UK Skills Mismatch in 2030

Industrial Strategy Council

Research Paper

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Contents

Executive Summary

This analytical paper explores which qualifications, knowledge and workplace skills are likely to face greater or lesser mismatch by 2030 as a result of the changing nature of work.

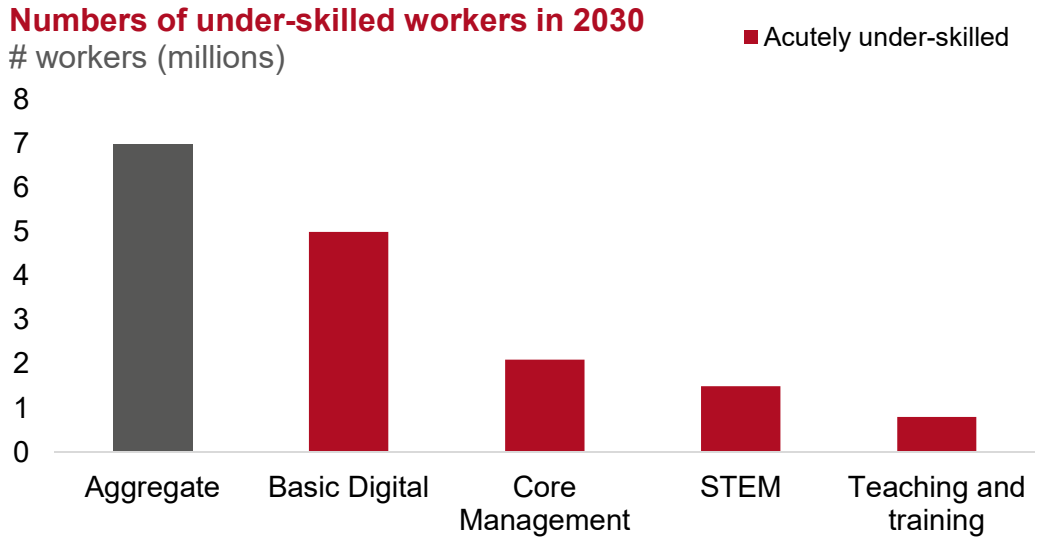
Existing evidence suggests the UK's demand for skills – particularly technology and interpersonal/people skills – will increase considerably over the next decade, while the supply of those skills will be constrained. Skills mismatch can reflect both skill shortage and skill surplus.

For example, the spread of automation and AI could boost productivity in some sectors but also displace some lower skilled jobs, while the demand for highly skilled labour will increase, as R&D and innovation become critical in a future tech-led economy. Such trends are highlighted by the Industrial Strategy Grand Challenges.

A skills mismatch can act as a drag on economic growth by limiting the employment and earnings opportunities of individuals and impacting on firm performance and productivity. UK firms have previously reported that lack of access to the right skills was the number-one threat to the competitiveness of the UK labour market.

The new in-depth analysis in this paper shows that, with 80% of the 2030 workforce already in the workforce today, **reskilling the existing workforce will be the major challenge between now and 2030.**

Figure 1: Estimated under-skilling in the workforce in 2030[1]



[1] The aggregate projection includes workers that are under-skilled across the weighted skill bundle required for their job. An individual could be under-skilled in a certain skill but might not be across their weighted skill bundle. The red bar shows a subset of specific workplace skills.

Participation in training has remained flat at best, part of the reason is low levels of both government and employer investment in adult training. There are a number of policies targeting areas where a skills mismatch could occur, but existing commitments do not look to be sufficient in scale to address the skills gaps predicted.

Box 1: UK Skills Mismatch in 2030 – key findings

The aggregate UK skills mismatch is predicted to worsen significantly

- The analysis finds that by 2030, 7 million additional workers could be under-skilled for their job requirements; this would currently constitute about 20% of the labour market. 0.9 million additional workers could be over-skilled. The model captures new skills mismatch opening up within existing jobs and from transitioning to new occupations. More severe skills shortages are predicted in 'workplace skills' than in 'qualifications' and 'knowledge'.

- The most widespread under-skilling is likely to be in basic digital skills; which are likely to look increasingly advanced, compared to what we might consider 'basic' to look like at present. In total, 5 million workers could become acutely under-skilled in basic digital skills by 2030, with up to two-thirds of the workforce facing some level of under-skilling.

- 2.1 million workers are likely to be acutely under-skilled in at least one core management skill (leadership, decision-making or advanced communication), of which 400,000 are also projected to be acutely under skilled in basic digital).

- 1.5 million workers are likely to be acutely under-skilled in at least one STEM workplace skill.

- 800,000 workers are likely to face an acute shortage in teaching and training skills; the ability of those in the working environment to upskill others. This under-skilling needs to be addressed or the delivery of broad-based reskilling efforts are likely to be significantly hampered.

The scale and type of skills shortfall anticipated, cannot be addressed through formal education outside of the workplace alone. **An urgent shift to a new norm of lifelong learning in the UK workforce is required.**

Employers, government and individuals will all have a role to play in reskilling and upskilling the existing workforce.

Introduction

The UK's record-high employment levels are making headlines.[2] That is a sign of the health of the country's labour market, but this strength hides a significant vulnerability; namely, a mismatch between workers' skills and those required by employers. The OECD finds that 40% of workers in the UK are engaged in an occupation for which they are not properly qualified; among the highest mismatch of the countries analysed.[3] Two thirds of the OECD knowledge areas experience skill shortage in the UK, and almost all workplace skills.[4]

Skills are an important component of productivity, so this mismatch has important implications for the UK economy. It hampers productivity, limits the competitiveness of UK businesses, and acts as a drag on the pay progression and job satisfaction of individuals. Investing in skills development can increase output directly through raising individual capabilities, but also indirectly by facilitating technological diffusion and innovation. Studies show that undertaking continuous education and training can also increase job satisfaction.[5]

The rapid adoption of technologies such as automation and artificial intelligence (AI) is one of the Grand Challenges for the UK economy set out in the Industrial Strategy (2017). Automation and AI have the potential to create widespread change in the labour market, displacing lower skilled jobs, while highly skilled labour will be needed to lead R&D and innovation in a future tech-led economy. Future Mobility and Clean Growth are two of the other Grand Challenges which will lead to demand for different skills and knowledge.

This paper does not attempt to present policy solutions for existing or future skills mismatches. Its aim is to provide evidence on the magnitude and nature of likely future skills mismatches facing the UK. At the core of the paper is an analytical model to estimate the potential future skills mismatch in the UK in 2030 based on how macroeconomic trends are expected to change the UK labour market. The analysis explores which qualifications, knowledge areas and workplace skills are likely to face greater or lesser mismatch as a result of the changing nature of work.

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[2] For example, *Financial Times* (16 April 2019). "Mothers and over-50s push UK employment to record high". Retrieved from: https://www.ft.com/content/8e0b58dc-6022-11e9-b285-3acd5d43599e

[3] OECD (2017). *Getting Skills Right*: *United Kingdom.* Retrieved from: https://www.oecd.org/unitedkingdom/getting-skills-right-united-kingdom-9789264280489-en.htm [Figures for 2015].

[4] OECD Skill Needs Database (Workplace skills not subject to skill shortage were negotiation, persuasion, and programming).

[5] Russo, G. (2013). *Benefits of vocational education in Europe, for people, organisations and countries*. CEDEFOP. Retrieved from: https://www.cedefop.europa.eu/en/publications-and-resources/publications/4121

The analytical approach is based on a model which projects future demand for occupations and the combination of skill types required for each occupation. The skills mismatch is the difference between the combination of skills possessed by each worker in 2017, and those required in the occupation which most closely matches their skills in 2030. The analysis presented in this paper builds on work conducted by the McKinsey Global Institute (MGI) and covers three key types of skills.[6] First, formal qualifications such as degrees and technical certificates. Second, knowledge; defined as subject-matter expertise ranging from mathematics to fine art to sales and marketing. Third, workplace skills such as management, critical thinking and digital skills.

Drawing on that analysis, the model considers the likely transitions between occupations that will be required for the job market to 'clear' (that is, for all jobs to be filled), in the absence of any further policy intervention. It does this by creating a 'mismatch score' for every potential transition between source occupation and target occupation, and allocating workers to target occupations, so as to minimise the total skills mismatch in the economy. The methodology assumes that workers in 2017 are either a perfect match for their occupation, or by 2030, will have acquired the skills to become a perfect match. This means that the mismatch estimates presented in the paper are incremental to the current skills mismatch.

This paper builds on several papers that have considered the drivers behind changes in demand for skills.[7] Others have conducted detailed work on the current skills mismatch.[8] More recently, a few papers have considered the kinds of

[6] 'MGI (2017). *Jobs lost, jobs gained: workforce transitions in a time of automation*. Retrieved from: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages

[7] CEDEFOP (2018). *Skills forecast: trends and challenges to 2030*. Retrieved from: https://www.cedefop.europa.eu/en/publications-and-resources/publications/3077
UKCES (2016). *Working futures 2014–2024*. Retrieved from: https://warwick.ac.uk/fac/soc/ier/wf6downloads
MGI (2017), op. cit.
Bakhshi, H., Downing, J., Osborne, M. & Shneider, P. (2017). *The future of skills employment in 2030*. Retrieved from: https://media.nesta.org.uk/documents/the_future_of_skills_employment_in_2030_0.pdf

[8] Henseke, G., Felstead, A., Gallie, D. & Green, F. (2017). *Skills Trends at Work in Britain*. Retrieved from: https://www.cardiff.ac.uk/__data/assets/pdf_file/0011/1229834/2_Skills_at_Work_Minireport_Final_edit.pdf
OECD (2015). *Skill Mismatch and Public Policy in OECD countries*. Retrieved from: http://dx.doi.org/10.1787/5js1pzw9lnwk-en
Office for Science (2016a). *Skills Demand, Training and Skills Mismatch: A Review of Key Concepts, allTheory and Evidence*. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/571667/ER4_Skills_Demand__Training_and_Skills_Mismatch_A_Review_of_Key_Concepts__Theory_and_Evidence.pdf
Office for Science (2016b). *The UK's Skills Mix: Current Trends and Future Needs*. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/571675/ER5_The_UK_s_Skills_Mix_Current_Trends_and_Future_Needs.pdf

transitions workers might make as the demands on the labour force change.[9] This paper attempts to bring these themes together by providing a projection of the aggregate skills mismatch for the UK economy. It quantifies the extent of the likely future skills mismatches at the level of the specific qualifications, knowledge and workforce skills; so providing a granular basis for assessing and prioritising current and future policy options.

The estimates produced from the modelling in this paper should not be considered as forecasts and there is, of course, uncertainty around them. However, the aim of the analysis is to estimate the scale of the future skills challenge rather than make an accurate prediction about the state of the UK labour market in 2030. The scale of the skills mismatches estimated are robust to a series of sensitivity tests and are broadly in line with similar studies on the effect of automation on the labour market.

The paper is structured into three sections:

- **Section 1: Skills: important today, critical tomorrow** – this section considers the importance of skills for the UK economy and summarises the existing evidence on each of the three skill types under consideration.
- **Section 2: Trends affecting future skills supply and demand** – this section highlights evidence indicating that the UK's demand for skills – in terms of skills required to perform their job effectively – is likely to change considerably over the next decade, while the supply of those skills is likely to evolve at a slower pace. It introduces the analytical model developed for this study.
- **Section 3: Skill mismatches highlighted by the analysis** – this section focuses on four critical issues highlighted by the analysis. Those include the increasing need to focus on lifelong learning beyond formal education; a significant increase in under-skilling in teaching and training skills across all industries; widespread shortages in both basic digital skills and leadership skills; and acute shortages of specialist STEM and health-care skills.

Department for Business Innovation and Skills (2016). *Research to understand the extent, nature and impact of skills mismatches in the economy*. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/522980/BIS-16-260-research-skills-mismatches-in-the-economy-May-2016.pdf
Department for Business Innovation and Skills (2015). *UK skills and productivity in an international context.* Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/486500/BIS-15-704-UK-skills-and-productivity-in-an-international_context.pdf
[9]World Economic Forum (2018). T*owards a reskilling revolution: A future of jobs for all*. Retrieved from: http://www3.weforum.org/docs/WEF_FOW_Reskilling_Revolution.pdf
World Economic Forum (2019). *Towards a reskilling revolution: Industry-led action for the future of work*. Retrieved from: http://www3.weforum.org/docs/WEF_Towards_a_Reskilling_Revolution.pdf

Section 1: Skills: Important today, critical tomorrow

Skills are an important determinant of aggregate productivity, company competitiveness, and workers' career success and standards of living. But it is no easy matter to determine an accurate picture of the UK's skills position today and it is even more difficult to estimate its future evolution.

To illustrate the challenge, consider the following example of a psychiatrist. Not only must they possess the relevant academic qualifications, they must also bring specialist subject-matter expertise as well as workplace skills which range from empathy to communication to digital skills. To perform effectively, a psychiatrist must bring a 'bundle' of wide-ranging skills to her occupation. To move jobs, say, to become a family general practitioner, they would take that bundle of skills with them. Many of their skills would remain relevant, but they would be used in different proportions in the new role. Some skills would require upgrading, other new skills may need to be acquired, and there may also be an element of over-qualification too, such as knowledge of psychology. Based on this example, mapping skills is a complex and difficult task.

This section introduces the methodology for identifying gaps in the bundles of skills required for 369 occupations across the UK economy (see Box 2). It draws on that methodology to highlight the serious skills mismatch that the UK faces today and suggests that this mismatch could well worsen significantly in the decade ahead as patterns of skills demand shift in fundamental ways.

Box 2: Occupations and skills bundles: a note on methodology

This paper uses occupational data as a useful descriptor of the different skills 'bundles' possessed by workers and demanded by employers. According to the Office for National Statistics (ONS) categorisation, there are 369 occupations in the UK. The analysis that underpins this paper is built on modelling the future demand for each of those occupations, and changes in the skills bundle required for each occupation. That skills bundle typically consists of eight separate skills spanning the 3 skill types; knowledge, qualifications and workplace skills.

- **Knowledge:** refers to the body of information that makes adequate performance of the job possible. It is defined as subject-matter expertise ranging from knowledge of plumbing for a plumber or mathematics for an

economist. The Occupational Information Network (O*NET) assigns (i) a level score and (ii) an importance score, for each of 33 knowledge areas, across all the occupations in its database.

- **Qualifications:** O*NET includes five qualification 'zones'. Zone 1 includes occupations requiring little or no preparation, perhaps a Secondary Education Diploma. Zone 3 covers occupations typically requiring vocational training, related on the job experience, or an associate degree and zone 5 covers occupations requiring a post-graduate degree.
- **Workplace skills**: occupational tasks are assigned to 25 workplace skills which can be grouped into 5 categories; physical and manual, basic cognitive, higher cognitive, social and emotional, and technological.

The focus on occupations is deliberate. Every job in every firm is slightly different, but occupations are the common unit of currency with which it is possible to compare different jobs across different firms performed by different individuals. This focus on occupations provides a window into what skills are required in the economy, but it does not provide perfect information on the individuals who hold those occupations. An individual may be under-skilled in some areas and they may fill a role without being 100% proficient in all the skills that the occupation requires. On the other hand, an individual may be over-skilled in certain areas and be able to perform that skill to a higher level than the occupation requires. Or a person may have a number of other skills that they are not able to apply in that occupation.

The UK's skills mismatch today

A first glance at the UK's labour market suggests a broadly positive picture as the economy has roughly the right number of jobs for workers. Employment in the UK has been steadily increasing since 2011 and, despite a slight dip in the previous quarter, remains at the highest level in decades. Equally, unemployment is currently estimated at 3.9%, which is close to its natural rate.[10] Even at a granular geographic

[10] ONS (2019). *Labour Market Overview, October 2019*. Retrieved from: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/october2019
Natural rate of unemployment is defined as the rate where markets are in equilibrium and unemployment is caused by structural factors, e.g. skills mismatches. According to the Bank of England, 4.25% is the natural rate of unemployment in the UK. See https://www.bankofengland.co.uk/-/media/boe/files/inflation-report/2018/august/inflation-report-transcript-august-2018, https://www.bankofengland.co.uk/inflation-report/2019/february-2019/supply-and-spare-capacity

level, very few local authority areas have unemployment rates of more than 6%.[11] But these positive figures mask a significant weakness: many workers do not bring the right bundles of skills to their occupations.

In one recent survey, 83% of executives at UK firms said that lack of access to the right skills was the number-one threat to the competitiveness of the UK labour market.[12] The relatively high level of skills mismatch present in the UK's workforce has been well documented.[13] As is shown later in this section, that mismatch matters; it drags down both company performance and the aggregate productivity of the economy.

It will not be simple to resolve the UK's skills mismatch. In fact, in a dynamic economy like the UK you would always expect to have some degree of skills mismatch. Even if workers' overall skill levels were a reasonable match for employers' needs, their qualifications, knowledge and workplace skills would not always be the ones required. Nor would all workers necessarily work in the occupations or jobs for which they were best suited. As a result of this, an economy such as the UK could face ongoing skills mismatches, which this paper examines at a more granular level, by occupation and by skills.

When considered through the lens of skills bundles, the UK labour market faces a level of skills mismatch considerably greater than that in most other countries in the OECD. This mismatch is evident across all three elements of the skills categorisation used in this paper.

40% of UK workers are employed in an occupation for which they do not have the correct *qualifications*, representing the fifth-worst skills mismatch among 30 countries analysed.[14] The OECD Skills for Jobs database indicates that 28% of the UK workforce is underqualified for their occupations, while 13% are overqualified, based on educational attainment being higher or lower than that required for the job.[15] However, according to the OECD Survey of Adults Skills, workers' views on having the right qualifications for their job are more positive than suggested by these estimates.[16] The ONS finds that 31% of people with a bachelor's degree work in

[11] ONS (2019). *Regional labour market statistics: Model based estimates of unemployment.* Retrieved from: https://www.ons.gov.uk/employmentandlabourmarket/peoplenotinwork/unemployment/datasets/modelledunemploymentforlocalandunitaryauthoritiesm01

[12] CBI (2018). *Employment Survey*.

[13] Office for Science (2016a, 2016b), BEIS (2015, 2016), op. cit.

[14] OECD (2017), op. cit.

[15] OECD Skills for Jobs database [2016 data] uses EU labour force survey, covering the whole of the UK.

[16] OECD (2016). *Skills Matter: Further results from the Survey of Adult Skills*. [Results from 2011-12]. Retrieved from: https://www.oecd.org/skills/skills-matter-9789264258051-en.htm

roles that do not require these qualifications.[17] At the same time, participation in vocational training in the UK is below the European Union average.[18] For example, there are persistent labour shortages for chefs, artists and graphic designers – roles which normally require vocational training – and appear on the Migration Advisory Committee (MAC) shortage occupation list.[19]

In terms of *knowledge*, the OECD estimates that the UK has a skills shortage in 21 out of 33 different types of subject knowledge analysed (Figure 2).[20] Knowledge areas refer to the body of information that makes adequate performance of the job possible (e.g. knowledge of plumbing for a plumber). The shortages in the UK are most prevalent in STEM related subjects such as medicine and dentistry, and in design; in these areas, the UK fares considerably worse than the OECD average.[21] For other kinds of subject-matter knowledge, such as industrial food production and sales and marketing, UK workers have a significant oversupply of skills compared to other OECD countries.

[17] ONS (2019). *Overeducation and hourly wages in the UK labour market*. Retrieved from: https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/compendium/economicreview/april2019/overeducationandhourlywagesintheuklabourmarket2006to2017

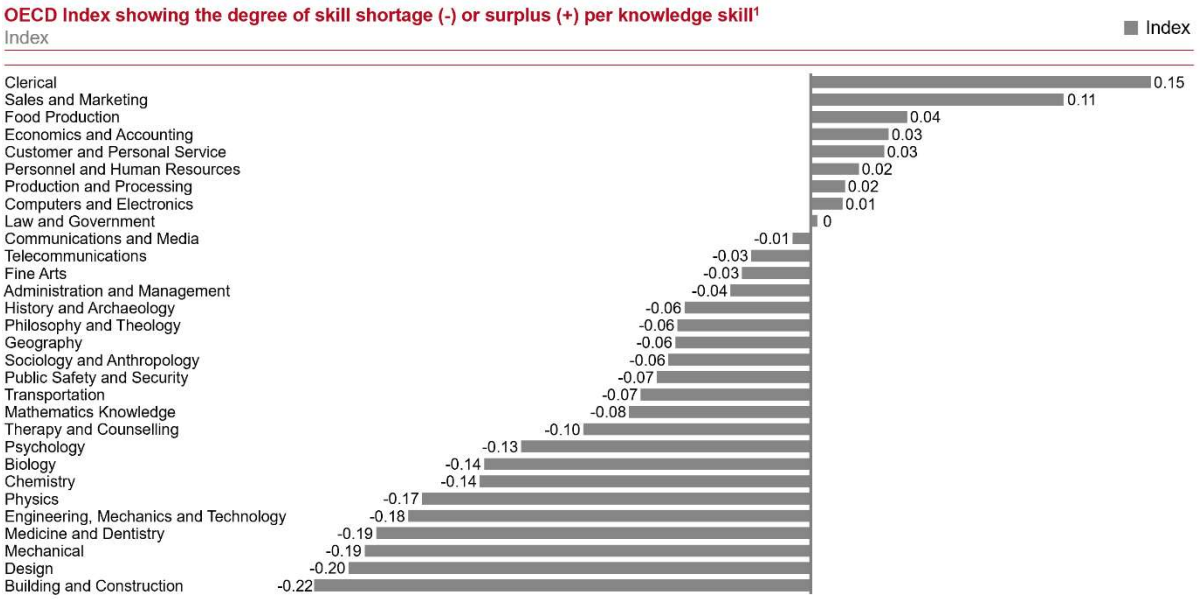
[18] Eurostat (2018). *Employment by sex, age and educational attainment level dataset* [ISCED classification: Upper secondary and post-secondary non-tertiary education]. Retrieved from: https://ec.europa.eu/eurostat

[19] Home Office (2016). *Shortage occupation list*. Retrieved from: https://www.gov.uk/guidance/immigration-rules/immigration-rules-appendix-k-shortage-occupation-list

[20] OECD Skill for Jobs Database. An "Occupational shortage indicator" is calculated for 33 occupational groups, skill requirements are extracted from O*NET, and knowledge skill shortages are then computed based on shortages of the occupations that use that particular skill. It should be noted, however, that the average number of elements in shortage across OECD countries is 25.

[21] Knowledge areas classified as STEM in this report are; Medicine and dentistry, Biology, Chemistry, Physics, Engineering and Technology, Computing and Electronics, and Mathematics.

Figure 2: OECD Index showing the degree of skill shortage (-) or surplus (+) per knowledge skill[22]



Source: OECD Skills need database

Turning attention to *workplace skills*, the OECD Skills for Jobs database estimates that the UK has a shortage in almost all skills apart from negotiation, persuasion, and programming. Notably, it estimates that the largest shortage is in scientific research skills.[23]

It is also worth emphasising that, across all three types of skills in the categorisation used in this paper, the mismatches identified include both under-skilling and over-skilling. A worker could be over-skilled relative to requirements in some areas, yet under-skilled in other areas. In a survey by YouGov for the Chartered Institute of Personnel and Development (CIPD), 37% of employees said they could cope with more demanding duties. This suggests that workers believed they were over-skilled for their existing roles.[24] At the same time, 12% reported they lacked some of the skills required to carry out their roles effectively.[25] That accords with findings that among OECD countries, over-skilling is roughly two and a half times more widespread than under-skilling.[26]

[22] Results are presented on a scale that ranges between -1 and +1. The maximum value reflects the strongest surplus observed across OECD (31) countries and skills dimensions.
[23] OECD Skill for Jobs Database, https://stats.oecd.org/
[24] CIPD (2018). *Over-skilled and underused, investigating the untapped potential of UK skills*. Retrieved from: https://www.cipd.co.uk/Images/over-skilled-and-underused-investigating-the-untapped-potential-of-uk-skills_tcm18-48001.pdf
[25] This is based on the CIPD survey which states that 33% jobs require advanced literacy and writing and 37% of employees are over-skilled. Therefore, on average 33% of those requiring those skills are over-skilled.
[26] OECD (2015), op. cit.

The high cost of skills mismatches at the national, firm and individual level

It is well established that countries that experience the most pronounced skills mismatches show lower productivity levels than their peers.[27] One academic study found that the UK could improve its productivity by 5% or more if it reduced the level of skills mismatch to that of best-practice peer nations.[28] Another study suggested that higher skill levels among London's workforce explain about two-thirds of the productivity gap between the capital and the rest of the country.[29]

These findings are crucial given the UK's recent poor productivity performance. The evidence points to skills having significant potential to boost UK productivity. For example, workforce up-skilling is estimated to have accounted for about 20% of pre-crisis productivity growth.[30]

Under-skilling impacts directly on companies' productivity. For example, the Employment Trends survey conducted by the Confederation of British Industry (CBI) shows that talent shortages are the biggest reason companies worry about their competitiveness.[31] The 2018 Business Barometer estimates that the UK skills shortage is costing organisations £6.3 billion a year in increased salaries, training and recruitment, and temporary staffing costs.[32]

Over-skilling is costly for individuals; workers whose skills are mismatched with employers' needs have lower average earnings, are less satisfied with their jobs, are more likely to become unemployed, and have lower standards of living.[33] CIPD research found that under-utilised workers suffer an average wage penalty of 7.5%. That review also found that being over-skilled increases an individual's probability of future unemployment compared to those who are matched, because of the signal their previous under-utilised job conveys to future employers.[34] Over-skilled

[27] OECD (2018). *Skills for Jobs.* Retrieved from: https://www.oecdskillsforjobsdatabase.org/data/Skills%20SfJ_PDF%20for%20WEBSITE%20final.pdf
[28] OECD (2015). *Labour Market Mismatch and Labour Productivity: Evidence from PIAAC Data*. Retrieved from: http://dx.doi.org/10.1787/5js1pzx1r2kb-en
OECD (2015), op. cit.
[29] *Financial Times* (14 September 2017). "Low skills and poor infrastructure blamed for UK productivity gap". Retrieved from: https://www.ft.com/content/b53933c0-8e23-11e7-9084-d0c17942ba93
[30] BEIS (2015), op. cit.
[31] CBI (2018), op. cit.
[32] The Edge Foundation (2018). *Skills shortages in the UK economy*. Retrieved from: http://www.edge.co.uk/sites/default/files/publications/skills_shortage_bulletin_2_final.pdf
[33] CEDEFOP (2015). *Skills, qualifications and jobs in the EU: the making of a perfect match?*. Retrieved from: https://www.cedefop.europa.eu/files/3072_en.pdf
[34] This estimate is derived from the average wage penalty, based on 38 estimates, in 10 papers which investigate the issue of the effect of over-skilling on income. Source: CIPD (2018), op. cit.

workers are also more likely to experience lower job satisfaction.[35] They are more likely to want to quit their current job and they are likely to experience less skills development than their peers.[36]

Shifts in skills demand

Subsequent sections of this paper focus on building a robust understanding of the future evolution of the UK's skills position. For now, it is worth emphasising how rapidly and fundamentally skills demand can change and how the advance of automation might accelerate that change over the decade ahead.

Ever changing work and living environments result in shifts in basic workplace skill requirements. For example, in 1975, only 48% of the UK population (aged 17 and above) had a driving licence. That had increased to 74% by 2017, but this percentage can be expected to decline in the decades ahead, given the introduction of autonomous vehicles.[37] Moreover, as the shape of an economy shifts, the occupations that make up the workforce change. An obvious example is the decline in UK manufacturing jobs and the rise of jobs in services. New technologies can also change the skills required within particular roles. For example, increasingly sophisticated translation software might make foreign-language skills less important for overseas sales roles.

The rate of change in skills demand is expected to increase over the next decade. The key driver of that acceleration is expected to be rising adoption of AI and the automation of an increasing number of human tasks. Recent technological innovation has been rapid. Growth in computing capacity and the development of more sophisticated artificial intelligence algorithms has increased the sheer volume and variety of data generated. Cheap and ubiquitous sensors and mobile devices continue to feed the explosion in data. Cisco estimates that by 2021 roughly half of all global devices and connections will be machine-to-machine.[38]

McKinsey Global Institute (MGI) estimates that 39% of work activities in the UK are already technically automatable using current technologies. It also finds that, globally, in six out of ten occupations, more than 30% of activities are technically automatable.[39]

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[35] Mavromaras, K., McGuinness, S., O'Leary, N., Sloane, P. & Fok, Y. (2010). *The problem of over-skilling in Australia and Britain*. Retrieved from: https://doi.org/10.1111/j.1467-9957.2009.02136.x
[36] McGuinness, S. & Wooden, M. (2019). *Over-skilling, Job Insecurity, and Career Mobility*. Retrieved from: https://doi.org/10.1111/j.1468-232X.2009.00557.x ; CEDEFOP (2015), op. cit.
[37] Department for Transport (2018). *National Travel Survey: Driving licence holding and vehicle availability*. Retrieved from: https://www.gov.uk/government/statistics/national-travel-survey-2018
[38] Cisco (2019). *Cisco Visual Networking Index: Forecast and Trends, 2017-2022 White Paper*. Retrieved from: https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html
[39] MGI (2017), op. cit.

As tasks currently carried out by workers are automated, and as the technological revolution changes the patterns of production and demand for products and services, new tasks and jobs will also be created. Some will require entirely new skills. Social-media marketing skills and cybersecurity expertise are examples of new skills that have become relevant only in the last decade or two. The content of many jobs will also shift towards uniquely human competencies, such as communication, interaction, and emotional connections. Finally, demand for some existing jobs will increase even as demand for others wane. For example, there is likely to be greater demand for technology and healthcare workers in future, and less demand for data-entry clerks. Box 3 sets out some of these trends and, more specifically, how they could impact the content and design of jobs.

Box 3: Examples of how automation could affect job design

Research by Bakhshi and colleagues shows that the demand for jobs in the UK is most likely to increase for managerial, professional and technical occupations; while production, sales, administrative and elementary jobs are at greatest risk of automation.[40] The paper concludes that this change will increase demand for interpersonal and higher cognitive skills, such as decision making, creativity, and complex problem solving.

While some jobs will disappear and others emerge, a vast number of current jobs will survive but their nature will be transformed in significant ways. In many cases automation and new technologies will be a complement to, and not a substitute for human workers. Many jobs combine a set of routine and automatable tasks with those requiring advanced analytical, interpersonal or manual skills that machines won't have. In those circumstances, automation will allow workers to focus on these non-routine tasks.

For example, MIT economist Erik Brynjolfsson[41] finds 27 distinct tasks that a radiologist needs to do. This includes reading medical images, which can soon be automated. However, radiologists also need to counsel patients and coordinate care with other doctors. If a computer helps a radiologist to read and interpret images, it will leave the radiologist time to see more patients. Similarly, as self-checkout machines are introduced in stores, cashiers can become checkout assistance helpers, who can help answer questions or troubleshoot the machines.

[40] Bakhshi, et al. (2017), op cit.
[41] Wired (22 April 2019). *The Robots Want to Steal (the Boring Parts of) Youth Job*. Retrieved from: https://www.wired.com/story/erik-rynjolfsson-robots-steal-boring-parts-of-your-job/

Section 2: Trends affecting future skills demand and supply

This section reviews the existing literature on trends in both the demand for and supply of skills. It highlights a key gap in the existing literature – a robust approach to assessing the aggregate skills mismatch for the UK economy – and sets out the analytical approach to modelling future demand for occupations and the combination of skills required to perform them.

Trends in skills demand: Much greater need for technology and people skills

Existing research suggests that the demand for skills in the UK is likely to change significantly by 2030. In particular, there could be an increase of more than 30% in the demand for technology-related skills such as basic digital skills, as well as for social and emotional skills such as empathy and leading and managing others.

The adoption of automation will be the biggest driver of this shift in skills. According to estimates by MGI, 39% of the activities that people are paid to do in the UK today could be automated by 2030 with current technology.[42] For example, demand will increase significantly in technology-related occupations such as software developers. Of course, the technical feasibility of automation is not the only factor. The cost of developing and deploying technology, the cost of labour, and regulatory and social acceptance will also affect the speed at which automation is adopted. Administrative occupations, retail, storage, and goods transportation are all occupations that are highly automatable.[43]

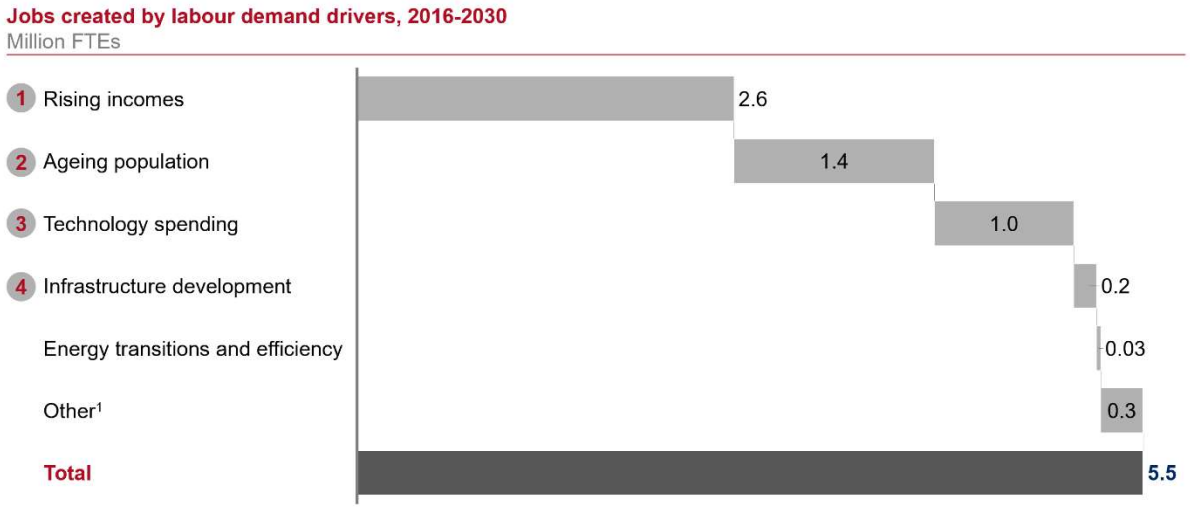
There is, however, little doubt that the trend of increasing automation will continue. That trend will affect different occupations to a greater or lesser extent and will therefore trigger a shift in the types and volume of jobs demanded across the economy.

Beyond automation, there are several other trends that are likely to shift labour demand towards occupations requiring technological and social and emotional skills. Those trends include rising incomes, ageing population, increasing technology spend, greater infrastructure spend, and a shift towards renewable energy. Analysis by MGI on workforce transitions shows that these five trends between them could

[42]MGI (2019). *The future of women at work in the United Kingdom*. Retrieved from: https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-women-at-work-in-the-united-kingdom

create 5.5 million new jobs in the UK by 2030 (Figure 3). For instance, demand will increase in social occupations such as personal care aides, which are relatively immune to automation and will be driven by trends such as population ageing.

Figure 3: Estimated job creation due to demand drivers[44]

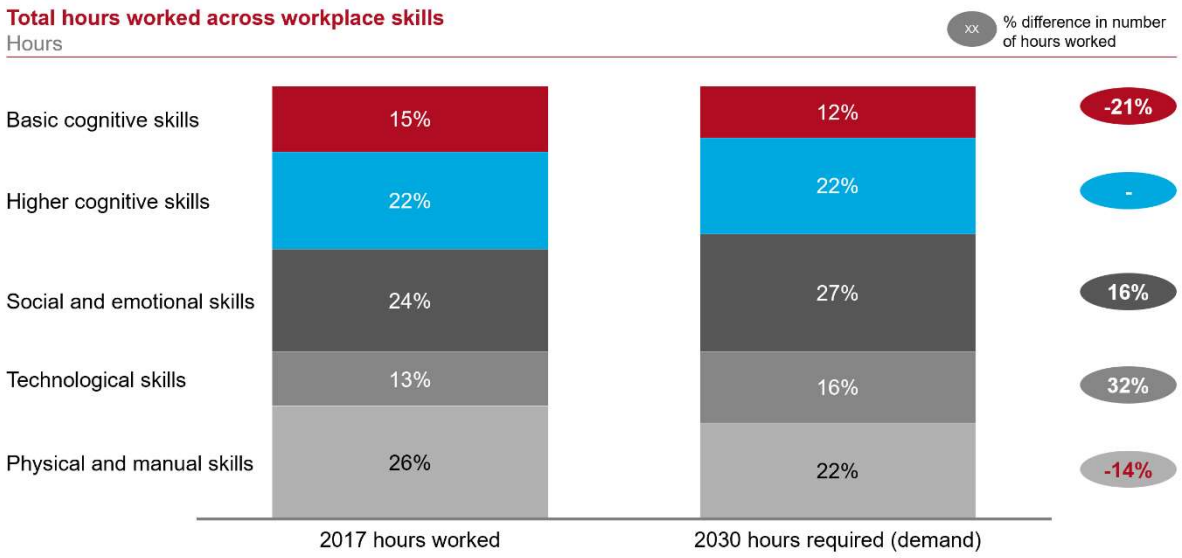


Source: McKinsey Global Institute

Returning to the skills bundles set out in section 1, it is worth asking how demand will shift in terms of qualifications, knowledge and workplace skills in 2030. In terms of workplace skills, these shifts will result in workers spending less time on tasks requiring physical, manual and basic cognitive skills, and more of their time using technological workplace skills. They will also devote more time to tasks requiring social and emotional workplace skills, such as leadership and managing others, teaching and training others, and interpersonal skills and empathy (Figure 4). The Technical Appendix provides more detail on the specific workplace skills that are captured by these high-level skills categories.

[44] Education falls into the 'Other[1]' category (see graph). Given the discrepancies between countries in funding models for education and healthcare, these drivers have been sized separately from the rest of consumer spending, despite some proportion of education and health care spending being funded directly by consumers. For both these sectors, MGI model the full sector, which would include that funded by consumers as well as public and private sector funding.

Figure 4: Projected change in hours worked for workplace skills categories

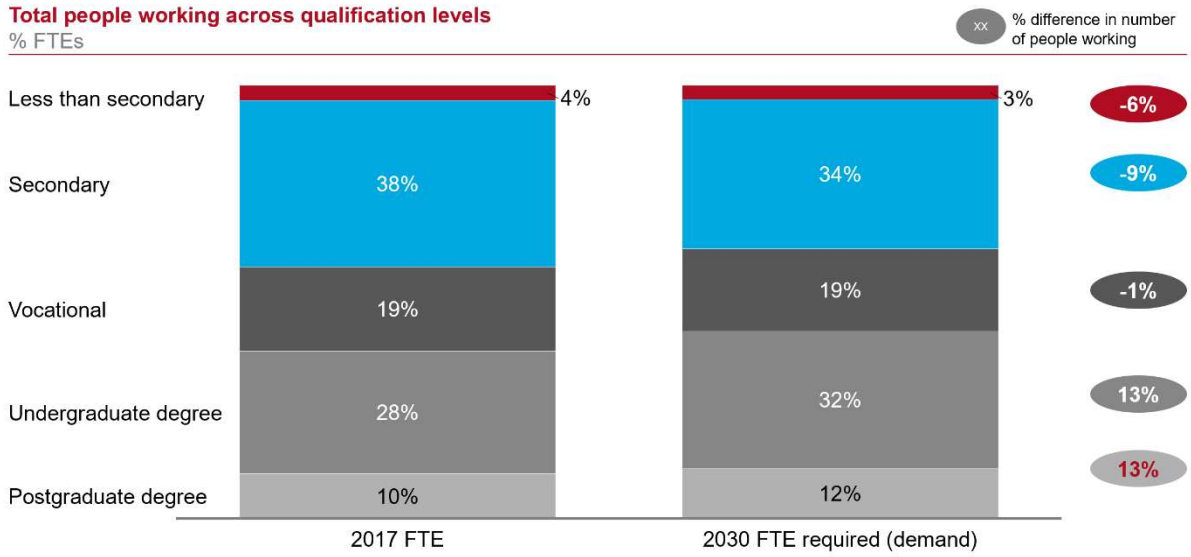


Source: McKinsey Global Institute

In terms of qualifications, analysis by MGI suggests there could be a 13% increase in jobs that require a bachelor's degree or a graduate degree – such as nurse anaesthetists and computer systems analysts – by 2030.[45] Over the same period, there could be a 9% decline in jobs that require secondary education without any additional formal preparation, such as truck drivers and postal-service clerks (Figure 5). These shifts are driven by a combination of more basic manual and cognitive tasks being automated, middle-income workers moving to more high-skilled occupations and the continued increase in customer-facing service jobs, especially in healthcare and education.[46]

[45] Vocational is classified as O*NET zone 3 and the UK equivalent would be 'higher education' which includes NVQ level 4 qualifications such as BTEC professional awards, foundation degrees, and diplomas of higher and further education.
[46] MGI (2018), op. cit.
OECD (2019). *Job polarisation and the work profile of the middle class*, Retrieved from: https://www.oecd.org/els/emp/Job-polarisation-and-the-work-profile-of-the-middle-class-Policy-brief-2019.pdf

Figure 5: Projected change in Full Time Equivalent jobs by qualification

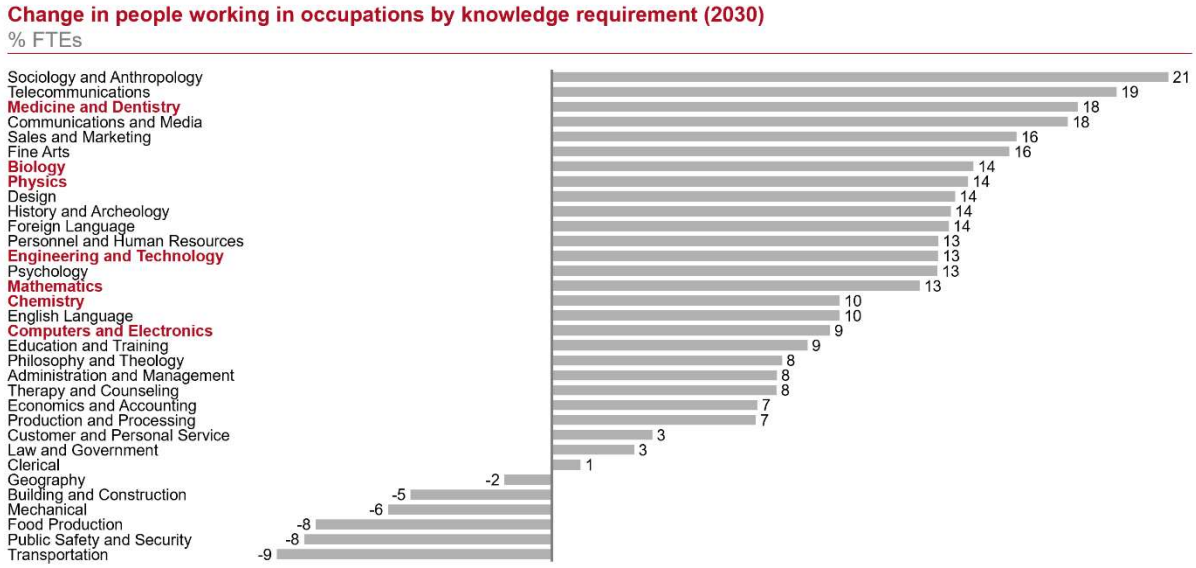


Source: McKinsey Global Institute

The knowledge required of workers will also change. Research by the National Endowment for Science, Technology and the Arts (NESTA) and the Oxford Martin School suggests that knowledge itself is going to become less important.[47] This is partly due to knowledge becoming easier to access via the internet and its embedding in to automated systems. However, the ability to apply knowledge will remain important, even if the types of knowledge required are set to change. The future workforce will require broad-based knowledge (Figure 6) for continuous learning and reskilling throughout workers' careers.

[47] Bakhshi, et al. (2017), op. cit.

Figure 6: Projected change in Full Time Equivelent jobs by knowledge type[48]



Source: MGI Jobs Lost Jobs Gained; O*NET; McKinsey Global Institute analysis

Trends in skills supply: Constraints that could heighten future skills mismatch

Even as demand increases significantly for critical skills such as technology and people skills, existing evidence suggests that the supply of those skills could remain constrained.

At least 80% of the UK's 2030 workforce is already in the workforce today, in part because increases in life expectancy and retirement age in the UK are keeping people in the workforce for longer. Between 2002 and 2017, economic activity among people aged 65 and over has increased by 6% a year; far outpacing growth in economic activity among those aged 25–64, at 1% a year.[49]

Given the above, the effect on the overall skills supply of new entrants to the UK workforce will be relatively small and will be felt only in a few skills areas. Nonetheless, these new workers will strengthen the supply of skills in three significant ways, as follows (see Figure 7):

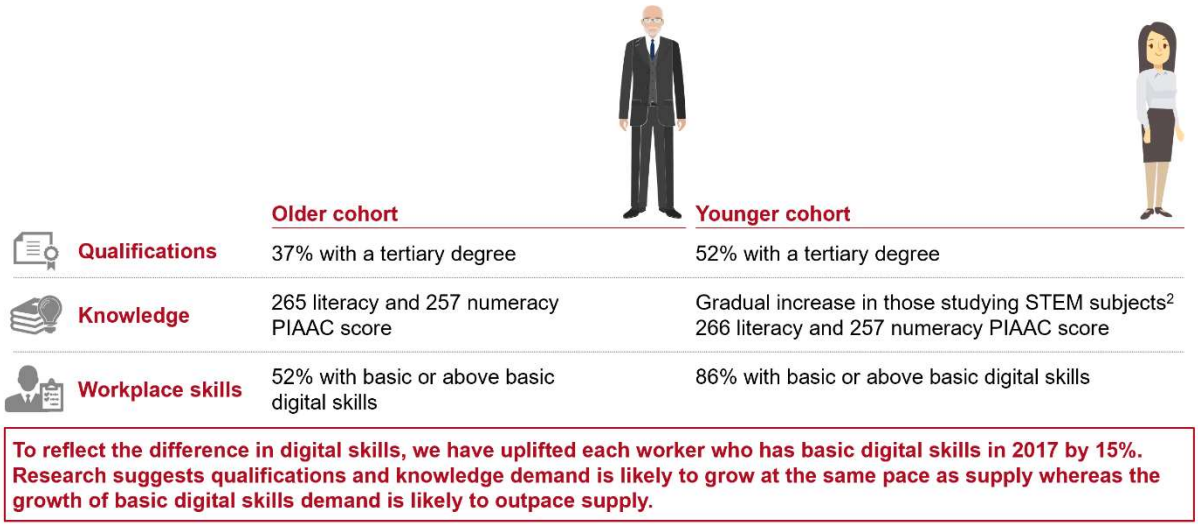
- They will have higher qualification levels
- They will have higher basic digital skills
- A higher proportion will have a STEM degree[50]

[48] Where knowledge level is above 4

[49] ONS (2019). *Labour force survey* [economic activity by age]. Retrieved from: https://www.ons.gov.uk/surveys/informationforhouseholdsandindividuals/householdandindividualsurveys/labourforcesurvey

[50] HESA student data shows that between 2013 and 2017 there was a 14 percent increase in those studying STEM subjects, while the numbers studying non-STEM subjects declined by 7 percent over the same period

Figure 7: Differences between those leaving and entering the workforce by 2030[51]



Source: OECD employment by educational attainment level; Eurostat individuals' level of digital skills; PIAAC; HESA graduates by subject

Immigration flows will have an impact on skills supply, but the overall effect is likely to be small through to 2030. In 2017, migrants filled 5.5 million jobs in the UK labour market, 18% of the total.[52] Overall, the skills bundles of immigrants are very similar to those of UK nationals, with a few exceptions at both the high skill and low skill end. Factory weighers, graders and sorters are examples from low skilled occupations, where 69% of jobs are filled by people born outside the UK, and high skilled examples would be natural and social science professionals and dentists, where 41% of roles are filled by people outside the UK.

The expansion in skills supply will also be limited by levels of regional and job immobility that many observers might find surprising. The number of graduates has doubled since 2001, but the share of graduates who move between regions for work has fallen by 80% since then. In 2016, only 0.6% of the workforce changed both their job and their region of residence. This is driven by young people, private renters, and graduates moving less than they used to.[53]

Research by the Resolution Foundation finds that, at least for now, it appears that millennials are less likely to 'job hop' than previous generations, even if that means they lose out on increased pay and advancement to higher-skilled jobs as a result.

[51] Older cohort: >55 years old, younger cohort: <25 years old. For tertiary degrees we have looked at those aged 25-34 years old as those under 25 may still be in education and those aged 55-64 years old. Gradual increase in younger cohort studying STEM subjects equals to 14% increase since 2013/14.
[52] ONS (2017). *Employment by occupation and country of birth.* Retrieved from: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employmentbyoccupationemp04
[53] Resolution Foundation (2017a). *Get a move on*. Retrieved from: https://www.resolutionfoundation.org/app/uploads/2017/08/Get-a-move-on.pdf

The research suggests that this may stem from a lack of confidence in looking for work.[54]

A model to quantify the UK's skills mismatch to 2030

Existing research points to significant shifts in skills demand, along with constraints as to how fast skills supply will be able to adjust to match these changes. There is a high likelihood of the UK's skills mismatch worsening over the next decade unless the existing workforce undertakes significant retraining. Despite the importance of this issue, to date there has been little progress in quantifying the probable future skills mismatch in terms of skills required by occupation.

This paper uses an analytical model which projects demand and supply of skills from 2017 to 2030, under different sensitivities, assuming no policy interventions or change in levels of private-sector training. The analysis, building on work conducted by MGI, covers all three skills types set out in Section 1; formal qualifications, knowledge and workplace skills. The analysis is conducted at a significant level of granularity. Specific jobs (occupations) are characterised by the extent to which they require any of 5 levels of qualifications, 33 knowledge areas, and 25 workplace skills.

The modelling approach uses macroeconomic trends, such as automation and an ageing population, to model shifts in the occupational mix and changing skill requirements within occupations. Broadly, the model operates by doing the following:

i. estimating the demand for skills in 2030;
ii. estimating the supply of skills in 2030;
iii. creating a 'mismatch score' for every potential transition between source occupation and target occupation;
iv. allocating workers to target occupations based on a 'market clearing' model that optimises for the lowest possible total mismatch in the economy.

The model assumes full employment, so all workers are allocated to a job regardless of the scale of the mismatch. The modelling approach and assumptions mean that the estimated skills mismatch is incremental to the current (2017) skills mismatch. More detail is provided in Box 4 and in the Technical Appendix.

The model does not project the likely impact of policies and programmes that are not yet complete, nor does it consider any additional interventions from policymakers, employers, or individuals. Nevertheless, it is possible to compare the skills mismatch identified in 2030 with policies already announced – including the Industrial Strategy – and infer whether they are likely to be sufficient to bridge the gap.

[54]Resolution Foundation (2017b). *Study, work, progress, repeat?.* Retrieved from: https://www.resolutionfoundation.org/app/uploads/2017/02/IC-labour-market.pdf

Box 4: Summary of modelling approach

The demand for skills in 2030

The following labour demand drivers predict additional jobs by 2030, and, in the case of automation, the skill mix *within* jobs too.

- Automation will change the skill mix required *within* occupations and *between* occupations as some jobs are displaced.
- Rising incomes, ageing population, technology spend, infrastructure investment, and investment in renewable energy will increase demand for certain occupations, causing workers to transition *between* occupations.

Estimating the supply of skills in 2030

The model uses the number of occupations and the skills required to perform them in 2017 to create a 'pool' of skills possessed by workers. The number of workers in the pool increases in line with population growth.

The model adjusts for some change in the skills of the workforce to reflect different skills of those entering and leaving work by 2030. However, it does not project the likely impact of policies and programmes that are not yet complete, nor does it consider any additional interventions from policymakers, employers, or individuals.

The model assumes that workers in 2017 are either a perfect match for their occupation in 2017 or will have acquired the skills to become a perfect match by 2030. So the estimated skill mismatch is incremental to current reported mismatch.

Creating a 'mismatch score'

To allocate full-time equivalent (FTE) workers to an occupation in 2030, the model calculates a composite similarity score between every possible combination of 'source occupation' (current worker) and 'target occupation' (future job). The composite score incorporates scores for all three skill elements (knowledge, qualifications, and workplace skills) and takes into account both under-skilling and over-skilling.

Allocating workers to target occupations

The model optimises for the lowest possible skills mismatch for the economy rather than for an individual. The model also assumes full employment, so all workers are allocated to a job regardless of the scale of the mismatch.

Section 3. Skills mismatches highlighted by the analysis

The overall finding is that skills mismatches in the UK's labour market are projected to worsen considerably by 2030, emphasising the importance of making lifelong learning the norm in the UK workforce, rather than relying solely on improving education for the pipeline of future workers. The areas with the most significant under-skilling are in those skills which are learnt or refined predominantly in the workplace, rather than being learnt during traditional schooling years. Even for the skills that can be learnt during schooling years, changes to traditional education will not impact on the 80% of the 2030 workforce that is already working.

The model projects more severe skills shortages in 'workplace skills' than it does in 'qualifications' and 'knowledge'. While the UK has mismatches in qualification levels today, these are not projected to worsen significantly. Granted, this is in part a function of the way the model works: it assumes that a worker already in an occupation meets, and will continue to meet, the qualification requirement for that occupation. But this finding reflects a broader point that shortages in qualifications are likely to become relevant only when new jobs are created or when demand for a given occupation increases.

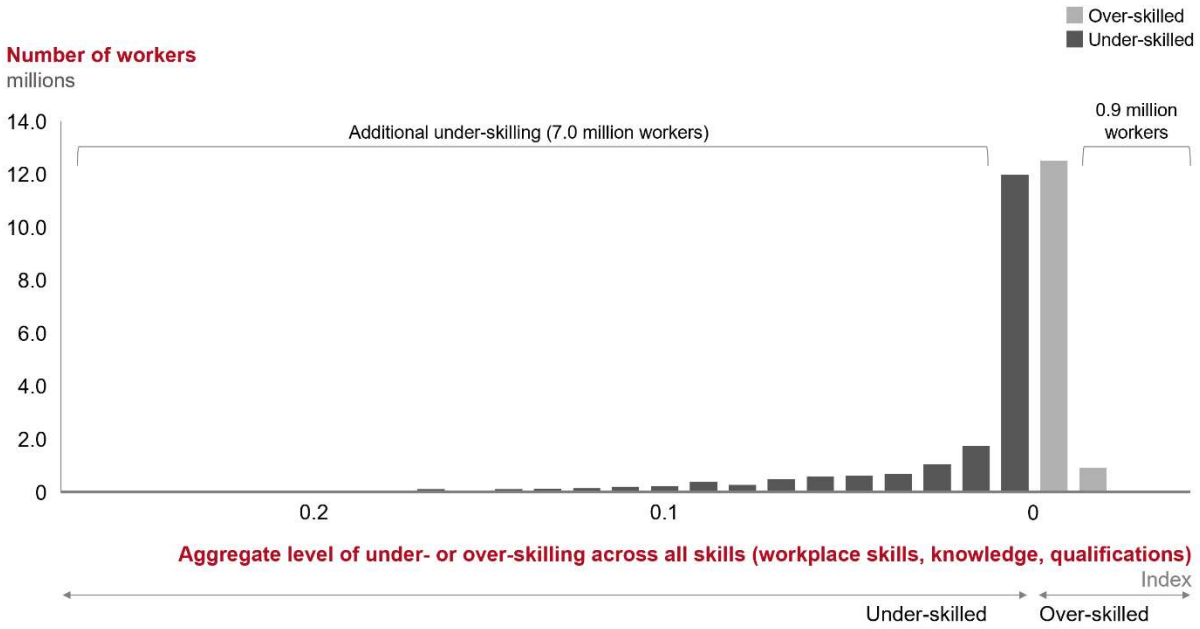
Knowledge is becoming increasingly accessible via the internet, but the application of knowledge will remain important, and will be complementary to workplace skills where there is likely to be extensive under-skilling. Shortages in workplace skills are more likely to bite as the nature of that occupation evolves and work is conducted in a different way.

The remainder of this section focuses on the skills mismatch findings for workplace skills. Instead of focusing on the 5 high-level workplace skill categories set out in Section 2 we focus on the more granular 25 workplace skills that fall under these categories (see the Technical Appendix for details).

Headline Findings

The model finds that the aggregate skills mismatch facing the UK will worsen significantly by 2030. 7 million additional workers could be under-skilled for their job requirements, as shown in Figure 8. This figure does not include the large number of workers who are marginally under-skilled because in a dynamic economy some level of transitional under-skilling would always exist. 7 million workers constitute about 20% of the labour market. Around 1 million additional workers could be over-skilled.

Figure 8: Aggregate UK skills mismatch in 2030



Source: 2030 skills mismatch model

It is worth noting that the model assumes no unemployment in 2030; a methodological approach taken to avoid arbitrarily choosing a mismatch threshold at which a person is unable to find a suitable job. The extreme nature of some of the occupation transitions simulated, such as farmers transitioning to become software developers, suggests that the 'real-life' outcome could be unemployment.

That said, the number of occupational transitions (5.7 million) implied by the model does not seem unrealistic relative to historical precedents. According to research by the University of Essex, over 10% of people (approximately 3.1 million people in 2017) change their occupation in Britain each year. That figure includes people who have left employment and then returned.[55] Given this, the model's estimate of 5.7 million transitions over a longer time period is plausible at a time when work is changing both within and across occupations.

While some level of under-skilling is the mark of a healthy economy, these figures are incremental to today's already significant under-skilling of 12% of the workforce (4 million workers) and over-skilling of 37% (12 million workers).[56]

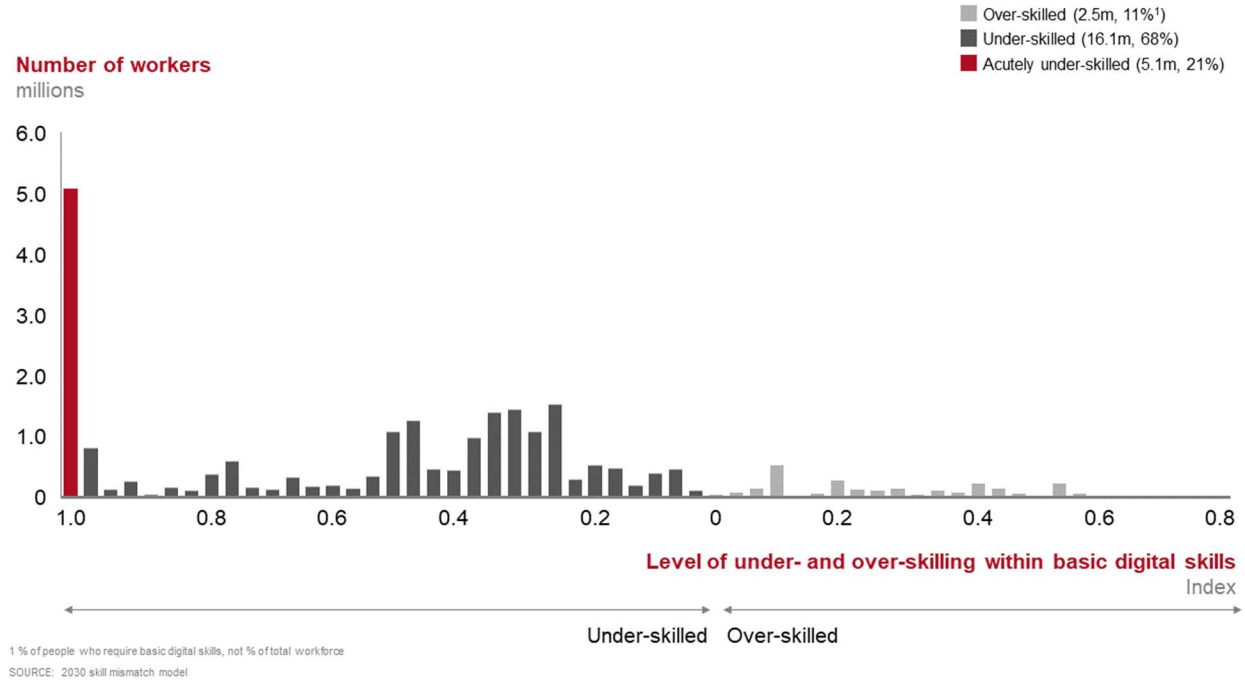
[55] Longhi, S. & Brynin, M. (2009). *Occupational Change in Britain and Germany*. Retrieved from: https://www.iser.essex.ac.uk/research/publications/working-papers/iser/2009-10.pdf.
[56] CIPD (2018), op. cit.

Specific skill challenges and findings

Basic Digital

The most widespread under-skilling is likely to be in basic digital skills, which are likely to look increasingly advanced, compared to what we might consider 'basic' to look like at present. In total, 5 million workers could become acutely under-skilled in basic digital skills by 2030, with up to two-thirds of the workforce facing some level of under-skilling.

Figure 9: Skill mismatch in 2030: Basic digital skills[57]



Source: 2030 skills mismatch model

This increase in under-skilling is stark, given existing evidence of digital skills shortages. One in five UK firms reports that they are unable to find workers with basic digital skills, while the Lloyds Bank Consumer Digital Index indicates that 53% of the working population do not have the essential digital skills needed for the workplace.[58] These include tasks such as being able to avoid suspicious links, and basic email tasks such as attaching and sharing documents.

[57] Percentages refer to % of people who require basic digital skills, not % of total workforce.
[58] CBI & TCS (2019). *Delivering skills for the new economy*. Retrieved from: https://www.cbi.org.uk/articles/delivering-skills-for-the-new-economy/ ; CBI & TCS (2019), op. cit. Lloyds Bank (2019). *Lloyds Bank Consumer Digital Index*. Retrieved from: https://www.lloydsbank.com/banking-with-us/whats-happening/consumer-digital-index.asp.

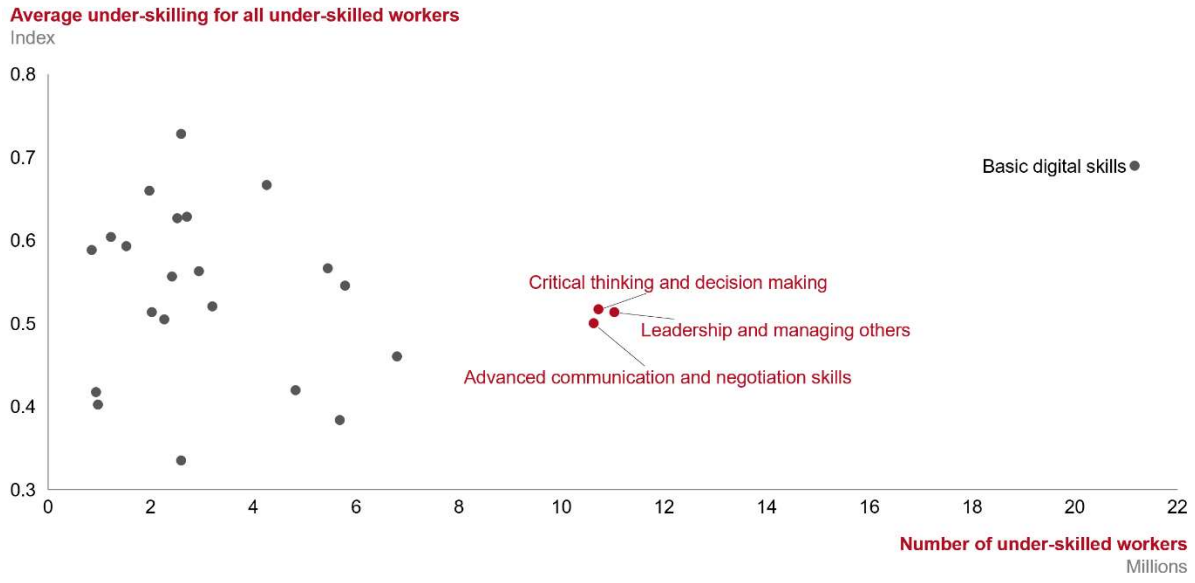
Moreover, there are important synergies between digital and technology skills and management skills. Unless managers can understand and interact with digital technologies to some degree, it is difficult for them to lead effectively, whether in designing strategy, coaching teams, or interpreting data. The model results show that many of those with leadership skills gaps also lack sufficient digital expertise.

Leadership and Management

The UK is already under-skilled in leadership and management skills as evidenced by the OECD and the World Management Survey.[59] The modelling done for this paper suggests that these shortages are likely to worsen, both in management knowledge and in workplace skills such as leadership, communication, negotiation, and critical thinking.

Within workplace skills, the second, third and fourth largest shortages projected in 2030 are core management skills including leadership and managing others, critical thinking and decision-making, and advanced communication and negotiation (Figure 10). In total, out of 22 million workers that are likely to face at least some degree of under-skilling, 2.1 million are likely to be acutely under-skilled in at least one core management skill (leadership, decision-making or advanced communication), of which 400,000 are also projected to be acutely under skilled in basic digital.[60]

Figure 10: Average under-skilling for all under-skilled workers



Source: 2030 skills mismatch model

As with education, good management skills are a key enabler for the economy. Improving management skills could help unlock all the important drivers of

[59] OECD Jobs for Skills database.
[60] Figure 10 shows that ~10 million workers will face at least some degree of under-skilling in each of these skills, which equates to 22 million workers across all three (de-duplicated).

productivity and growth including capital investment, technology adoption, on-the-job learning, and efficiency improvements. Research from CBI indicates that businesses that improve their management practices from the lowest levels to the UK median can increase their productivity by 19%.[61] Good managers will send their workers on training courses to upskill, provide mentoring and coaching, or create other ways in which workers can learn on the job. Moreover, better managers also tend to be better at using Information and Communication Technologies (ICT) to improve firm productivity.[62]

This is particularly relevant, given the dual shortages in management and digital skills in the UK workforce. Basic digital skills are the workplace skill with the single largest shortage projected in 2030. 5.1 million workers requiring no digital skills in 2017 will be required to use them for their jobs in 2030. This transition will require significant upskilling of workers (Figure 9). There is likely to be such a widespread increase in digital under-skilling that up to two-thirds of the workforce could lack the basic digital skills required to perform their job effectively.

STEM

STEM stands for science, technology, engineering and mathematics but the context in which this term is used determines its precise definition.[63] In education, it means the study of these subjects, either exclusively or in combination. In employment, STEM refers to jobs requiring the application of science, technology, engineering and mathematics skills or a qualification in a relevant subject or located in a particular industry or sector. The Government refers to STEM-M&H for occupations related to Science, Technology, Engineering and Mathematics, and Medicine and Health, which include medicine and dentistry. This research paper has used the term 'STEM' and STEM-related to refer to what government would call 'STEM-M&H'.

Therefore, STEM is defined in the model as; mathematics, computer and electronics, physics, chemistry, biology, medicine and dentistry and engineering and technology.

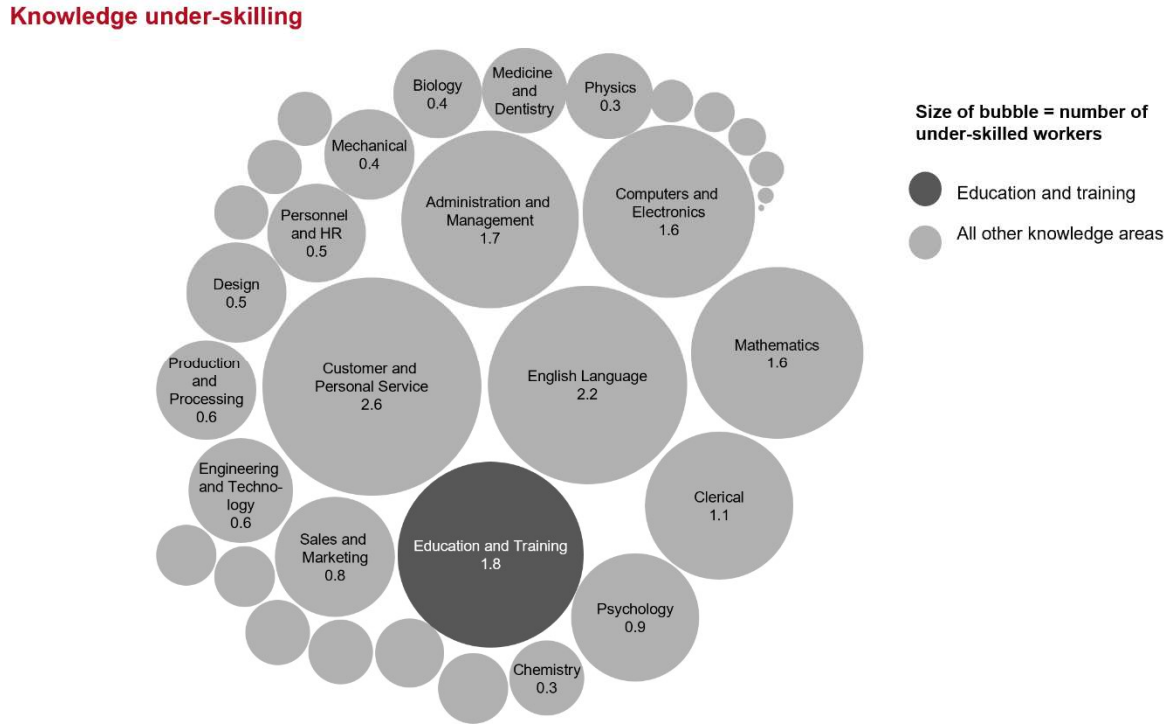
The model projects acute shortages of specialist skills in STEM and health services by 2030. Although the absolute number of people affected is small relative to management and digital skills shortages, these roles represent some of the most productive occupations, the demand for which is projected to increase with advances

[61] CBI (2019). *Great Job: Solving the productivity puzzle through the power of people*. Retrieved from: https://www.cbi.org.uk/articles/great-job-solving-the-productivity-puzzle-through-the-power-of-people/
[62] Siebers, P-O., et al. (2008). *Enhancing Productivity: The Role of Management Practices*. Retrieved from: https://arxiv.org/ftp/arxiv/papers/0803/0803.2995.pdf.
[63] NAO Report (2018), Delivering STEM (science, technology, engineering and mathematics) skills for the economy https://www.nao.org.uk/wp-content/uploads/2018/01/Delivering-STEM-Science-technology-engineering-and-mathematics-skills-for-the-economy.pdf

in technology and the ageing of populations worldwide. Shortages in these roles could decrease UK competitiveness.

STEM shortages in 2030 are likely to show up in terms of both knowledge (for example, mathematics) and workplace skills (for example, scientific research and development (R&D), and advanced IT skills).[64]

Figure 11: Knowledge under-skilling by 2030

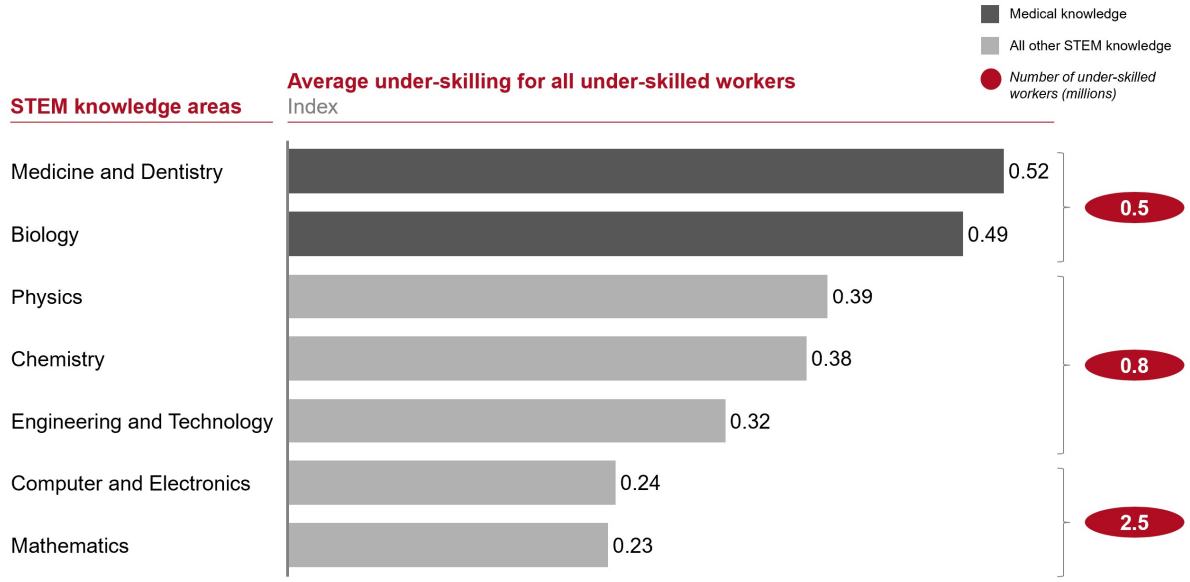


Source:2030 Skills Mismatch model

Acute knowledge shortages are likely to affect a small number of people in specific STEM-related occupations and health services in 2030. In total, 2.7 million workers are likely to be affected by under-skilling in at least one STEM subject. This is especially significant given that knowledge shortages in the UK today are already most prevalent in STEM subjects. The most extreme knowledge gap is likely to be in health-related knowledge (medicine, dentistry, and biology), affecting 0.5 million workers. It is worth noting here that a knowledge area such as biology can experience shortages, even if associated qualifications, suggest otherwise. This reflects biology as a knowledge area being required by a growing number of health-related occupations, in response to an ageing demographic. Larger numbers of workers are likely to face knowledge under-skilling in STEM areas like mathematics, computer science, and electronics (2.5 million), but the degree of shortage will likely be smaller than in medicine and dentistry.

[64] STEM subjects include mathematics, computer and electronics, physics, chemistry, biology, medicine and dentistry and engineering and technology.

Figure 12: Average under-skilling by STEM knowledge area



Source:2030 Skills Mismatch model

The model finds that the occupations that will be affected by STEM knowledge gaps include software developers, office managers, and nurse anaesthetists. For example, given likely shortages in nursing, the model calculates that the 'optimal' outcome for the overall economy – one that minimises skills mismatches – would require people with no medical knowledge to enter this occupation by 2030. These new nurses might previously have held roles such as statistical assistants and industrial production managers.

Within STEM workplace skills, 1.5 million workers will face acute under-skilling, of a total 8.9 million workers facing at least some degree of under-skilling. The shortage in STEM workplace skills is significant given that scientific R&D is already ranked by OECD as the number-one skill gap among all workplace skills. Increased shortages in STEM-related workplace skills are likely to be focused on specialist occupations such as software developers, engineers and purchasing managers.

While the degree of under-skilling is high, it is worth noting that the absolute numbers of workers with increased gaps in STEM skills is low relative to other workplace skills (Figure 13). However, the depth of the skills gap (per worker) is high in these areas, worsening an already acute problem in these subsections of the labour market. For instance, in 2013, the employer-perceptions survey found that 22% of skills gaps were in advanced IT or software skills.[65]

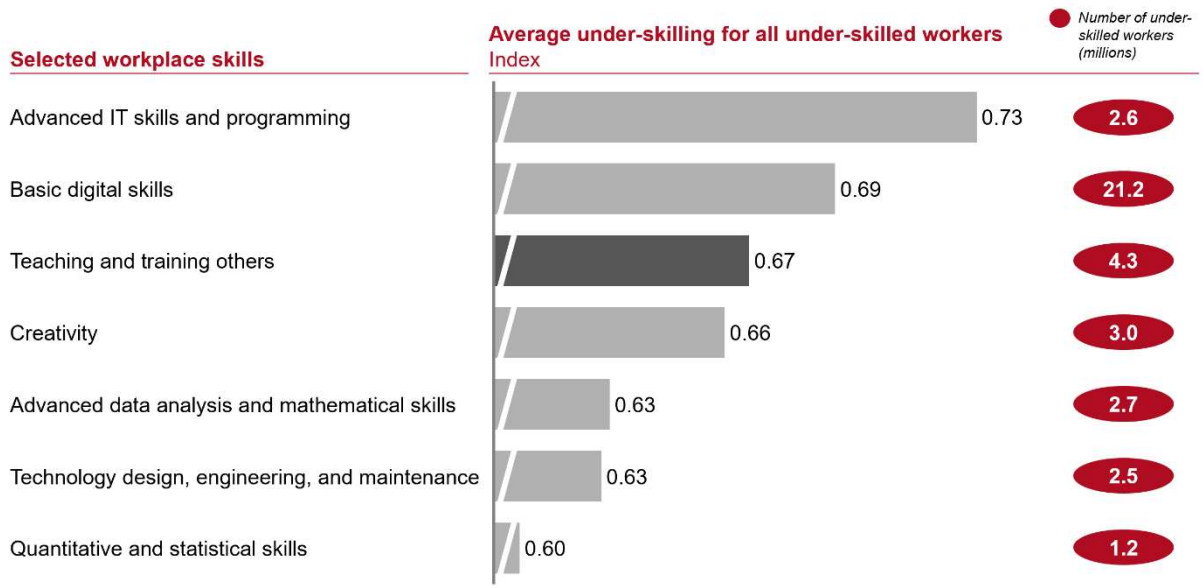
[65] Skills Funding Agency (2016). *Review of publicly funded digital skills qualifications.* Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/499031/Review_of_Publicly_Funded_Digital_Skills_Qualifications_2016_FINAL.pdf

Teaching and training

800,000 workers are likely to face an acute shortage in teaching and training skills; the ability of those in the working environment to upskill others. This is of a total 4.3 million that are likely to experience at least some level of under-skilling in teaching and training. Moreover, 1.8 million workers are estimated to face under-skilling in terms of knowledge necessary for educating and training (Figure 11). Given that a key factor in the UK's future competitiveness and productivity will be its ability to meet the significant economy-wide reskilling challenge, shortages of workers who can help others learn new skills could become a serious bottleneck.

These gaps are not just in traditional teaching occupations, but also in management occupations, and so relate to on-the-job training as much as to school-based education. This poses a challenge in terms of managing the broader reskilling agenda effectively and ensuring there are enough people in the workplace with the skills required to upskill others to meet future workplace demands.

Figure 13: Average under-skilling for selected workplace skills[66]



Source:2030 Skills Mismatch model

Testing the sensitivity of the modelled findings

The estimates produced from the modelling in this paper should not be considered as forecasts and there is, of course, uncertainty around them. However, the aim of the analysis is to estimate the scale of the future skills challenge rather than make an accurate prediction about the state of the UK labour market in 2030. The findings

[66] Selected workplace skills represent the seven workplace skills with the highest degree of over-skilling out of a total 25 workplace skills.

have been tested against key sensitivities, including potential changes in immigration patterns and limitations in inter-regional mobility, for which the model's projections remain very similar. The modelling of those sensitivities is set out in detail in the Technical Appendix, and the results are briefly summarised below.

Regional mobility: The baseline model assumes workers can transition to a new occupation anywhere in the UK. To better reflect the fact that only 0.6% of people move regions for an occupation, the model was solved for each individual region and the results were combined for the UK. Restricting regional mobility produced similar skill mismatch projections, which is to be expected, given the distribution of occupations (albeit not sectors) is similar across regions, with the exception of London.

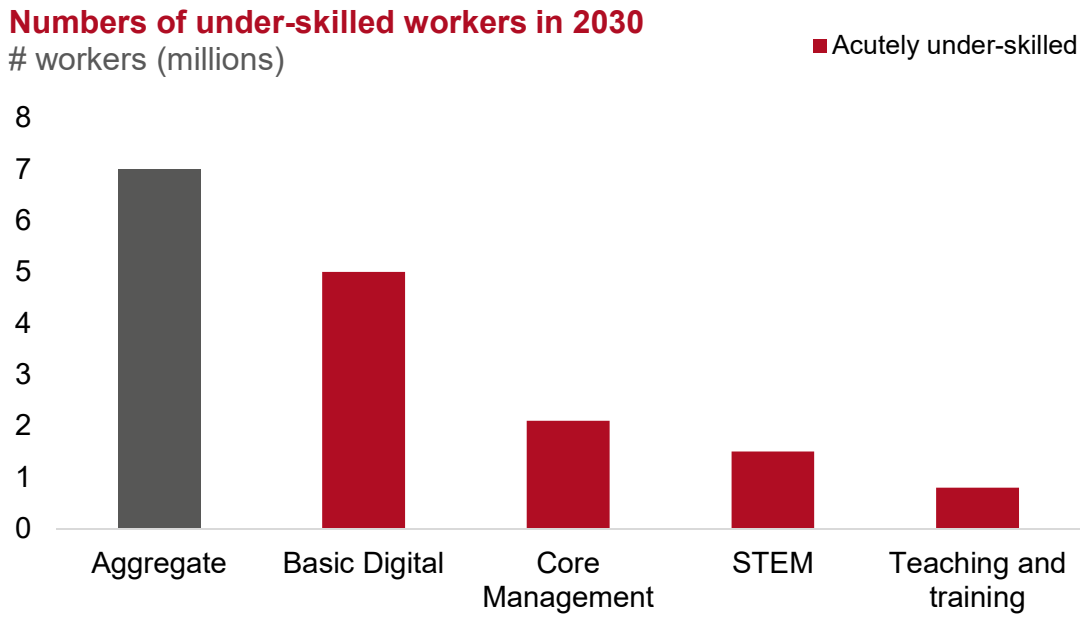
Immigration: To test immigration as a sensitivity, the population was restricted to just include the skills bundles of UK-born nationals. When looking at UK-only population (the most extreme of our two immigration scenarios), acute under-skilling across the pool of workplace skills held by the population increased from 14 million to 15 million. In terms of workers, this under-skilling is unlikely to affect more than 125,000. Given this finding, the model is considered to be robust to sensitivities.

Faster automation: The effect of faster automation on each workplace skill for a given occupation reduced the total number of jobs to 24 million, from 32.4 million in the base case. The results of the sensitivity test show that faster automation could result in more extreme under-skilling in the UK economy. In this scenario, 13.1 million additional workers could be under-skilled by 2030, compared to 7.0 million in the base case. Similarly, 3.3 million workers could be over-skilled compared to 0.9 million in the base case. The number of acutely under-skilled workers also nearly doubles, driven by the higher number of occupation transitions predicted in the model; 14 million compared to 5.7 million in the base case. If automation were to take place twice as quickly as predicted in the base case, the number of acutely under-skilled workers in STEM workplace skills would be likely to more than double.

Key challenges suggested by the findings

With 80% of the 2030 workforce already in the workforce today, the analysis suggests that reskilling the existing workforce will be the major challenge between now and 2030. The analysis finds that by 2030, 7.0 million additional workers could be under-skilled for their job requirements; this would currently constitute about 20% of the labour market. More severe skills shortages are predicted in 'workplace skills' than in 'qualifications' and 'knowledge'. The workplace skills set to experience the most acute under-skilling in 2030 are basic digital, STEM and social and emotional skills (leadership and management and teaching and training). These headline results are captured in Figure 14.

Figure 14: Estimated under-skilling in the workforce in 2030[67]



Source:2030 Skills Mismatch model

There are a number of policies targeting areas where skill mismatch could occur, but existing commitments do not look to be sufficient in scale to address the skills gaps predicted. For example, the Industrial Strategy contains a number of policies designed to address basic digital skills (see Box 5). The model output demonstrates that such interventions need to focus on those already in the workforce, not just the

[67] The aggregate projection includes workers that are under-skilled across the weighted skill bundle required for their job. An individual could be under-skilled in a certain skill but might not be across their weighted skill bundle. The red bar shows a subset of specific workplace skills.

next generation of workers. The National Retraining Scheme and Adult Digital Skills Entitlement policy, for instance, do aim to address upskilling of those already in the workforce. However, these are unlikely to be large enough in scale to address the skills mismatch projections in this paper.

It also has to be acknowledged that Government introduced the Apprenticeship Levy across the UK with the aim of encouraging sustained employer investment in high quality apprenticeships, as well as the Skills Advisory Panels aiming to bring together local employers and skills providers to pool knowledge on skills and labour market needs.

Addressing STEM skill shortages is one of the priority areas in the Industrial Strategy White Paper, but it is focused predominantly on younger people still in education. For instance, the government is investing £16 million in mathematics and £500 million in technical education. The £16 million programme seeks to increase participation in and attainment at level 3 mathematics by financially incentivising schools for each additional student enrolled. Similarly, there is a National Centre for Computing Education (NCCE) to improve the teaching of computer science. This paper shows that an equal or even more pronounced focus should be given to those already in work.

The likely future shortfalls in STEM workplace skills – alongside under-skilling in STEM knowledge – highlight an overarching theme. It will not be enough to improve the knowledge of those in the young cohort entering the workforce; it is also important to ensure that people within jobs have ongoing lifelong upskilling in order to operate most productively. Moreover, while the model does not directly highlight this point, it is worth noting that STEM workers will typically need a broad range of other skills too.

The Industrial Strategy seeks to address some gaps in leadership skills and digital skills; including some policies targeted on those already in the workforce. On leadership skills, the Business Basics Programme aims to test ways of encouraging small and medium-sized businesses to adopt existing technology and management practices to improve their productivity.

The under-skilling in teaching and training skills predicted in this paper needs to be addressed or the delivery of broad-based reskilling efforts is likely to be significantly hampered.

Finally, it is important to note that while government policy will be crucial for addressing the future skills mismatch, employers and individuals also have a role to play in upskilling the existing workforce.

The Council is undertaking further work to obtain workplace perspectives on skills development and is exploring factors underpinning successful skills systems through a series of international case studies.

Box 5: Examples of policies targeting digital skills

Industrial Strategy policies targeting digital skills include the following:

- An £84 million National Centre for Computing Education (NCCE) to strengthen the teaching of computing and computer science in schools and to explore ways of improving take up at GCSE and A level to ensure that all pupils are acquiring the digital skills they need to be successful in a technology-dependent society.
- The National Retraining Scheme has begun its rollout in Liverpool as a digital service called Get Help to Retrain which is designed to help adults learn about new opportunities and the skills they need in the digital age.
- The West Midlands Combined Authority is also establishing a £5 million digital-skills retraining pilot which aims to provide training tailored to local employers' demand, i.e. short, intensive, skills-based (rather than qualification-based) programmes for adults to retrain – particularly those who are in jobs that are low-paid or at risk of automation.
- Digital T-levels will be included in the £500 million annual allocation to the T-level programme.
- A £20 million Institute of Coding is bringing together a consortium of universities, businesses and experts.
- A £20 million Cyber Discovery programme will train the next generation of cybersecurity specialists, with the aim to train about 6,000 people by 2021.
- There are several other digital reskilling policies in place, of which the following are just a few examples:
    - The Adult Digital Skills Entitlement policy aims to mirror the existing legal entitlements for English and mathematics, which means fully funded basic qualifications for digital skills.
    - The government has set up Local Digital Skills Partnerships in order to bring public, private and third sector organisations together to increase digital capabilities in England.
    - A Digital Inclusion Fund has also been set up to help older and disabled people acquire digital skills such as booking GP appointments online and using apps to communicate with friends and family.

Box 6: Examples of employer digital-training schemes

Employers have also provided digital-skills enablement. For example:

- Barclays eagle-surfers help people operate iPads, a skill becoming increasingly in demand.
- Google's digital garage programme has provided digital-skills training for businesses and individuals across 80 towns in the UK and has pledged to provide five hours of digital training to every person and small business in the UK.
- Cisco has set up more than 300 academies across schools, colleges, university technical colleges, universities, prisons, apprenticeship training providers, non-for-profit and other organisations to prepare people with skills for the digital economy.