25	3.12	3.32	3.75	
Originality	3.44	3.25	3.13	2.98	3.13	3.62	
…n [130]							

Each UK SOC occupation is then weighted by employment in England,[5] as demonstrated in **Table 3** below. For each skill, the cross product of importance score and employment weight is averaged across all occupations, creating a list of skills, each accompanied by an aggregate importance score.[6] This creates a ranking of skills (**skills ranking A**) that provides a measure of skill demand sensitive to how important a skill is across occupations, accounting for the size of their employment shares. For example, a skill that is extremely important in lots of mid-size occupations could achieve a higher skill demand rank than a skill that is only moderately important in large-size occupations. The analysis identifies the upper quartile of skills ranking A as **skills in high demand.** Because they are important across a majority of occupations; they are also referred to as **core transferable skills.**

Similarly, **skills in lower demand** are identified as those in the lower quartile of skills ranking A. A subset of these are **specialist skills**; they are defined as those skills which, across all occupations, have 'hockey-stick'-shaped importance ratings – where the sum

[4] **LMI for All** is a portal which aims to provide high quality, reliable labour market information to inform careers decisions. LMI For All – LMI For All

[5] Annual Population Survey 2019

[6] Normalise vectors (x/mean(x)) before taking cross product such that mean of the normalised vector = 1

of the 90th and 100th percentile of importance ratings is greater than the sum of the 10th to 80th percentiles. This describes a set of skills which are important in relatively few occupations – see **Figure 1** for a graphical representation.

The analysis also identifies which occupations require[7] these specialist skills, and if any of these occupations are in shortage. In total, 26 shortage occupations are identified as requiring at least one of these specialist skills (see **Section 4.2.1.2**).

Table 3: A 6x6 sample of skill by UK SOC matrix for O*NET importance scores including employment weight

Skill	UK SOC						
	1115	**1121**	**1122**	**1123**	**1131**	**1132**	**…n [365]**
APS employment	**100,300**	**10,300**	**275,300**	**182,700**	**12,500**	**321,200**	
Oral Comprehension	4.25	4.06	3.96	4.10	4	4	
Written Comprehension	4.13	4.03	3.92	3.92	4.06	4	
Oral Expression	4.19	4	3.92	4.05	4.06	4	
Written Expression	4.06	3.75	3.80	3.67	3.94	3.88	
Fluency of Ideas	3.44	3.34	3.25	3.12	3.32	3.75	
Originality	3.44	3.25	3.13	2.98	3.13	3.62	
…n [130]							

4.1.3 Indicators of labour shortage

The SPB explored a broad range of indicators used in existing research to provide insights into the state of the labour market and, in particular, where there is high level demand for employment in particular occupations. This echoes the approach adopted by the Migration Advisory Committee for producing its Shortage Occupation List.[8]

The SPB used the following criteria to narrow down their choice of indicators – emphasis was given to selecting a wide range of indicators that captured **different labour market signals and responses** to shortage (e.g. wage/hours growth, vacancies) based on:

[7] A skill is defined as required for an occupation if its importance rating for that occupation is greater than mean +1 standard deviation of all importance ratings

[8] Migration Advisory Committee, Review of the shortage occupation list: 2020 - GOV.UK (www.gov.uk)

- As far as possible, their **relation to skills** (rather than reflecting the whole labour market).
- The **granularity and validity** of the data (e.g. at 4-digit SOC level, and with reasonable sample sizes – so using administrative data rather than survey data where possible).
- **Comparability** across time and location, and the ability to get reasonably **up-to-date** information.
- Using **multiple data sources** and focusing on **objective measures** where possible

Table 4: Summary of selected indicators of labour shortage at an occupation level

	Indicator[9]	Measure	Source
1	Change in % of migrant workers	Migrant worker density = Count of migrant workers per SOC 4-digit occupation / Total employed per SOC 4-digit occupation	APS[10]
2	Vacancies as a % of employment	Vacancy density = All vacancies by SOC 4-digit occupation / Employment by SOC 4-digit occupation	ESS[11]
3	Skill shortage vacancies as a % of all vacancies	Skill shortage vacancy (SSV) density = Skills shortage vacancies by SOC 4-digit occupation / All vacancies by SOC 4-digit occupation	ESS
4	Real-time online vacancies	Vacancy posting density = Vacancies by occupation / Employment (APS)	Burning Glass[12] and APS
5	Hourly wage growth	Percentage change in mean total hourly pay	ASHE[13]
6	Relative wage premium to a skilled occupation	Compares standardised mean gross hourly pay in jobs that require similar skill levels using the ONS Skills Levels (1-4)	ASHE
7	Change in paid hours worked	Percentage change in mean paid hours worked	ASHE

[9] All data is for England only; working age is defined as 19-66; inflation is taken as the CPI index; suppressed values (due to small sample sizes) are imputed from SOC 3-digit values.

[10] Annual Population Survey – APS is a combined survey of households in Great Britain. Annual Population Survey - Nomis - Official Labour Market Statistics (nomisweb.co.uk)

[11] Employer Skills Survey - ESS asks employers about their skills challenges, both in terms of their existing workforce and when recruiting. Employer skills survey 2019: England results - GOV.UK (www.gov.uk)

[12] Burning Glass – Real-time vacancy data web-scraped from job boards and other places where job adverts are posted. Burning Glass Technologies | Real-Time Job Market Analytics Software (burning-glass.com)

[13] Annual Survey of Hours and Earnings – ASHE includes data on occupations and earnings for a representative sample. Tracks the same representative sample since 2004, but it only covers 1% of employees with a National Insurance number. Annual Survey of Hours and Earnings (ASHE) - Office for National Statistics (ons.gov.uk)

For each indicator, the 365 occupations are ranked from 1-100 (using decimals). For each occupation, an average is then taken across all indicators to produce a final **ranking of occupations in shortage**. Throughout this report, occupations in the upper quartile of this occupation ranking are defined as **shortage occupations**. Similarly, occupations in the lower quartile of the occupation ranking are defined as **lower demand occupations.**

The SPB's analysis suggests that the occupation ranking is not driven solely by individual indicators, and that final skill rankings (defined below) are reasonably robust to the inclusion, exclusion, or different weighting of indicators. Correlations between indicators are generally low (coefficients range between -0.38 to 0.06), suggesting that indicators are reflecting different and diverse drivers of labour demand (see **Table 13** and **Table 14** in the Appendix for indicator correlations and key figures including range and mean of raw values).

Table 5: A 6x6 sample of skill by UK SOC matrix for O*NET importance scores including employment weight and occupation rank

Skill	UK SOC						
	1115	**1121**	**1122**	**1123**	**1131**	**1132**	**…n [365]**
APS employment	**100,300**	**10,300**	**275,300**	**182,700**	**12,500**	**321,200**	
Occupation rank	**61.21**	**69.43**	**36.32**	**51.09**	**26.52**	**52.48**	
Oral Comprehension	4.25	4.06	3.96	4.10	4	4	
Written Comprehension	4.13	4.03	3.92	3.924	4.06	4	
Oral Expression	4.19	4	3.92	4.05	4.06	4	
Written Expression	4.06	3.75	3.79	3.67	3.94	3.88	
Fluency of Ideas	3.44	3.34	3.25	3.12	3.32	3.75	
Originality	3.44	3.25	3.13	2.98	3.13	3.62	
…n [130]							

Combining the above occupation ranking with skills ranking A by using a cross product of occupation rank[14] produces a second ranked list of skills (**skills ranking B**) which considers both the employment size of an occupation and the relative demand for it based on the indicators of labour shortage. The analysis shows that the list of skills in the

[14] Normalise vectors (x/mean(x)) before taking cross product such that mean of the normalised vector = 1

upper quartile of skills ranking B are identical to those in skills ranking A, i.e. what we have defined as core transferable skills.

The reason these skills are potentially – rather than definitely in shortage – is because the indicators identify shortage occupations but not skills in shortage. It does not logically follow that the skills important in shortage occupations are in shortage themselves. For any given occupation, it may be that the most important skill (highlighted in the analysis) is not driving any apparent shortage issues, but a less important skill is; equally it could be a non-skill supply issue (see **Section 4.2.1.3**). To definitively identify skills in shortage, a comprehensive understanding of skills supply is required; this is not something that we have explored (see **Section 5**).

4.1.4 Priority areas

To examine the question of changing skills demand, the SPB chose to narrow its focus to four priority areas – Health, Managers, Science and Technology, and Skilled Trades.

1. **Health**: including nursing, medical radiography, paramedics, and care workers. Nurses and care workers are particularly fast-growing occupations, and we know that health and social care is a priority for government.
2. **Science and Technology**: including research, engineering, programmers, and software development professionals. We have seen evidence of several science and technology roles, such as programmers, increase in demand over time. We also know that digital and tech is an area government is keen to focus on.
3. **Managers**: including corporate and financial managers and directors, both of whom have seen particularly significant growth. Although not directly a sector, the Industrial Strategy Council research found that 2.1 million workers are likely to be under-skilled in at least one core management skill by 2030.[15] As the number of management roles are expected to increase, it will be important to produce cross-cutting analysis and look at how these skills needs will change.
4. **Skilled Trades**: including construction and building trades, electricians, carpenters, welders, glaziers, and fitters.

Together, the priority areas include 79 4-digit SOC codes and represent approximately 29% of the labour market. See **Table 15** in the Appendix for the full list of occupations.

The criteria for defining these four priority areas were:

[15] UK Skills Mismatch in 2030, Industrial Strategy Council, October 2019. Available at: Microsoft Word - UK Skills Mismatch 2030 - Research paper (industrialstrategycouncil.org)

- Occupations which have **grown in employment** over the last five years (2015-2020)[16] and are predicted to represent a relatively large share of employment in the future.[17]
- Occupations which provide employment across **all regions in England**, particularly outside London and the Southeast.
- Occupations within an expanding sector which represent a **broad range of skill types** also common in other sectors.

Many of these occupations appear on the shortage occupation list; 58% of Health, 24% of Science and Technology, 19% of Managers, and 42% of Skilled Trades occupations are **shortage occupations**.

4.1.5 Changing skills demand

In addition to examining current skills demand, this report seeks to understand how skills needs change in the future. There are two parts to this. First, as a particular occupation grows, there will be more demand for the skills needed to perform the tasks associated with that occupation. This has been examined using **quantitative analysis**. Second, within existing occupations, the tasks performed might change over time and, by extension, so might the skills required to perform those tasks. This has been explored through **qualitative analysis**.

The **quantitative analysis** uses Working Futures,[18] a Department for Education (DfE) commissioned dataset which projects employment by occupation out to 2027. The O*NET skills importance ratings and Working Futures projections of future employment by occupation are combined to develop two measures of future skills needs (in 2027):

- **Future skill importance** – this is the ranked skill list identified in **Section 4.1.2** (skills ranking B), weighted by future occupation size from Working Futures. This provides a measure of future importance but doesn't necessarily identify those skills that have grown in importance the most.
- **Growth in importance** – this is the ranked change between current and future importance ratings.[19] Ranked change is defined as the future importance rating

[16] APS share of employment by occupation 2015-2020

[17] Working Future 2017-27

[18] **Working Futures** 2017-27 provides projections of sectoral, regional, and occupational employment. These are projections, rather than forecasts, of future employment. IER - Working Futures (warwick.ac.uk)

[19] For future skill importance, we use Working Futures 2027 data. However, for the growth in skill importance, APS 2018/19 data is grown using growth rates derived from Working Futures 2018 to Working Futures 2027. This is because Working Futures 2018 (a projection at the time of publication) does not align with the outturn APS 2018/19 data. For consistency, when comparing current and future importance scores, the same dataset (APS) is used. Therefore, a slightly different approach is required across the two indicators of future demand.

minus the current importance rating, ranked from 0-1. This helps identify the biggest changes in importance, but not necessarily the most important skills in the future.

There is an important caveat to the approach used to estimate future skills needs. The methodology described above relies on the projected growth in employment sizes of occupations, and therefore is only considered for those occupations whose employment sizes are projected to grow. This is because when projected employment sizes of an occupation fall, our approach down weights the skills important for that occupation today. Consequently, when examining skills important in the future, the analysis produces counterintuitive outputs, i.e. a list of skills that are of lower importance (for that occupation) today as amongst the most important in the future. For growth in importance, this results in large growth in skills that are not important for that occupation. This is because the importance scores of these less important skills decrease by a smaller magnitude than those of the more important skills. This applies to all occupations in the Skilled Trades priority area, and consequently we have not applied our methodology to that group of occupations.

The **qualitative analysis** involves a series of interviews and validation workshops with industry experts and members of employer representative bodies to develop an understanding of the changing skills needs within a specific set of occupations over the next 5-20 years.[20] This involves understanding the factors expected to influence skills needs, how tasks are expected to change with time, and what skills or occupations will be needed to respond to these changes. This research focused on the four priority areas defined in **Section 4.1.4**.

Across the four priority areas, the semi-structured interviews were conducted with representatives of professional bodies and associations of these occupations. These were conducted for a narrowed set of occupations which were selected based on current and expected occupation size as well as the ability of representatives to comment on similar occupations.

4.1.6 Distribution of levels across skills

In addition to identifying skills that are in demand across a range of occupations and occupational groups, the analysis also uses O*NET level ratings (ranked 0-7) to examine the level at which skills are required. For each skill, level anchors are provided for three levels. For example, for the skill Oral Comprehension, O*NET level 2 is defined as the

[20] This research has been externally commissioned to RAND Europe and will be published alongside other SPB outputs.

level required to ‘Understand a television commercial’, level 4 is ‘Understand a coach’s oral instruction for a sport’, and level 6 is to ‘Understand a lecture on advanced physics’.

The SPB established four classifications of level – none, basic, intermediate, and advanced:

- An occupation requires a skill to an **advanced** level if its level rating is greater than the median level plus 50% as measured across all occupations.
- Skills with a level rating within +/- 50% of the median value are categorised as **intermediate**.
- Skills with a level rating less than the median minus 50% are categorised as **basic**.
- Skills with a level rating less than 0.5 are assigned to a ‘**none**’ category.[21]

For each of the 365 occupations, the 130 skills have been assigned to one of these four categories.

Table 6 provides the values of the O*NET level ratings that define the four categories alongside the proportions of occupation-skill combinations in each category. The proportions refer to the number of occupation-skill combinations in each skill classification defined above (where the total number of occupation-skill combinations is 365 × 130 = 47,450). This table indicates that the majority of occupations use skills at the intermediate level.

Table 6: Summary of O*NET level categories

Level category	Level values	Criteria	Proportion of all skills
None	0.000-0.499	Assigned 0 level due to low importance rating	7%
Basic	0.500-1.417	Less than median minus 50%	14%
Intermediate	1.418-4.250	Median of all levels across included skills +/-50% of the median value	70%
Advanced	4.251-7.000	Greater than the median plus 50%	9%

Where levels are discussed for certain skills, they are employment-weighted averages.[22] This provides an indication of the number of people (rather than the number of occupations) that require the specified skill to the specified level.

[21] This is because O*NET automatically rates skills as level 0 if their importance rating is 1 (i.e. so unimportant that no level rating is appropriate). As the methodology involves mapping from O*NET to SOC 2010, which requires some occupations to be combined and averaged, the level of certain skills (for certain occupations) is between 0 (none) and 1 (the lowest actual level assigned). In such cases, the level is adjusted to reflect where it would more likely lie – i.e. to no level (0) or to a basic level (1).

[22] Using APS 2019

Throughout the analysis, we have used importance ratings as the basis for our ranking of skills with levels analysis used to supplement findings. This is because level ratings (and the level anchors) are not always directly or easily comparable across skills. They also tend to be quite specific and can be regarded quite differently depending on one's actual skillset. For example, Writing O*NET level 6 is 'writing a novel for publication' and Reading O*NET level 6 is 'reading a scientific journal article describing surgical procedures'. In contrast, the language for the important scale is consistent across all skills (not important (1) to extremely important (5)) which allows direct comparisons to be made.

4.2 Findings

4.2.1 Identifying current skills in demand

The SPB's approach provides two different measures of skills demand:

- **A measure of current skills use** – to understand which skills are important for jobs across the economy as a whole.
- **A measure of skills potentially in shortage** – to understand which skills are relatively more important in shortage occupations than non-shortage occupations.

4.2.1.1 Across the whole economy

The SPB analysis identifies a set of **core transferable skills**,[23] which are skills found to be important across occupations in the economy.

These skills can be grouped into five categories (see **Table 16** for full list of core transferable skills):

- **Communication skills**: 73% of skills in this category are identified as being in high demand, including 100% of skills in the Verbal subcategory (Active Listening, Speaking, Oral Communication, and Oral Expression), English Language, and Reading Comprehension.
- **Digital and data skills**: 64% of skills in this category are identified as being in high demand, including 100% of the Information subcategory (Analysing Data or Information, Making Decisions and Solving Problems etc.) and Interacting with Computers.

[23] Upper quartile of skill ranking A and B

- **Application of knowledge skills**: 36% of skills in this category are identified as being in high demand, including Critical Thinking, Inductive and Deductive Reasoning, and Information Ordering.
- **People skills**: 26% of skills in this category are identified as being in high demand including, Social Perceptiveness, Training and Teaching Others, and Customer and Personal Service.
- **Mental processes**: 17% of skills in this category are identified as being in high demand specifically Thinking Creatively, Problem Sensitivity, and Monitoring.

These skills are primarily from the O*NET **work activity** and (cognitive) **ability** descriptors. Across all occupations, work activities account for 41% of core transferable skills, but only 34% of all skills, meaning they are over-represented amongst core transferable skills. O*NET defines work activities as 'general types of job behaviours occurring on multiple jobs', validating the decision to define them as core transferable skills.

Levels

Across all occupations and jobs in England,[24] the majority of jobs use these core transferable skills to an intermediate level (see **Table 16** for the breakdown of level required for each skill). For example:

- **Communication skills**, including English language, Oral Comprehension and Expression, Written Comprehension and Expression, and Active Listening are used to an intermediate level by the majority (between 68-95%) of jobs in England.
- Similarly, **People skills,** including Social Perceptiveness, Communicating with Persons Outside Organisation, Training and Teaching Others, and Interpreting the Meaning of Information for Others are all used to an intermediate level by the majority (between 77-98%) of jobs in England.
- **Digital and data skills,** including Interacting with Computers, Analysing Data or information, and Processing Information are used to an intermediate level by the majority (53-88%) of jobs in England.

There are several exceptions to this, such as skills that are used to an advanced level by the majority of jobs in England (e.g. some specific People, Data and Digital, and Management skills – see **Table 16** for specific skills).

Despite being important across all occupations, when comparing the level used in shortage occupations vs lower demand occupations (**Figure 4**), core transferable skills

[24] Weighted by APS Employment 2019 at SOC 4-digit level

are more likely to be used to an advanced level in shortage occupations, with lower demand occupations using them to an intermediate or basic level.

Skills in lower demand

The analysis also identifies a set of **skills in lower demand**[25] (see **Table 18** in the Appendix for full details).

Skills in lower demand cover several skill categories:

- **Technical and physical skills**: 60% of all skills in this category are identified as skills in lower demand, including skills from the Maintenance (67%), Production (67%), and Operation (55%) subcategories. Of these, five are specialist skills, including Repairing, Installation, and Food Production.
- **Subject specific knowledge**: 60% of all skills in this category are identified as skills in lower demand, including skills from the SHAPE (86%) and STEM (67%) subcategories.[26] Of these, six are specialist skills, including Biology, Medicine and Dentistry, and History and Archaeology.
- **Digital and data**: 21% of all skills in this category (and 50% of the IT subcategory) are identified as skills in lower demand, including specifically Troubleshooting, Technology Design, and Programming. Of these, only Programming is a specialist skill.

4.2.1.2 In occupations facing labour shortages

The analysis identifies a set of **skills potentially in shortage,** defined as those skills that are statistically significantly more important[27] in shortage occupations than lower demand occupations (see **Table 19** in the Appendix for full list of skills and test statistics).

These cover five skill categories:

- **STEM knowledge**: 83% of skills in this subcategory are relatively more important in shortage occupations – both in more applied areas, such as Medicine and Dentistry and Engineering and Technology, and in more general areas, including Mathematics, Physics, and Biology.

[25] Lower quartile of skill ranking A

[26] SHAPE includes Design, Geography, and Sociology and Anthropology; STEM includes Biology, Physics, and Medicine and Dentistry

[27] Independent sample t-test p-value ≤ 0.1

- **Digital and data skills**: 36% of skills in this category are relatively more important in shortage occupations, including 50% of skills in the Information subcategory (Making Decisions and Solving Problems, Analysing Data or Information etc.).
- **Mental processes**: 22% of skills in this category are relatively more important in shortage occupations, including Selective Attention, Perceptual Speed, and Visualisation.
- **Application of knowledge**: 21% of skills in this category are relatively more important in shortage occupations, specifically Mathematical Reasoning, Science and Updating and Using Relevant Knowledge.
- **Technical and physical**: 15% of skills in this category are relatively more important in shortage occupations, including Equipment Selection and Repairing.

In addition, two skills were identified as being significantly more important in lower demand occupations than shortage occupations. These are **Coaching and Developing Others** and **Monitoring and Controlling Resources**.

Of the skills potentially in shortage, five are also identified as core transferable skills:

- **Digital and data skills**, specifically Evaluating Information to Determine Compliance with Standards, Identifying Objects, Actions and Events, Making Decisions and Solving Problems, and Analysing Data or Information.
- **Updating and Using Relevant Knowledge** in the Logic and Reasoning subcategory.

Four of the skills potentially in shortage are also specialist skills. They are – **Repairing** in the Technical and Physical category, and **Science**, **Biology,** and **Medicine and Dentistry** in the Utilisation and STEM subcategories.

Levels

Of the skills identified as being potentially in shortage, most are used to an intermediate level by the majority of jobs in shortage occupations (see Table 20). For example,

- **Digital and data skills**, including Making Decisions and Solving Problems, Analysing Data or Information, and Troubleshooting are used to an intermediate level by most (between 47-74%) of jobs in shortage occupations.
- Similarly, **Mental processes,** including Selective Attention, Perceptual Speed and Visualisation are used to an intermediate level by the vast majority (99-100%) of jobs in shortage occupations.

Some exceptions to this rule are in the STEM skills category (specifically Biology and Medicine and Dentistry) and Technical and Physical skills category, including

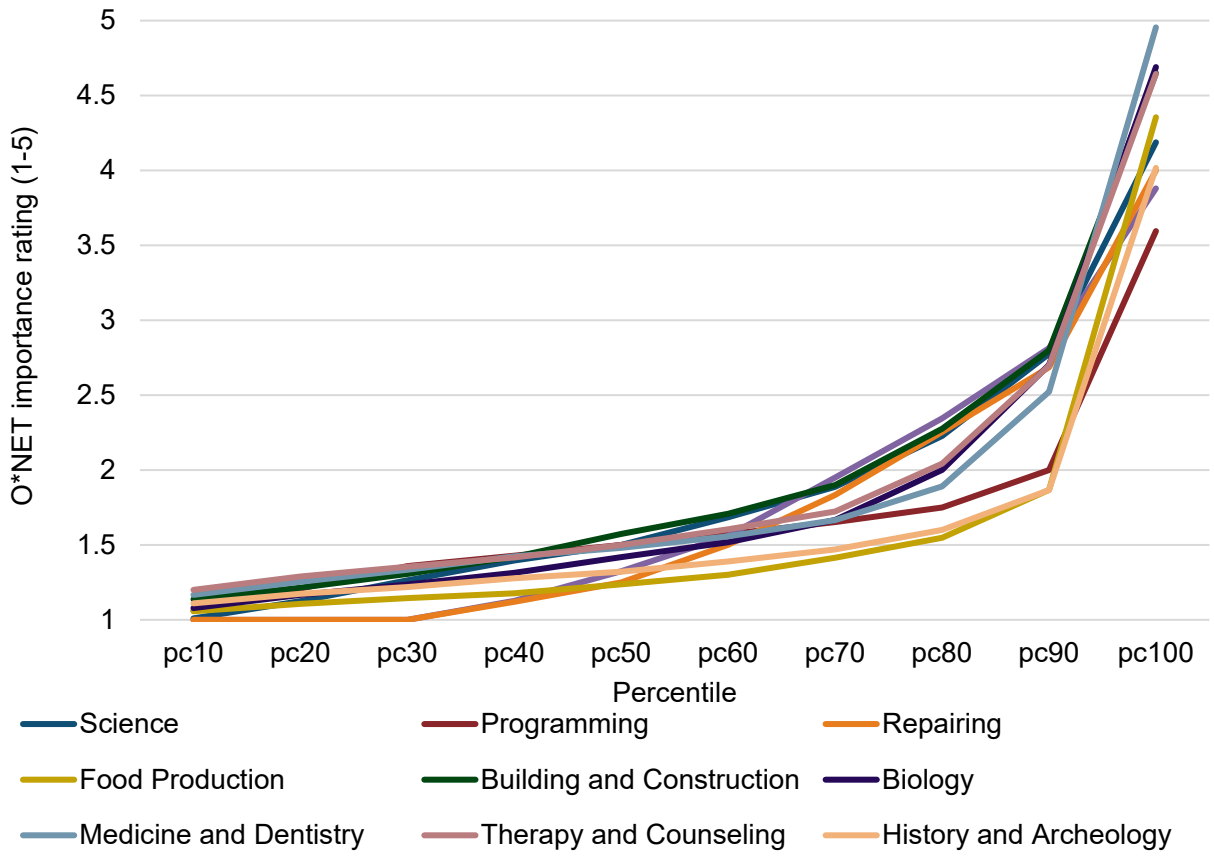
Repairing and Equipment Selection. These skills are mostly used to a basic level or not at all (None) by shortage occupations (see Table 20 for the full skill list).

Comparison of the level used of skills potentially in shortage reveals that, as well as being significantly more important in shortage occupations, they are also generally used to a higher level in shortage occupations than lower demand occupations – see **Figure 6** for all skill level difference.

Specialist skills in shortage occupations

A subset of skills in lower demand are **specialist skills**, defined as those skills which, across all occupations, have 'hockey-stick'-shaped importance ratings – where the sum of the 90th and 100th percentile of importance ratings is greater than the sum of the 10th to 80th percentiles.

Figure 1: A selection of specialist skills



Of all the specialist skills, the analysis identified a number that are highly important[28] in specific shortage occupations (see **Table 20** in the Appendix for the full list):

[28] Greater than or equal to the mean +1SD of importance ratings across all 130 skills included

- **Medicine and Dentistry:** important in 13 shortage occupations, including Midwives, Nurses, Medical Radiographers, and Paramedics.
- **Biology:** important in 10 shortage occupations, including Physiotherapists, Dental Practitioners, and Managers in Agriculture and Horticulture.
- **Therapy and Counselling:** important in 7 shortage occupations, including Occupational Therapists, Psychologists, and Nurses.
- **Building and Construction:** important in 3 shortage occupations, including Architects, Architectural Technologists and Pipe Fitters.

4.2.1.3 Challenges – Measuring current skills in the economy

The board relied on the existing O*NET taxonomy of skills to carry out this analysis, and more specifically to establish which skills are most important for each occupation. It's worth noting that O*NET was designed for the United States' labour market, and only a mapping to the UK Standard Occupational Classification (SOC) has been used in this analysis. Consistent and comparable terminology is critical, and ideally the UK would have its own taxonomy that related to its own labour market. However, developing a UK-specific skills taxonomy would require significant time and resource and the Board considered it appropriate to first test the suitability of O*NET (and other available taxonomies) for the UK before considering developing a UK-specific equivalent.[29] The TOG's work (discussed above on p. 11) is considering such questions currently.

The indirect approach provides a good view on the skills most in demand and disaggregating skills from occupations enables consideration of:

- Skills that appear common or transferable across a range of occupations and therefore are among the most appropriate skills to prioritise developing or incorporating into core curricula. Better information on these skills and the role they play in productivity could help prepare people for a rapidly changing labour market.
- How best to develop those skills (or bundles of skills) in demand – including whether smaller taught units or courses may be most appropriate (and efficient) at providing only the additional skills a person requires to move into a new occupation in high-demand.

Note that with this approach we can only say that skills identified are in high demand, not necessarily in shortage. If there is a shortage, this may mean one of two things: the skills system

[29] Further detail is available in the board's commissioned research on available taxonomies and their relevance to the UK - Frontier Economics. (2022) Review of skills taxonomies, London: Frontier Economics

is not developing these skills sufficiently, or there are enough people with those skills across the workforce but there is a problem of matching people to jobs in shortage. This may be a result of people lacking information on their options, or terms and conditions in the job (including pay) being unsatisfactory to induce people to fill those jobs (taking account of individual preferences). In the latter case, simply training more people would not solve the underlying problem. Better data on skills supply is crucial to answering the question of skills shortage more comprehensively.

The Board's paper[30] discusses the opportunities for improvement, specifically developing ways of capturing local level data and making this available in an accessible format to local level audiences, and contributing, encouraging, and validating web-scraped vacancy data.

4.2.2 Identifying future skills needs

4.2.2.1 Across the whole economy

Across all occupations, **Communication** and **Digital and data** skills are expected to be the most important in the future, based on projections of future occupation sizes in 2027 (see **Table 15** in the Appendix for the full list). This is consistent with the current skills picture and indicates that the skills in high demand today will remain important in the future. Contrastingly, **People** skills and **Mental processes** are expected to see the biggest *growth* in importance between now and the future, suggesting this might be an area in which to increase current skills training (see **Table 21** in the Appendix for the full list).

Some skills are identified as being both important in the future *and* expecting large growth in importance, including establishing relationships and communicating with others, organising and planning work, and thinking creatively (see **Table 7**). Each of these skills is also a core transferable skill (identified in **Section 4.2.1.1**), underlining the conclusion that skills currently in high demand are expected to remain in high demand in the future.

Several skills, including Interacting with Computers, Written Comprehension, Documenting/Recording Information, and Evaluating Information to Determine Compliance with Standards, are expected to be important in the future but not to see growth in importance.

Some skills, despite seeing large growth in importance, will remain in lower demand. These skills come largely from the **technical and physical** and **subject specific** categories, including Building and Construction, Equipment Maintenance, Philosophy and Theology, and History and Archaeology. Of the skills that see growth in importance but

[30] Skills and Productivity Board. (2022) Opportunities and challenges for improving labour market information on skills, London: Skills and Productivity Board.

remain in low demand, 75% of them are specialist skills identified in **Section 4.2.1.2**, and they constitute nearly half (46%) of the entire specialist skills list.

Table 7: Skills identified as both important in the future and expecting large growth with the corresponding skill level across all jobs

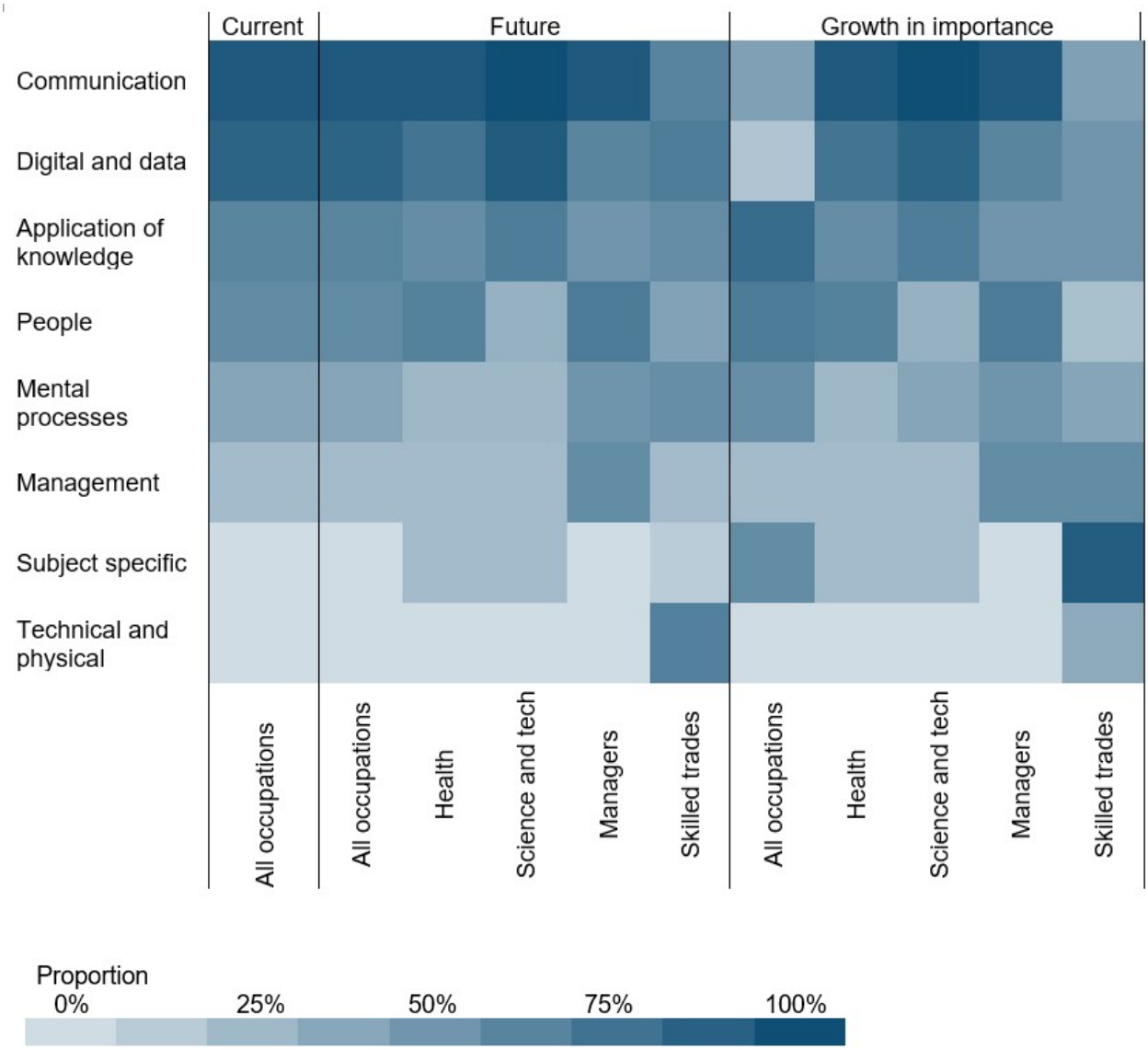
Skill category	Skill subcategory	Specific skill	Skill level		
			Basic	Intermediate	Advanced
Application of knowledge	Logic and reasoning	Inductive Reasoning	0%	96%	4%
Communication	Verbal	Oral Comprehension	0%	75%	25%
Digital and data	Information	Identifying Objects, Actions, and Events	0%	66%	34%
Management	Planning	Organizing, Planning, and Prioritizing Work	0%	37%	63%
Mental processes	Perception	Monitoring	0%	95%	5%
	Capability	Thinking Creatively	0%	71%	29%
People	Relationships	Establishing and Maintaining Interpersonal Relationships	0%	31%	69%
	Organisational	Communicating with Persons Outside Organization	2%	71%	27%
	Interaction	Social Perceptiveness	0%	99%	1%

4.2.2.2 In the priority areas

Quantitative analysis

There is a very strong overlap between the skills that are important across occupations in the economy as a whole and those that are important in occupations in our priority areas, as shown in **Figure 2.**

Figure 2: Importance of different skill categories in each priority area and the economy as a whole



Across three of the four priority areas, the most important skills in the future coincide with the biggest expected growth in importance.

- For Health (see **Table 23**), the biggest future skills needs are in the **Communication** and **Digital and data** categories – these skills represent 64% of the Communication and 50% of the Digital and data. These changes are driven by occupations from the *61 Caring personal service* occupations 2-digit SOC code[31] which are projected to grow faster than the rest of the Health priority area.

[31] 6121 Nursery nurses and assistants, 6141 Nursing auxiliaries and assistants, 6142 Ambulance staff (excluding paramedics), 6143 Dental nurses, 6145 Care workers and home carers, 6146 Senior care workers, 6147 Care escorts

- For Science and Technology (see **Table 24**), the biggest future skills needs are in the **Communication** and **Digital and data** categories – these skills represent 82% of the Communication and 71% of the Digital and data categories. These changes are mainly driven by the *21 Science, research, engineering and technology professionals* 2-digit SOC group.[32]
- For Managers (see **Table 25**), the biggest future skills needs are in the **Communication** and **People** categories – these skills represent 73% of the Communication and 43% of the People categories. These changes are mainly driven by managers in marketing, construction, IT, and transport sectors.[33]

Skilled Trades occupations are projected to decline in employment size the future, and therefore require a different methodology to the one used for the other three priority areas. The reasons for this are articulated in the methodology section above (see **Section 4.1.5**). Instead, future skills needs in the Skilled Trades priority area are analysed only through the qualitative analysis.

In summary, the Health and Science and Technology priority areas are similar to the broader set of occupations in that **Communication** and **Digital and data** skills are expected to account for a majority of skills important in the future. With the managers priority area, as one might expect, there is a marginally stronger emphasis on **People** skills.

Some skills are important across all four priority areas – these also coincide with the core transferable skills and are therefore of particular interest. See **Table 8** below.

[32] 2112 Biological scientists and biochemists, 2113 Physical scientists, 2114 Social and humanities scientists, 2119 Natural and social science professionals n.e.c. (not elsewhere covered), 2121 Civil engineers, 2122 Mechanical engineers, 2123 Electrical engineers, 2124 Electronics engineers

2126 Design and development engineers, 2127 Production and process engineers, 2129 Engineering professionals n.e.c., 2133 IT specialist managers, 2134 IT project and programme managers, 2135 IT business analysts, architects and systems designers, 2136 Programmers and software development professionals, 2137 Web design and development professionals, 2139 Information technology and telecommunications professionals n.e.c., 2141 Conservation professionals, 2142 Environment professionals, 2150 Research and development managers

[33] 1122 Production managers and directors in construction, 1123 Production managers and directors in mining and energy, 1132 Marketing and sales directors, 1134 Advertising and public relations directors, 1136 Information technology and telecommunications directors, 1161 Managers and directors in transport and distribution

Table 8: Skills expected to be important across all four priority areas and more widely across all occupations

Skill category		Skill subcategory		Specific skill
Application of knowledge	21%	Utilisation	13%	Deductive Reasoning
		Logic and reasoning	33%	Critical Thinking
				Updating and Using Relevant Knowledge
Communication	36%	Verbal	75%	Oral Comprehension
				Oral Expression
				Active Listening
		Theory	33%	English Language
Digital and data	21%	Information	38%	Getting Information
				Identifying Objects, Actions, and Events
				Making Decisions and Solving Problems
Management	10%	Planning	33%	Organizing, Planning, and Prioritizing Work
Mental processes	6%	Perception	8%	Problem Sensitivity
People	9%	Organisational	20%	Communicating with Supervisors, Peers, or Subordinates
		Relationships	14%	Establishing and Maintaining Interpersonal Relationships

Some skills are priority area specific (see **Table 9** for the full list). For example, STEM knowledge is important for Health and Science and tech occupations, care skills are important in Health occupations, a range of management skills, including motivating and directing subordinates, developing strategies and objectives, are important for Managers.

Table 9: Skills more important in priority areas than all occupations (in the UQ for the priority area but not in the UQ for all occupations)

Priority area	Skill category	Specific skill
Health	People	Service Orientation
		Interpreting the Meaning of Information for Others
		Assisting and Caring for Others
		Performing for or Working Directly with the Public
	Subject specific	Psychology
		Medicine and Dentistry
Science and Technology	Application of knowledge	Complex Problem Solving
	Digital and data	Computers and Electronics
	People	Interpreting the Meaning of Information for Others

	Subject specific	Engineering and Technology
		Mathematics
Managers	Management	Administration and Management
		Developing Objectives and Strategies
	People	Coordination
		Resolving Conflicts and Negotiating with Others
		Coordinating the Work and Activities of Others
		Developing and Building Teams
		Guiding, Directing, and Motivating Subordinates
		Coaching and Developing Others
Skilled Trades	Mental processes	Visualization
		Judging the Qualities of Things, Services, or People
	Subject specific	Mathematics
	Technical and physical	Operation Monitoring
		Mechanical
		Inspecting Equipment, Structures, or Material
		Performing General Physical Activities
		Handling and Moving Objects
		Controlling Machines and Processes
		Operating Vehicles, Mechanized Devices, or Equipment
		Repairing and Maintaining Mechanical Equipment

Levels

Across all occupations in the four priority areas, the distribution of level required for all skills is concentrated at the intermediate level. This statement is strongest for the Managers priority area (highlighted in **Table 10** below), which require 81% of all skills at this level. In contrast, Science and Technology and Skilled Trades require a fifth of their skillset to be at an advanced level.

Table 10: All skills – distribution of levels across occupations in each of the four priority areas

Priority area	None	Basic	Intermediate	Advanced
Health	5%	13%	67%	14%
Science and Technology	7%	12%	61%	20%
Managers	3%	11%	81%	5%
Skilled Trades	5%	9%	66%	19%

Qualitative analysis – interim results[34]

Interviews for the **Health** priority area examined the skills needed in three occupations – care workers and home carers, medical practitioners, and physiotherapists. Technological developments and a shift towards digitalisation accelerated by the Covid-19 pandemic have brought about important changes to skills needed in all occupations in this area:

- **Digital and data**: in the next 5-10 years, there is a particular need for integrating technology and ensuring it is effectively used in all occupations (such as adoption of wearable devices); this would free up professionals' time for more specialised work.
- **Interaction** and **relationships**: participants discussed skills needs around the ability to interact with patients, to work in a team to address complex needs in a coordinated way, and to cope with uncertainty and react calmly to unexpected events.
- **Emerging**: new and emerging skills were identified around conducting telemedicine and video consultations as well as meeting higher patient expectations.

Interviews for the **Science and Technology** priority area focused on programmers and software development professions, biological scientists and biochemists, and design and development engineers:

- **IT**: the main technical and digital skills identified as important in the future surround data analytics, use of big data, artificial intelligence, machine learning, and cloud-based computing – more graduates with these skills need to enter the workforce.
- **STEM**: knowledge of statistics is particularly important for biological scientists and biochemists. Across the priority area, given the level of innovation in the sector, a willingness to learn and adapt to new technologies is needed, including knowledge of role-relevant tools, Computer aided design for design engineers, coding languages for programmers, and laboratory equipment for biological scientists and biochemists.
- **Emerging**: in addition to the above, a key skill around integrity, including equality, diversity, and inclusion in the workplace was highlighted.

Interviews for the **Managers** priority area focused on skills needs for financial managers and directors, production managers and directors in manufacturing, and information technology and telecommunications directors:

[34] Full report will be published in due course.

- **IT**: knowledge of and engagement with digital technology, cyber security, and cloud skills were identified as being important in the future.
- **Organisational**: adjusting to modern ways of working, including hybrid working, job-shares, and alternating shift patterns.
- **Emerging**: in addition to the above, ethical integrity, including awareness of ethics, climate change and sustainability, as well as equality, diversity, and inclusion, is also needed among managers.

Interviews for the **Skilled Trades** priority area focused on electricians and electrical fitters, carpenters and joiners, and plumbing and heating and ventilating engineers:

- **IT**: participants identified some important technical and digital data skills, including operational knowledge of new technologies, adapting to new equipment, and digital literacy (e.g. the ability to use technological aids such as mobile phones and tablets for communication, book-keeping, and research of products).
- **Communication**: communication skills, particularly with other professionals and customers, were identified as growing in importance.
- **Emerging**: an awareness of upcoming changes, including staying up to date with new regulations to understand the impact on projects, was identified as particularly important.

4.2.2.3 Challenges – Measuring changing skills in the future

Quantitative analysis

The only driver of future skills needs in the quantitative analysis is the Working Futures projections of **future occupation sizes** and the corresponding change in employment shares of different occupations, including within each priority area.[35]

While Working Futures provides a good understanding of possible future employment sizes in the UK labour market, it has its limitations. At the time it was produced in 2016, it took account of all known information (e.g. Brexit). However, it couldn't account for unknown and unpredictable changes such as the Covid-19 pandemic and Government's 2050 Net Zero target. The latter resulted in the publication of the Net Zero Strategy, and the Green Jobs Taskforce report,[36] all of which place greater emphasis on 'green skills', a concept Working Futures doesn't address.

Despite its limitations, it is still the most useful dataset for understanding future changes in employment shares of occupations in the UK labour market.

[35] At the 4-digit SOC level there is a small negative correlation between current employment size and the absolute magnitude of change Working Futures projects, see **Figure 7** in the Appendix for details
[36] Green Jobs Taskforce report - GOV.UK (www.gov.uk)

Qualitative analysis

The main limitation with the qualitative analysis is that, primarily for resource reasons, any interviews and focus groups are restricted to small groupings of occupations. Consequently, there is a risk that the chosen occupations are not exhaustive in their representation of an area (e.g. health, science and technology), which might have implications for any conclusions drawn. The outputs from this type of qualitative research also depend on the interviewees themselves, what questions they feel confident responding to, how many occupations they can comment on, and what their assessment is of changing skills within occupations in the future. There is a risk of arriving at wide ranging and possibly inconclusive outputs, although this is mitigated to a certain extent by using validation workshops to arrive at consensus conclusions.[37]

[37] More discussion on this methodology is provided Skills and Productivity Board. (2022) Understanding current and future skills needs - Policy Report, London: Skills and Productivity Board.

5 Supply

Thus far we have focused on estimating the current and future demand for skills. But identifying **skills mismatches** requires us to assess whether there is a difference between the ***demand for skills*** and the ***supply of skills*** – the skills workers possess that could be deployed to meet the demand for skills.

We can think of the supply of skills as coming from two sources: education and training, and work experience (including any on-the-job training). *Direct* measures of the supply of skills typically rely on asking individuals about the skills they possess (such as via the Skills and Employment Survey, or, more recently, via web-scraping of job sites such as LinkedIn), which relies on the accuracy of self-reported information.

Some skills can be captured *indirectly*, such as via the qualifications that individuals hold. But there is no consistent way of identifying the skills – and, in particular, the additional skills – that individuals obtain from undertaking different qualifications. Qualifications also only partially capture the skills that individuals possess, because new skills develop through experience and learning undertaken while in work.

5.1 Supply of qualifications

The below is a summary of the SPB's initial attempt to map between supply and demand measures for **skills potentially in shortage** (limited to O*NET knowledge elements because they can be more clearly mapped to qualification subjects). This section is an exploration of potential methods and challenges with a view to forming a foundation for subsequent analysis in the area.

5.1.1 Stock – LEO analysis

Stock – all the skills in supply across all people in the labour force

Dataset: count of highest qualification in April 2021 by SSA and level from Longitudinal Education Outcomes (LEO) for individuals born between 1989-2006 (aged 19-31 years).

Time period: April 2021
Population: Individuals in England born between 1989-2006 (aged 19-31)
Qualifications: All level from entry to RQF level 8+
Measure: Highest level qualification
Subject taxonomy: SSA within LEO

Across all qualification levels, two subjects account for a quarter (26%) of individual's highest qualifications; **Science and mathematics** (SSA 2, 13%) and **Arts, media and publishing** (SSA 9, 13%). A further 20% of highest-level qualifications are in **Health,**

public services and care (SSA1, 10%) and **Business, administration and law** (SSA 15, 9%) qualifications. Again, the majority of these are below RQF level 4.

The only subject which has a higher proportion of qualifications at RQF level 4+ is **Education and training** (SSA 13) for which more than 80% of qualifications are in level 4+ qualifications. However, this subject makes up less than 2% of highest qualifications held.

Table 11: Percentage of highest-level qualification by SSA1 and broad qualification level

Note: Highlighting indicates the qualification level which the highest proportion of individuals have in a given subject area

	SSA subject	Total (%)	Total (Count)	Below level 4 (%)	Level 4+ (%)	Unknown
1	Health, Public Services and Care	9.98%	941,535	77.62%	21.73%	0.65%
2	Science and Mathematics	13.30%	1,254,463	80.39%	19.53%	0.08%
3	Agriculture, Horticulture and Animal Care	1.81%	170,510	85.54%	13.77%	0.69%
4	Engineering and Manufacturing Technologies	6.18%	582,825	82.67%	17.10%	0.24%
5	Construction, Planning and the Built Environment	3.50%	329,883	83.67%	16.07%	0.26%
6	Information and Communication Technology	4.24%	399,770	81.45%	18.02%	0.53%
7	Retail and Commercial Enterprise	4.87%	459,302	98.31%	1.25%	0.44%
8	Leisure, Travel and Tourism	5.68%	535,618	83.28%	16.31%	0.40%
9	Arts, Media, and Publishing	13.06%	1,232,254	76.41%	22.85%	0.74%
10	History, Philosophy and Theology	2.29%	215,922	68.40%	31.46%	0.14%
11	Social Sciences	4.24%	400,163	66.80%	33.07%	0.14%
12	Languages, Literature and Culture	8.90%	840,040	87.36%	9.92%	2.73%
13	Education and Training	1.64%	155,008	15.84%	82.90%	1.26%
14	Preparation for Life and Work	6.51%	613,864	95.32%	0.03%	4.64%
15	Business, Administration and Law	9.40%	886,678	69.10%	30.54%	0.36%
NA	NA	4.28%	404,016	6.20%	93.58%	
UN	Not known	0.13%	11,997	32.19%	4.93%	62.87%
	TOTAL		9,433,848	76.40%	22.62%	0.96%

5.1.2 Flow

Flow – the changes in the stock of skills over time, most notably from those leaving education and entering the labour force and those leaving the labour force through retirement and non-participation, even if temporary.

Dataset: post-19 FE learners (up to Level 3)

Analysis from Individualised Learner Record (ILR) on FE by Sector Subject Area Tier 2 for learners aged 19+.[38] Data for all levels are available but this section only includes learners enrolled in qualifications below RQF level 4; higher-level learners will be captured in the higher-level entrants publication[39] discussed below.

Time period: Academic year 2018/19
Population: Post-19 in England
Qualifications: Below RQF level 4
Measure: Enrolments
Subject taxonomy: SSA

In England in the academic year 2018/19, learners enrolled in just over 2 million qualifications below RQF level 4. Almost half (48%) of those were for qualifications in **Preparation for Life and Work** (SSA 14[40]) related subjects.

Dataset: post-16 higher level entrants (Level 4 and above)

This ad hoc statistical publication[41] presents an overview of participation in higher level learning at Further Education Providers (FEPs) and Higher Education Providers (HEPs) for English-domiciled learners in England. The statistics provide a holistic view of higher-level learning across the further and higher education sectors.

Time period: Academic year: 2018/19
Population: Post-16 in England
Qualifications: RQF level 4 and above
Measure: Entrants
Subject taxonomy: JACS

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[38] Higher Level Learners in England, Academic Year 2018/19 – Explore education statistics – GOV.UK (explore-education-statistics.service.gov.uk)
[39] Due to deduplication and rationalisation of individual learners in higher level learners publication.
[40] 14.1 Foundations for learning and life potential learning outcomes include personal development, vocational support, and literacy and numeracy, as well as sector specific modules; 14.2 Preparation for work potential learning outcomes include understanding organisation, own role within organisation and preparation for first day.
[41] Higher Level Learners in England Academic Year 2018/19

In England in the academic year 2018/19, learners enrolled in almost 800,000 qualifications at RQF level 4 and above.

Across all qualification levels

Combining the above sources for academic year 2018/19 gives an indication of the number of new learners across all qualification levels. To combine these, a mapping between SSA and JACS categories was developed (see **Table 26** in the Appendix for mapping between JACS tier 1 and SSA1).

Across all qualification levels, more than a third (35%) of enrolments in academic year 2018/19 in England were for qualifications in **Preparation for Life and Work** (SSA 14) related subjects. All of these were for qualifications below RQF level 4.

Aside from SSA 14, two subjects account for another quarter (27%) of enrolments in the same period: **Health, public services, and care** (SSA1, 15%) and **Business administration and law** (SSA 15, 12%).

- For Health-related subjects (SSA1), two thirds (68%) of enrolments were for qualifications below RQF level 4. In contrast, in Business-related qualifications (SSA 15) these lower-level qualifications accounted for just under half (46%) of all qualifications in the subject.

Table 12: Percentage of enrolments by SSA1 and broad qualification level – 2018/19

Note: Highlighting indicates the qualification level with the highest proportion of entrants

SSA subject		Total (%)	Total (Count)	Below level 4 (%)	Level 4+ (%)
1	Health, public services, and care	15.13%	418,615	67.51%	32.45%
2	Science and mathematics	5.25%	145,220	31.86%	68.14%
3	Agriculture, horticulture, and animal care	1.25%	34,595	72.58%	27.39%
4	Engineering and manufacturing technologies	3.43%	95,030	60.95%	39.05%
5	Construction, planning and the built environment	2.94%	81,335	77.86%	21.83%
6	Information and communication technology	4.40%	121,875	71.16%	27.99%
7	Retail and commercial enterprise	4.50%	124,680	99.94%	0.00%
8	Leisure, travel, and tourism	1.74%	48,020	99.94%	0.00%
9	Arts, media, and publishing	4.27%	118,210	40.61%	59.03%
10	History, philosophy, and theology	0.86%	23,905	12.05%	87.83%
11	Social sciences	2.70%	74,770	7.38%	92.62%
12	Languages, literature, and culture	2.21%	61,285	64.68%	34.96%

13	Education and training	3.77%	104,435	36.25%	63.75%
14	Preparation for life and work	35.22%	974,800	98.04%	0.00%
15	Business administration and law	11.75%	325,335	46.11%	53.88%
NA	NA	0.56%	15,565	0.19%	48.92%
	TOTAL		2,767,675	71.33%	27.61%

5.2 Comparison to skills demand

5.2.1 Skill utilisation

To enable comparison between the above supply of qualifications analysis and demand, further analysis was undertaken to quantify skill utilisation of the 33 knowledge elements included in the O*NET taxonomy (see **Table 27** in the Appendix for mapping between SSA and O*NET knowledge).

Skill utilisation was calculated as the percentage of UK SOC occupations for which the identified O*NET knowledge elements was 'required',[42] weighted by employment from APS – this gives a crude measure of the number and proportion of jobs which require each skill. Duplicates occur where more than one O*NET knowledge skill mapped into a single SSA code – for example SSA 2 Science and Mathematics covers four separate O*NET knowledge skills (Mathematics, Chemistry, Biology and Physics); these are removed within SSA codes e.g. occupations where more than one of the skills are required are counted only once.

Proportion of individuals undertaking certain qualifications compared to how many jobs currently required those areas of knowledge

Analysis previously discussed in this report identified **skills potentially in shortage**. Taking only the O*NET knowledge elements from this list provides a relatively short list of skills to attempt to compare across supply and demand variables, these are:

- Science and Mathematics, SSA 2;
- Medicine and Dentistry, SSA 1 (Health, public services, and care);
- Engineering and Technology, SSA 4; and
- Digital, SSA 6 (Information and computer technology).

[42] Required is defined as having an importance rating greater than or equal to the median +50% of all knowledge elements

A comparable list of O*NET knowledge elements are drawn from the list of **skills in lower demand**, these are:

- History and Philosophy, SSA 10 (History, philosophy, and theology);
- Social Sciences, SSA 11;
- Arts, Media, and Publishing, SSA 9; and
- Construction, SSA 5 (Construction, planning and the built environment).

This is not to say that these skills are not important in some specific occupations (e.g. Construction knowledge is vitally important in a small number of occupations), rather that they are on average across all jobs less in demand in the current labour market than those STEM skills previously mentioned.

Comparing the supply (flow and stock) and demand of these specific skills gives some high-level indication of whether the current system is under or over supplying these skills to the labour market.

Figure 3: Comparison of the percentage of flow and stock qualifications in specific knowledge areas

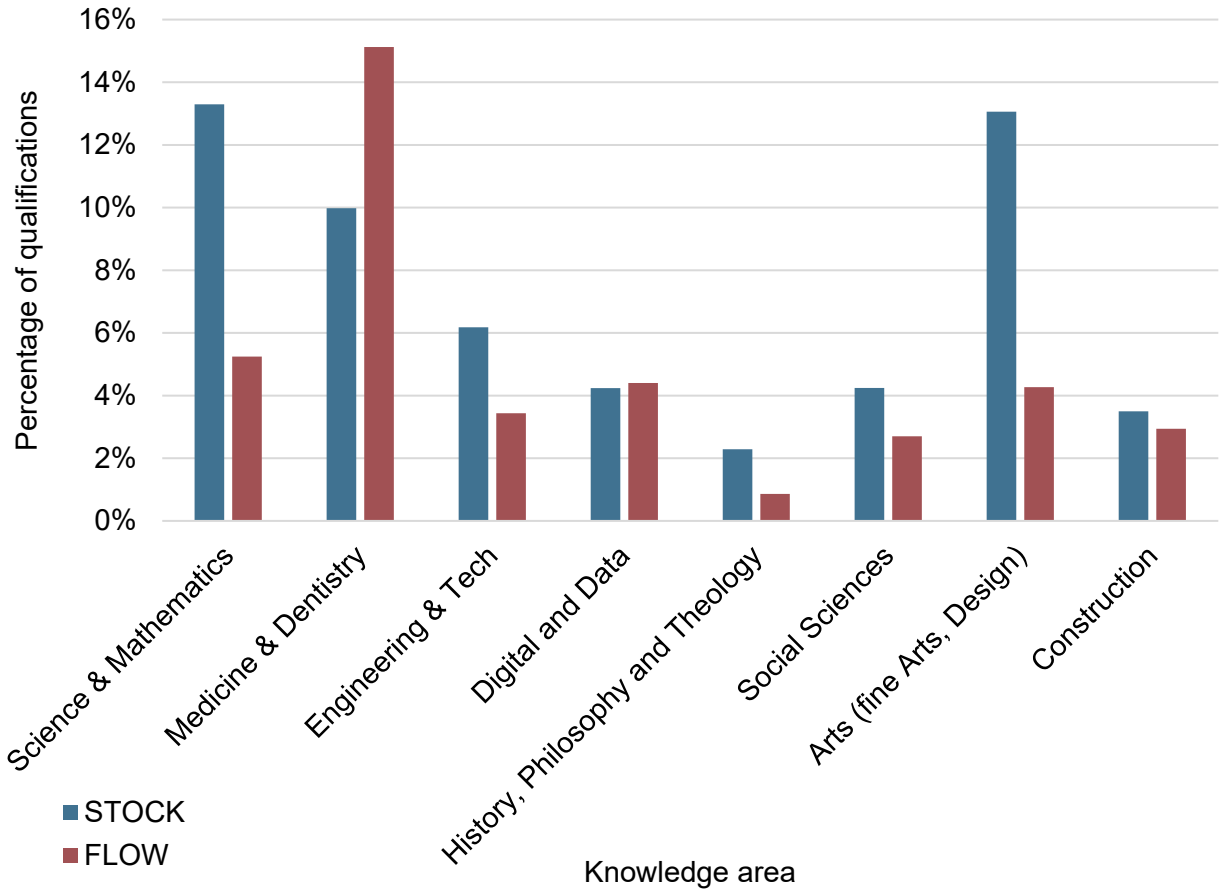
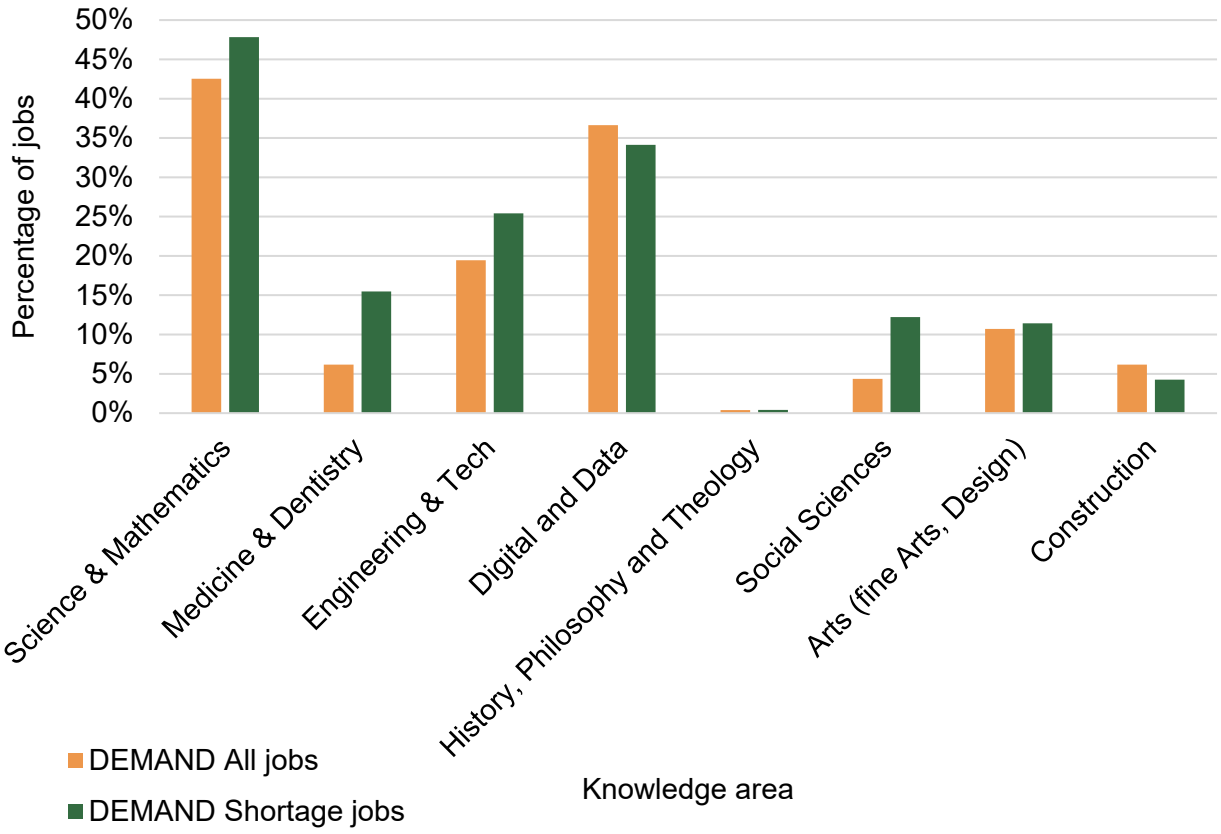


Figure 4: Percentage of jobs in England that require skills in specific knowledge areas



5.3 Challenges – comparing supply and demand

The LEO dataset provides full coverage of qualifications for individuals born after 1989 (age 31 and under), with limited information on those born before then.

This analysis looks only at individuals' highest qualification. This decision was pragmatic and allowed the SPB to produce proof of concept analysis in the time available. There are possible additions to the analysis using available data which would improve the overall picture provided. These are:

- Considering all of an individual's qualifications rather than focusing only on highest level or most recent qualification as in this analysis;
- Cut analysis by cohort and look at changes for different subjects over time;
- Consider specific occupations which require a particular qualification (such as nursing).

Qualification sources are not directly comparable due to the different age cohorts they cover and the subject categorisations used (SSA and JACS). For current analysis both have been translated to SSA1 level (see **Table 26** in Appendix for mapping). Incorporating learner hours in future analysis would provide more information on the time investment of different qualification subjects, in turn providing more information on the contribution of Preparation for Life and Work (SSA14) qualifications.

It is possible to complement the approach above to better understand the skills qualifications produce by:

1. Developing consistent, comparable frameworks where providers identify all the skills they intend to develop with each programme and qualification.

2. Evaluating specific education programmes to test whether they deliver the intended skills as a means of verifying the accuracy of the aforementioned frameworks. However, there are significant challenges measuring skills (as opposed to knowledge) gained.

Qualifications typically already list the skills they intend to develop but this is not always consistent or comparable and may prioritise certain types of skills over others. Occupational standards already list the skills, knowledge, and behaviours a student will develop but emphasise technical skills rather than transferable skills (although these can appear as ‘behaviours’). Transferable skills are of increasing interest in preparing for future changes in demand, which are highly uncertain.

In this analysis, skill utilisation is at the job level, and is therefore not actually a direct measure of skill utilisation, rather it is demand at the job level translated through to skills. This means that within a given job, it may not be [only] the most important skill (the one that is highlighted in the analysis) that is driving any apparent demand issues, rather a different, less important skill, combination of skills or a non-skill supply issue.

A single occupation can require skills in multiple knowledge areas, and skills in a single knowledge area can lead to multiple occupations. For these reasons, a direct one-to-one comparison mapping between qualifications and occupational demand is particularly complex. Additionally, some knowledge areas are also likely to be important in lots of occupations (leading to high demand) but at a relatively low level, for example looking at Science and Mathematics and Digital skills. The analysis demonstrates that these skills are required by large numbers of occupations, but if these relate to basic numeracy, literacy, or digital literacy skills these would not necessarily be taught in those subject specific qualifications included in the supply analysis but rather in early schooling or picked up through experience. Future analysis should map demand for these skills at particular levels with the levels at which they’re being supplied as carefully as possible.

6 Appendices

6.1 Key definitions

Concept	Definition	Count
Skills	The capability to carry out the tasks that comprise a particular job: O*NET elements excluding physical, psychomotor, and sensory abilities	130
Shortage occupations	Occupations in demand: the upper quartile of occupation ranking (using demand indicators)	92
Lower demand occupations	Symmetrical to shortage occupations: the lower quartile of occupation ranking (using demand indicators)	92
Skills ranking A	A measure of skill demand sensitive to how important a skill is across occupations, accounting for the size of their employment shares	130
Skills ranking B	A measure of skills demand which accounts for both the employment share of an occupation and the relative demand for it based on the indicators of labour shortage	130
Skills in high demand	Skills that are important across lots of jobs in the economy: skills in the upper quartile of the employment-weighted, but not occupation ranked, index (i.e. the upper quartile of skills ranking A)	32
Core transferable skills	Alternative term used to refer to skills in high demand	32
Skills in lower demand	Symmetrical to skills in high demand, these are skills not important across lots of jobs in the economy: skills in the lower quartile of the employment-weighted, but not occupation ranked, index (i.e. the lower quartile of skills ranking A)	32
Specialist skills	A subset of lower demand skills above Skills which are relatively more important in relatively few occupations: these have ‘hockey-stick’-shaped importance ratings – where the sum of the 90th and 100th percentile of importance ratings is greater than the sum of the 10th to 80th percentiles	13
Skills potentially in shortage (surplus)	Skills which are particularly important in shortage occupations: skills significantly more important in the UQ of occupations ranking than the LQ	20
	Skills identified as significantly more important in LQ than UQ	2

6.2 Tables and figures

Table 13: Correlation coefficients across indicators of labour shortage

		1	2	3	4	5	6	7	Average
1	Change in % of migrant workers	1							
2	Vacancies as a % of employment	-0.1120	1						
3	Skill shortage vacancies as a % of all vacancies	0.0147	0.0319	1					
4	Real-time online vacancies	-0.0607	-0.0050	0.0617	1				
5	Hourly wage growth	-0.0020	0.1417	0.0199	-0.0653	1			
6	Relative wage premium to a skilled occupation	-0.0312	-0.0729	-0.3755	0.1587	-0.0183	1		
7	Change in paid hours worked	-0.0145	-0.0911	0.0486	-0.0047	0.0751	-0.0019	1	
	Average	0.3117	0.3576	0.3233	0.4317	0.4531	0.2556	0.3956	1

Table 14: Key statistics for indicators of labour shortage

Indicator		Measure	n	mean	sd	median	min	max	range
1	Change in migrant worker density (%)	Migrant worker density = Count of migrant workers per SOC 4-digit occupation / Total employed per SOC 4-digit occupation	362	0.368	1.310	0.088	-0.01	0.14	0.15
2	Vacancy density (%)	Vacancy density = All vacancies by SOC 4-digit occupation / Employment by SOC 4-digit occupation	347	0.032	0.025	0.025	0.00	0.22	0.22
3	Skill shortage vacancy density (%)	Skill shortage vacancy (SSV) density = Skills shortage vacancies by SOC 4-digit occupation / All vacancies by SOC 4-digit occupation	347	0.283	0.148	0.269	0.01	0.73	0.72
4	Real-time online vacancy density (%)	Vacancy posting density = Vacancies by occupation / Employment (APS)	369	0.205	0.305	0.125	0.00	0.05	0.05
5	Hourly wage growth (%)	Percentage change in mean total hourly pay	368	0.008	0.064	0.009	-0.71	0.58	1.30
6	Relative wage premium to a skilled occupation (£)	Compares standardised mean gross hourly pay in jobs that require similar skill levels using the ONS Skills Levels (1-4)	368	-0.018	0.171	-0.026	-0.42	0.79	1.21
7	Change in paid hours worked (%)	Percentage change in mean paid hours worked	368	0.005	0.053	0.002	-0.19	0.61	0.80

Table 15: Full list of occupations included in each of the SPB's four priority areas

Health	Science and Tech	Managers	Skilled Trades
2211 Medical practitioners	2111 Chemical scientists	1115 Chief executives and senior officials	5215 Welding trades
2212 Psychologists	2112 Biological scientists and biochemists	1116 Elected officers and representatives	5221 Metal machining setters and setter-operators
2213 Pharmacists	2113 Physical scientists	1121 Production managers and directors in manufacturing	5223 Metal working production and maintenance fitters
2214 Ophthalmic opticians	2114 Social and humanities scientists	1122 Production managers and directors in construction	5231 Vehicle technicians, mechanics, and electricians
2215 Dental practitioners	2119 Natural and social science professionals n.e.c.	1123 Production managers and directors in mining and energy	5232 Vehicle body builders and repairers
2217 Medical radiographers	2121 Civil engineers	1131 Financial managers and directors	5241 Electricians and electrical fitters
2218 Podiatrists	2122 Mechanical engineers	1132 Marketing and sales directors	5249 Electrical and electronic trades n.e.c.
2219 Health professionals n.e.c.	2123 Electrical engineers	1133 Purchasing managers and directors	5314 Plumbers and heating and ventilating engineers
2221 Physiotherapists	2124 Electronics engineers	1134 Advertising and public relations directors	5315 Carpenters and joiners
2222 Occupational therapists	2126 Design and development engineers	1135 Human resource managers and directors	5316 Glaziers, window fabricators and fitters
2223 Speech and language therapists	2127 Production and process engineers	1136 Information technology and telecommunications directors	5319 Construction and building trades n.e.c.
2229 Therapy professionals n.e.c.	2129 Engineering professionals n.e.c.	1139 Functional managers and directors n.e.c.	5323 Painters and decorators
2231 Nurses	2133 IT specialist managers	1150 Financial institution managers and directors	

2232 Midwives	2134 IT project and programme managers	1161 Managers and directors in transport and distribution	
3213 Paramedics	2135 IT business analysts, architects, and systems designers	1162 Managers and directors in storage and warehousing	
3216 Dispensing opticians	2136 Programmers and software development professionals	1190 Managers and directors in retail and wholesale	
3217 Pharmaceutical technicians	2137 Web design and development professionals		
3218 Medical and dental technicians	2139 Information technology and telecommunications professionals n.e.c.		
3219 Health associate professionals n.e.c.	2141 Conservation professionals		
6121 Nursery nurses and assistants	2142 Environment professionals		
6141 Nursing auxiliaries and assistants	2150 Research and development managers		
6142 Ambulance staff (excluding paramedics)	3111 Laboratory technicians		
6143 Dental nurses	3112 Electrical and electronics technicians		
6145 Care workers and home carers	3113 Engineering technicians		
6146 Senior care workers	3114 Building and civil engineering technicians		
6147 Care escorts			

Table 16: Core transferable skills and the corresponding distribution of level required across all jobs in England (APS employment weighted)

Note: Highlighting indicates the skill level required by the highest proportion of jobs

Skill category	Skill subcategory	Specific skill	Skill level			
			None	Basic	Intermediate	Advanced
Communication	Theory	English Language	0%	0%	72%	28%
	Verbal	Oral Comprehension	0%	0%	68%	32%
		Oral Expression	0%	0%	77%	23%
		Active Listening	0%	0%	95%	5%
		Speaking	0%	0%	95%	5%
	Written	Written Comprehension	0%	0%	78%	22%
		Reading Comprehension	0%	0%	79%	21%
		Written Expression	0%	0%	92%	8%
People	Interaction	Social Perceptiveness	0%	0%	98%	2%
	Organisational	Communicating with Supervisors, Peers, or Subordinates	0%	0%	40%	60%
		Communicating with Persons Outside Organization	0%	0%	77%	22%
	Relationships	Establishing and Maintaining Interpersonal Relationships	0%	0%	29%	71%
		Training and Teaching Others	0%	0%	85%	15%
		Interpreting the Meaning of Information for Others	0%	4%	90%	7%
	Service	Customer and Personal Service	0%	0%	44%	56%
Digital and data	Information	Getting Information	0%	0%	48%	52%
		Making Decisions and Solving Problems	0%	0%	47%	53%
		Identifying Objects, Actions, and Events	0%	0%	53%	47%
		Processing Information	0%	0%	58%	42%
		Documenting/Recording Information	0%	4%	76%	21%
		Evaluating Information to Determine Compliance with Standards	0%	0%	74%	26%
		Analysing Data or Information	0%	0%	58%	42%

	IT	Interacting With Computers	0%	2%	88%	10%
Mental processes	Capability	Thinking Creatively	0%	0%	73%	27%
	Perception	Problem Sensitivity	0%	0%	85%	15%
		Monitoring	0%	0%	93%	7%
Application of knowledge	Logic and reasoning	Updating and Using Relevant Knowledge	0%	0%	41%	59%
		Critical Thinking	0%	0%	93%	7%
		Inductive Reasoning	0%	0%	97%	3%
	Utilisation	Deductive Reasoning	0%	0%	88%	12%
		Information Ordering	0%	0%	100%	0%
Management	Planning	Organizing, Planning, and Prioritizing Work	0%	0%	26%	74%

Figure 5: Core transferable skills – difference in distribution of levels for shortage occupations compared to lower demand occupations

Percentage point difference in skill level required by shortage occupations, ordered by largest difference at the advanced level

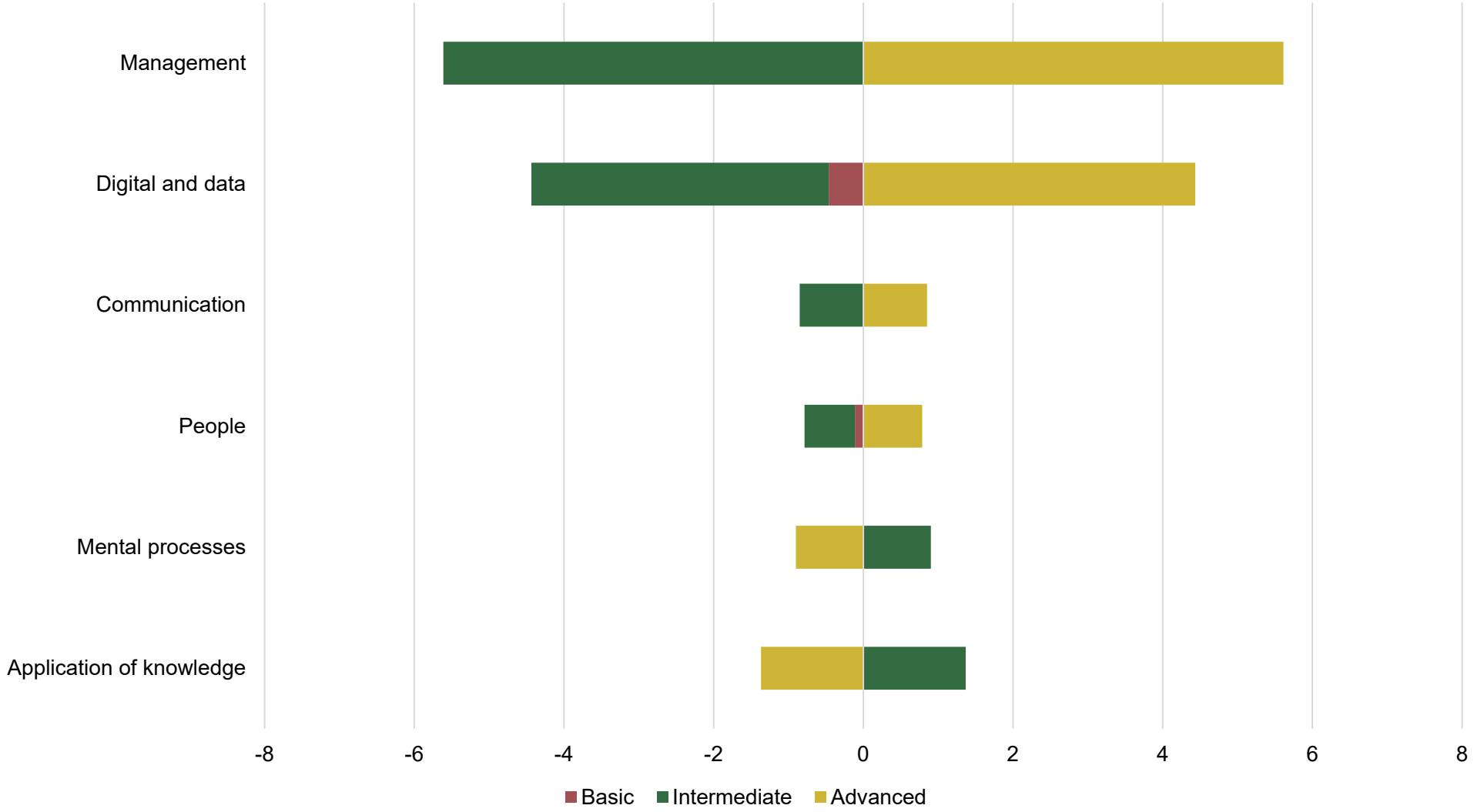


Table 17: Skills in high demand – upper quartile of skill ranking including indicators of labour shortage and employment weighting (skills ranking B)

Category		Subcategory		Skills
Application of knowledge	36%	Logic and reasoning	50%	Updating and Using Relevant Knowledge
				Critical Thinking
				Inductive Reasoning
		Utilisation	25%	Deductive Reasoning
				Information Ordering
Communication	73%	Theory	33%	English Language
		Verbal	100%	Oral Comprehension
				Oral Expression
				Active Listening
				Speaking
		Written	75%	Written Comprehension
				Reading Comprehension
				Written Expression
Digital and data	64%	Information	100%	Getting Information
				Making Decisions and Solving Problems
				Identifying Objects, Actions, and Events
				Processing Information
				Documenting/Recording Information
				Evaluating Information to Determine Compliance with Standards
				Monitor Processes, Materials, or Surroundings
				Analysing Data or Information
		IT	17%	Interacting With Computers
Management	10%	Planning	33%	Organizing, Planning, and Prioritizing Work
Mental processes	17%	Capability	17%	Thinking Creatively
		Perception	17%	Problem Sensitivity
				Monitoring

People	26%	Interaction	14%	Social Perceptiveness
		Organisational	40%	Communicating with Supervisors, Peers, or Subordinates
				Communicating with Persons Outside Organization
		Relationships	29%	Establishing and Maintaining Interpersonal Relationships
				Training and Teaching Others
		Service	25%	Customer and Personal Service

Table 18: Skills in lower demand – lower quartile of skill ranking including indicators of labour shortage and employment weighting (skills ranking B)

Category		Subcategory		Name	Specialist
Technical and physical	60%	Maintenance	67%	Repairing	Yes
				Equipment Maintenance	Yes
				Repairing and Maintaining Mechanical Equipment	No
				Repairing and Maintaining Electronic Equipment	No
		Operation	55%	Mechanical	No
				Transportation	No
				Installation	Yes
				Equipment Selection	No
				Operation and Control	No
				Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment	No
		Production	67%	Food Production	Yes
				Building and Construction	Yes
Subject specific	50%	SHAPE	86%	Fine Arts	Yes
				History and Archaeology	Yes
				Philosophy and Theology	Yes
				Geography	No
				Sociology and Anthropology	No
				Design	No

		STEM	67%	Biology	Yes
				Physics	No
				Medicine and Dentistry	Yes
				Chemistry	No
		Vocational	25%	Therapy and Counselling	Yes
Mental processes	11%	Perception	17%	Spatial Orientation	No
				Operations Analysis	No
Management	20%	Resources	50%	Management of Financial Resources	No
				Management of Material Resources	No
Digital and data	21%	IT	50%	Programming	Yes
				Technology Design	No
				Troubleshooting	No
Communication	9%	Theory	33%	Foreign Language	No
Application of knowledge	7%	Utilisation	13%	Science	Yes

Table 19: Skills significantly more important in UQ of occupation ranking than LQ – independent sample t-test p-value ≤ 0.1

Category		Subcategory		Skill	Statistic	p.value
Application of knowledge	21%	Logic and reasoning	17%	Updating and Using Relevant Knowledge	1.83	0.069
		Utilisation	25%	Science	2.03	0.044
				Mathematical Reasoning	1.70	0.091
Digital and data	36%	Information	50%	Evaluating Information to Determine Compliance with Standards	2.96	0.003
				Identifying Objects, Actions, and Events	1.93	0.055
				Making Decisions and Solving Problems	1.78	0.076
				Analysing Data or Information	1.65	0.100
		IT	17%	Troubleshooting	1.66	0.100
Mental processes	22%	Capability	17%	Selective Attention	2.65	0.009
		Perception	25%	Perceptual Speed	2.30	0.022
				Visualization	2.25	0.026
				Flexibility of Closure	1.83	0.068
Subject specific	25%	STEM	83%	Medicine and Dentistry	2.62	0.010
				Physics	2.56	0.011
				Mathematics	2.11	0.036
				Biology	2.07	0.040
				Engineering and Technology	1.75	0.081
Technical and physical	15%	Maintenance	17%	Repairing	1.82	0.071
		Operation	18%	Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment	2.09	0.038
				Equipment Selection	2.03	0.044
People	4%	Relationships	14%	Coaching and Developing Others	-2.25	0.026
Management	10%	Resources	25%	Monitoring and Controlling Resources	-1.93	0.056

Table 20: Distribution of level for skills potentially in shortage (significantly more important in shortage occupations than lower demand occupations)

Note: Highlighting indicates the skill level required by the highest proportion of jobs in shortage occupations

Skill category	Skill subcategory	Specific skill	Skill level			
			None	Basic	Intermediate	Advanced
Subject specific	STEM	Medicine and Dentistry	29%	39%	20%	12%
		Physics	16%	40%	43%	1%
		Mathematics	0%	0%	80%	20%
		Biology	41%	38%	19%	3%
		Engineering and Technology	1%	36%	52%	11%
Technical and physical	Maintenance	Repairing	72%	8%	20%	0%
	Operation	Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment	10%	53%	36%	1%
		Equipment Selection	47%	34%	20%	0%
Digital and data	Information	Evaluating Information to Determine Compliance with Standards	0%	0%	74%	26%
		Identifying Objects, Actions, and Events	0%	0%	53%	47%
		Making Decisions and Solving Problems	0%	0%	47%	53%
		Analysing Data or Information	0%	0%	58%	42%
	IT	Troubleshooting	25%	27%	49%	0%
Mental processes	Capability	Selective Attention	0%	0%	100%	0%
	Perception	Perceptual Speed	0%	0%	100%	0%
		Visualization	0%	0%	99%	1%
		Flexibility of Closure	0%	0%	100%	0%
Application of knowledge	Logic and reasoning	Updating and Using Relevant Knowledge	0%	0%	41%	59%
	Utilisation	Science	35%	30%	35%	0%
		Mathematical Reasoning	0%	10%	90%	0%

Figure 6: Skills potentially in shortage – difference in distribution of levels for shortage occupations compared to lower demand occupations

Percentage point difference in skill level required by shortage occupations, ordered by largest difference at the advanced level

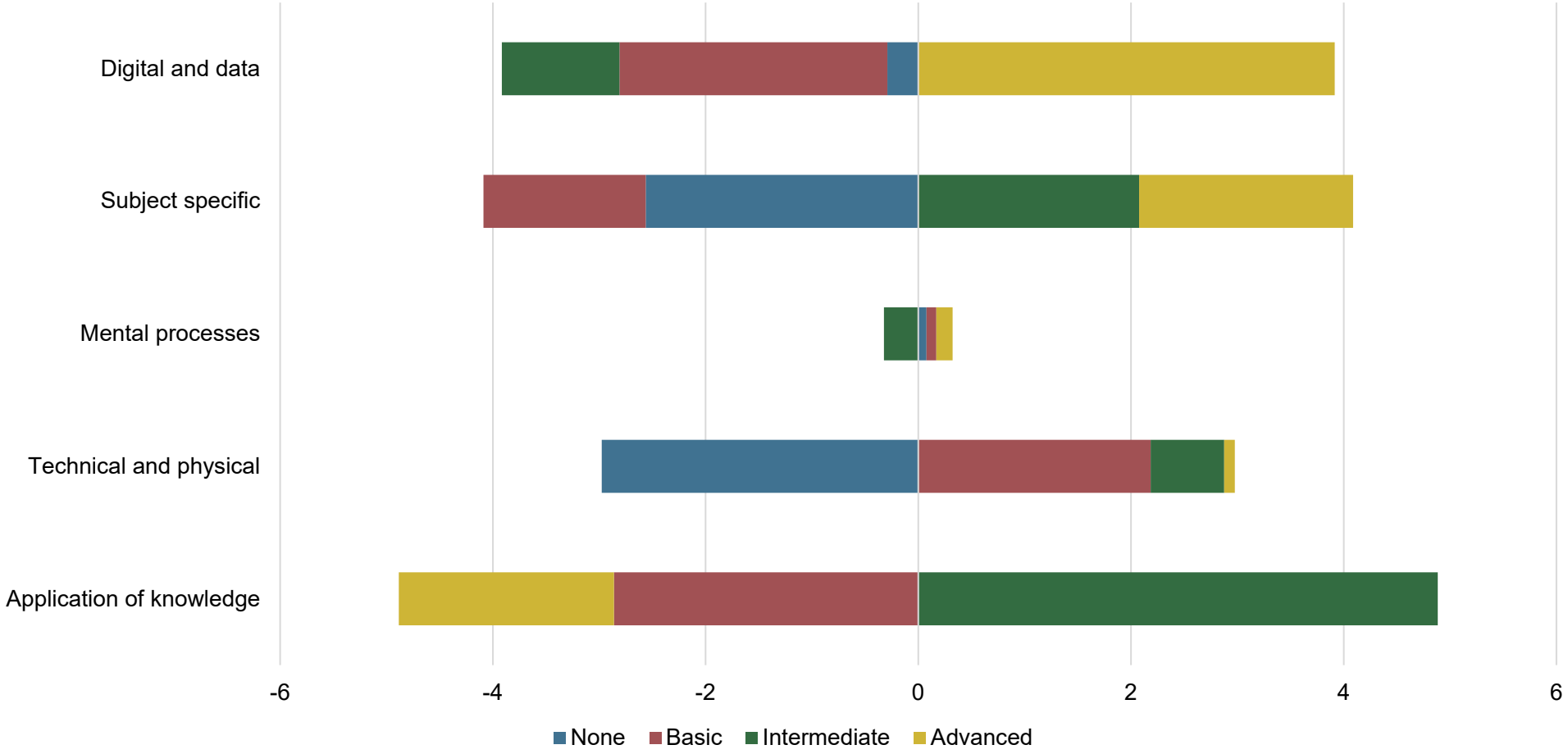


Table 21: Future skills in high demand – upper quartile of skill ranking

Category		Subcategory		Skill
Application of knowledge	36%	Logic and reasoning	50%	Updating and Using Relevant Knowledge
				Critical Thinking
				Inductive Reasoning
		Utilisation	25%	Deductive Reasoning
				Information Ordering
Communication	73%	Theory	33%	English Language
		Verbal	100%	Active Listening
				Speaking
				Oral Comprehension
				Oral Expression
		Written	75%	Reading Comprehension
				Written Comprehension
				Written Expression
Digital and data	64%	Information	100%	Documenting/Recording Information
				Making Decisions and Solving Problems
				Processing Information
				Evaluating Information to Determine Compliance with Standards
				Analysing Data or Information
				Getting Information
				Identifying Objects, Actions, and Events
				Monitor Processes, Materials, or Surroundings
		IT	17%	Interacting With Computers
Management	10%	Planning	33%	Organizing, Planning, and Prioritizing Work
Mental processes	28%	Capability	17%	Thinking Creatively
		Perception	17%	Monitoring
				Problem Sensitivity
People	30%	Interaction	14%	Social Perceptiveness

	Organisational	40%	Communicating with Supervisors, Peers, or Subordinates
			Communicating with Persons Outside Organization
	Relationships	29%	Establishing and Maintaining Interpersonal Relationships
			Training and Teaching Others
	Service	25%	Customer and Personal Service

Table 22: Future skills growth – upper quartile of skill ranking

Category		Subcategory		Name
Application of knowledge	36%	Logic and reasoning	50%	Inductive Reasoning
				Critical Thinking
				Updating and Using Relevant Knowledge
		Utilisation	25%	Deductive Reasoning
				Information Ordering
Communication	73%	Theory	33%	English Language
		Verbal	100%	Oral Comprehension
				Oral Expression
				Active Listening
				Speaking
		Written	75%	Written Comprehension
				Written Expression
				Reading Comprehension
Digital and data	64%	Information	100%	Getting Information
				Monitor Processes, Materials, or Surroundings
				Identifying Objects, Actions, and Events
				Processing Information
				Evaluating Information to Determine Compliance with Standards
				Analysing Data or Information
				Making Decisions and Solving Problems

				Documenting/Recording Information
		IT	17%	Interacting With Computers
Management	10%	Planning	33%	Organizing, Planning, and Prioritizing Work
Mental processes	17%	Capability	17%	Thinking Creatively
		Perception	17%	Problem Sensitivity
				Monitoring
People	26%	Interaction	14%	Social Perceptiveness
		Organisational	40%	Communicating with Supervisors, Peers, or Subordinates
				Communicating with Persons Outside Organization
		Relationships	29%	Establishing and Maintaining Interpersonal Relationships
				Training and Teaching Others
		Service	25%	Customer and Personal Service

Table 23: Biggest future skills needs in the Health priority area

Note: the final column denotes whether the skill is in both lists: most important skills in the future and biggest skill changes

Skill category		Skill subcategory		Specific skill	In both lists
Application of knowledge	29%	Logic and reasoning	50%	Critical Thinking	Yes
				Inductive Reasoning	Yes
				Updating and Using Relevant Knowledge	Yes
		Utilisation	13%	Deductive Reasoning	Yes
Communication	64%	Theory	33%	English Language	Yes
		Verbal	100%	Active Listening	Yes
				Oral Comprehension	Yes
				Oral Expression	Yes
				Speaking	Yes
		Written	50%	Written Comprehension	Yes
				Reading Comprehension	Yes

Digital and data	50%	Information	50%	Documenting/Recording Information	Yes
				Making Decisions and Solving Problems	Yes
				Identifying Objects, Actions, and Events	Yes
				Evaluating Information to Determine Compliance with Standards	Yes
				Monitor Processes, Materials, or Surroundings	Yes
				Processing Information	Yes
				Getting Information	Yes
Management	10%	Planning	10%	Organizing, Planning, and Prioritizing Work	Yes
Mental processes	11%	Perception	11%	Monitoring	Yes
				Problem Sensitivity	Yes
People	39%	Interaction	29%	Social Perceptiveness	Yes
				Service Orientation	Yes
		Organisational	20%	Communicating with Supervisors, Peers, or Subordinates	Yes
		Relationships	43%	Establishing and Maintaining Interpersonal Relationships	Yes
				Interpreting the Meaning of Information for Others	Yes
				Training and Teaching Others	Yes
		Service	75%	Assisting and Caring for Others	Yes
				Customer and Personal Service	Yes
				Performing for or Working Directly with the Public	Yes
Subject specific	10%	SHAPE	14%	Psychology	Yes
		STEM	17%	Medicine and Dentistry	Yes

Table 24: Biggest future skills needs in the Science and Technology priority area

Note: the final column denotes whether the skill is in both lists: most important skills in the future and biggest skill changes

Skill category		Skill subcategory		Specific skill	In both lists
Application of knowledge	43%	Logic and reasoning	67%	Complex Problem Solving	Yes
				Critical Thinking	Yes
				Inductive Reasoning	Yes
				Updating and Using Relevant Knowledge	Yes
		Utilisation	25%	Deductive Reasoning	Yes
				Information Ordering	Yes
Communication	82%	Theory	33%	English Language	Yes
		Verbal	100%	Active Listening	Yes
				Oral Comprehension	Yes
				Oral Expression	Yes
				Speaking	Yes
		Written	100%	Reading Comprehension	Yes
				Writing	Biggest skills needs
				Written Comprehension	Yes
				Written Expression	Yes
Digital and data	71%	Information	100%	Analysing Data or Information	Yes
				Documenting/Recording Information	Yes
				Evaluating Information to Determine Compliance with Standards	Yes
				Getting Information	Yes
				Identifying Objects, Actions, and Events	Yes
				Making Decisions and Solving Problems	Yes
				Monitor Processes, Materials, or Surroundings	Most important in the future
				Processing Information	Yes

		IT	33%	Computers and Electronics	Yes
				Interacting With Computers	Yes
Management	10%	Planning	33%	Organizing, Planning, and Prioritizing Work	Yes
Mental processes	11%	Capability	17%	Problem Sensitivity	Yes
		Perception	8%	Thinking Creatively	Yes
People	13%	Organisational	20%	Communicating with Supervisors, Peers, or Subordinates	Yes
		Relationships	29%	Establishing and Maintaining Interpersonal Relationships	Yes
				Interpreting the Meaning of Information for Others	Yes
Subject specific	10%	STEM	33%	Engineering and Technology	Yes
				Mathematics	Yes

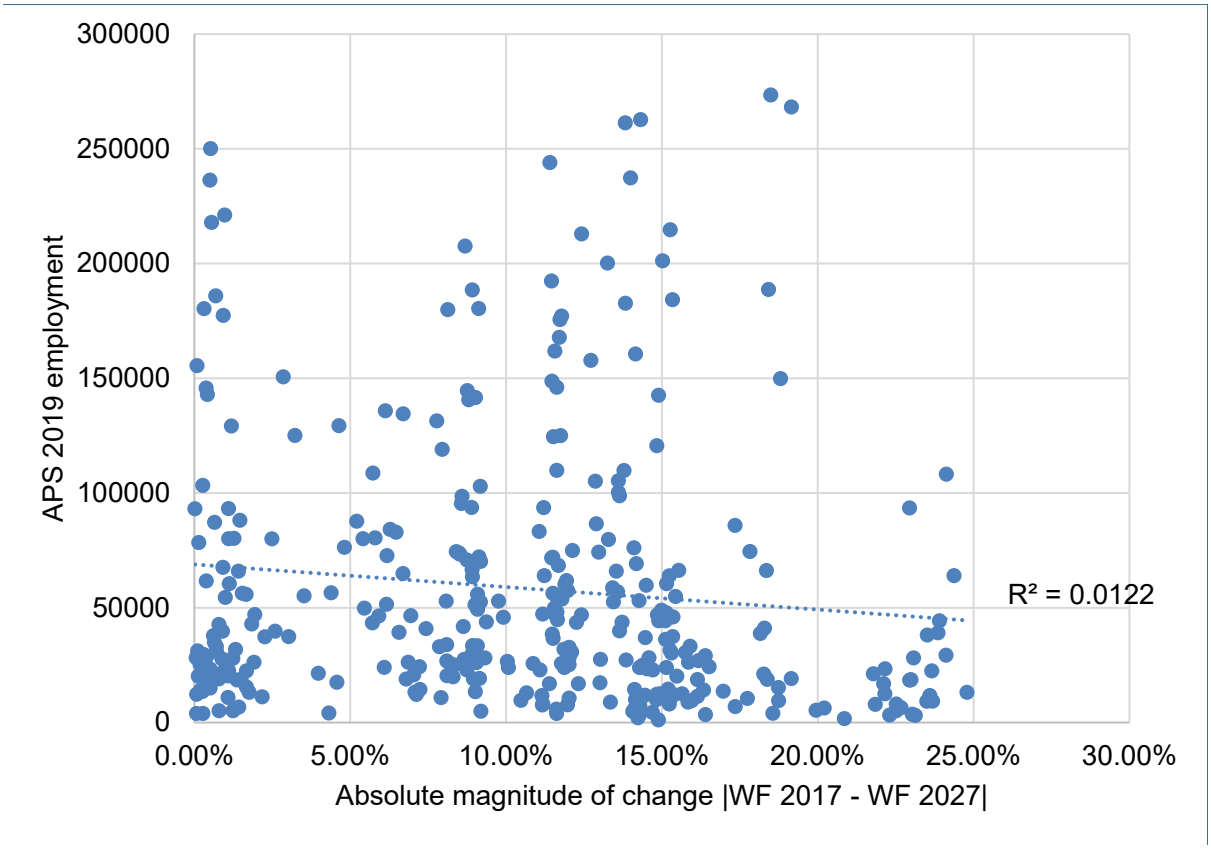
Table 25: Biggest future skills needs in the Managers priority area

Note: the final column denotes whether the skill is in both lists: most important skills in the future and biggest skill changes

Skill category		Skill subcategory		Specific skill	In both lists
Application of knowledge	21%	Logic and reasoning	33%	Critical Thinking	Yes
				Updating and Using Relevant Knowledge	Yes
		Utilisation	13%	Deductive Reasoning	Yes
Communication	73%	Theory	33%	English Language	Yes
		Verbal	100 %	Active Listening	Yes
				Oral Comprehension	Yes
				Oral Expression	Yes
				Speaking	Yes
		Written	75%	Reading Comprehension	Yes
				Written Comprehension	Yes
				Written Expression	Yes
Digital and data	36%	Information	50%	Analysing Data or Information	Yes
				Getting Information	Yes

				Identifying Objects, Actions, and Events	Yes
				Making Decisions and Solving Problems	Yes
		IT	17%	Interacting With Computers	Yes
Management	30%	Admin	33%	Administration and Management	Yes
		Planning	67%	Developing Objectives and Strategies	Yes
				Organizing, Planning, and Prioritizing Work	Yes
Mental processes	22%	Capability	17%	Thinking Creatively	Biggest skills needs
		Perception	25%	Judgment and Decision Making	Most important in the future
				Monitoring	Yes
				Problem Sensitivity	Yes
People	43%	Interaction	14%	Coordination	Yes
		Organisational	60%	Communicating with Persons Outside Organization	Yes
				Communicating with Supervisors, Peers, or Subordinates	Yes
				Coordinating the Work and Activities of Others	Yes
		Relationships	71%	Coaching and Developing Others	Yes
				Developing and Building Teams	Yes
				Establishing and Maintaining Interpersonal Relationships	Yes
				Guiding, Directing, and Motivating Subordinates	Yes
				Resolving Conflicts and Negotiating with Others	Yes
		Service	25%	Customer and Personal Service	Yes

Figure 7: Employment vs. Absolute magnitude of change in employment



Note: Excluding potential outliers (+/- 2 SDs from mean)

Table 26: Mapping between SSA1 and JACS1 subjects

SSA1	SSA1 subject	JACS1	JACS1 subject
-1	Unknown	-1	Unknown
1	Health, Public Services and Care	1	Medicine and dentistry
1	Health, Public Services and Care	2	Subjects allied to medicine
2	Science and Mathematics	3	Biological sciences
2	Science and Mathematics	6	Physical sciences
2	Science and Mathematics	7	Mathematical sciences
2	Science and Mathematics		
3	Agriculture, Horticulture and Animal Care	4	Veterinary sciences
3	Agriculture, Horticulture and Animal Care	5	Agriculture and related subjects
4	Engineering and Manufacturing Technologies	9	Engineering and technology
4	Engineering and Manufacturing Technologies		
5	Construction, Planning and the Built Environment	A	Architecture, building and planning
6	Information and Communication Technology (ICT)	8	Computer science
7	Retail and Commercial Enterprise	-	-
8	Leisure, Travel and Tourism	-	-
9	Arts, Media, and Publishing	E	Mass communications and documentation
9	Arts, Media, and Publishing	H	Creative arts and design
10	History, Philosophy and Theology	G	Historical and philosophical studies
10	History, Philosophy and Theology		
11	Social Sciences	B	Social studies
11	Social Sciences		
12	Languages, Literature and Culture	F	Languages
13	Education and Training	I	Education
14	Preparation for Life and Work	-	-
15	Business, Administration, Finance and Law	C	Law
15	Business, Administration, Finance and Law	D	Business and administrative studies
-	-	J	Combined

Table 27: Mapping between O*NET knowledge skills and SSA1 for specific knowledge areas for high and low demand skills

Knowledge area	Skill code	Skill name	SSA1	SSA1 subject
Art and Design	2.C.7.c	Fine Arts	9	Arts, Media, and Publishing
	2.C.3.c	Design	9	Arts, Media, and Publishing
Construction	2.C.3.d	Building and Construction	5	Construction, Planning and the Built Environment
Digital	2.C.3.a	Computers and Electronics	6	Information and Communication Technology (ICT)
Engineering and Technology	2.C.3.b	Engineering and Technology	4	Engineering and Manufacturing Technologies
	2.C.3.e	Mechanical	4	Engineering and Manufacturing Technologies
History and Philosophy	2.C.7.d	History and Archaeology	10	History, Philosophy and Theology
	2.C.7.e	Philosophy and Theology	10	History, Philosophy and Theology
Medicine and Dentistry	2.C.5.a	Medicine and Dentistry	1	Health, Public Services and Care
	2.C.5.a	Medicine and Dentistry	1	Health, Public Services and Care
Science and Mathematics	2.C.4.d	Biology	2	Science and Mathematics
	2.C.4.b	Physics	2	Science and Mathematics
	2.C.4.a	Mathematics	2	Science and Mathematics
	2.C.4.c	Chemistry	2	Science and Mathematics
Social Sciences	2.C.4.f	Sociology and Anthropology	11	Social Sciences
	2.C.4.g	Geography	11	Social Sciences

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