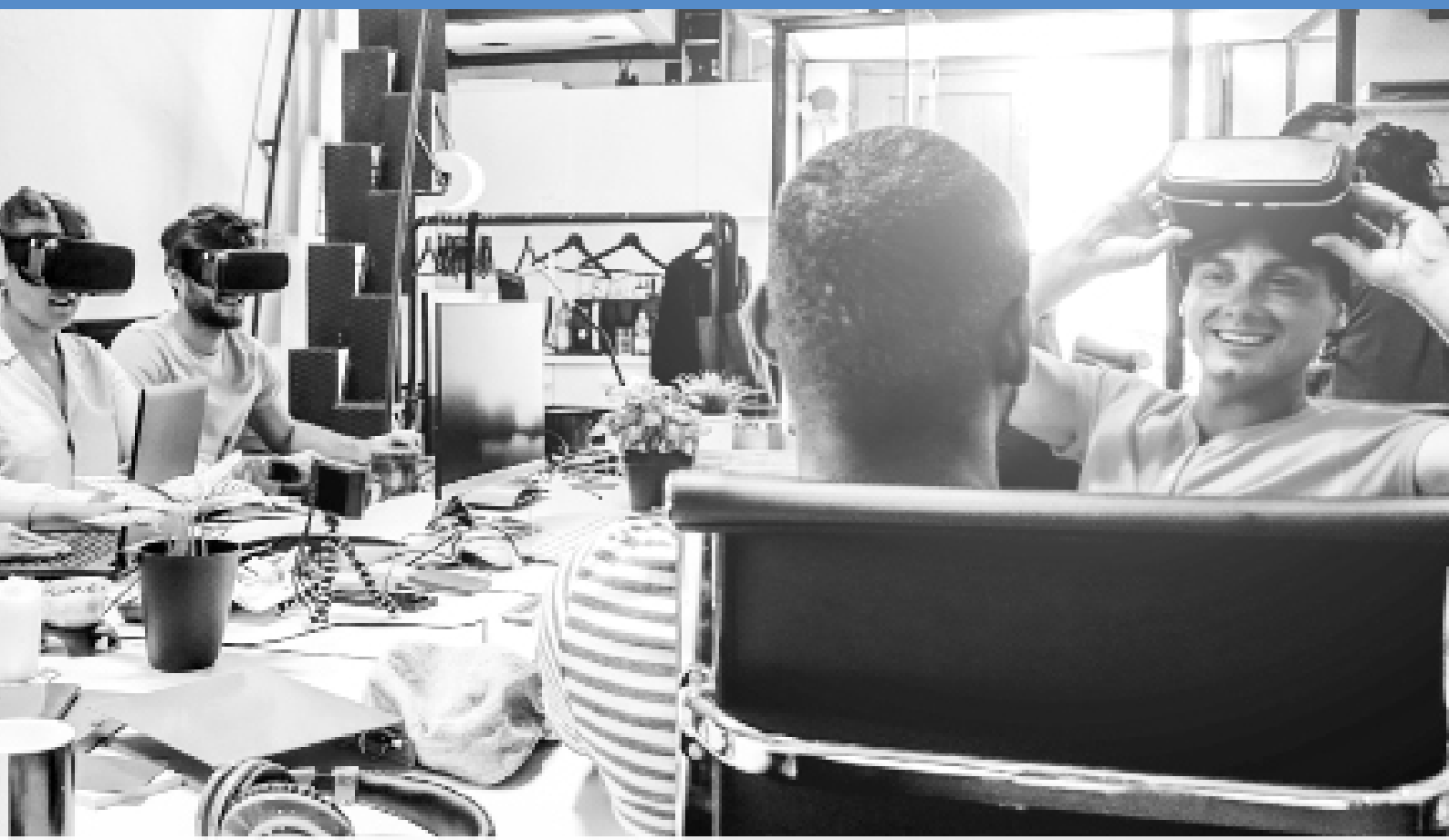
No Longer Optional:
Employer Demand for Digital Skills

June 2019



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Executive Summary

This research was commissioned by the Department for Digital, Culture, Media and Sport (DCMS). It aims to provide an overview of digital skills demand and to help inform the development of evidence-based digital skills policy.

We know digital skills are becoming ever more important in today's economy, and employers indicate that about one-third of vacancies they find difficult to fill are, to some degree, attributable to a lack of appropriate digital skills amongst applicants.[1] But the term "digital skills" covers a wide array of competencies, knowledge, and skills, making it difficult to design interventions to address digital skills needs. This report attempts to illuminate the issue through analysis of millions of online job adverts in the UK to highlight the skills employers demand. It aims to provide an overview of digital skills demand and provide a useful basis to inform an evidence-based skills development policy.

Specifically, the research highlights the importance of both baseline digital skills, such as those required to use productivity software tools, and of skills for more specific software tools that are critical for job seekers to qualify for middle- and high-skill roles. Specific digital skills are key to unlocking opportunities for job seekers and addressing the shortage of digitally skilled workers in the UK.

Digital skills are essential entry requirements for two-thirds of UK SOC occupations[2] and carry with them a wage differential over non-digital roles. These occupations account for 82%[3] of online job vacancies.

To understand the demand for digital skills at various levels of the market, we have broken the job market down by skill level[4] – low-skill jobs that require minimal training, middle-skill jobs that require Higher National Diplomas / Certificates, and high-skill jobs that require a degree or above. We examined the importance of digital skills at each level.

Through this analysis, we find digital skills are becoming near-universal requirements for employment. The move up the career ladder from low- to high-skill jobs comes with increased demand for specific digital skills. Acquiring specific digital skills makes career progression as well as a pay increase more likely. In certain fields, job seekers need to develop digital skills related to specific technical tools of their chosen discipline to advance their careers.

1. M. Winterbotham, D. Vivian, et al., "Employer skills survey 2017, Research report", Department for Education, 2018, https://assetspublishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/733509/Employer_Skills_Survey-report.pdf.

2. UK Standard Occupation Classification that classifies jobs based on skill level and skill content (https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc).

3. Unless otherwise noted, all data on employer demand for jobs and skills in this report is sourced from Burning Glass's database on online job postings and reflects the 12-month period from 01/04/2017 to 31/03/2018.

4. Definitions on skill levels used in this report can be found in the Methodology section.

Examples are computer-aided design for engineers and technicians, search engine optimisation for marketers, and data analysis skills such as the programming languages SQL and R for analysts.

Specifically, this paper focuses on understanding demand in terms of eight common clusters of digital skills (clusters are skills that are often found together in job postings that have been grouped together). The Productivity Software cluster is requested in the vast majority of job adverts across the economy, and we categorise these as 'baseline' digital skills. The other seven clusters are digital skills required within specific roles or sectors: Software and Programming; Networking Systems; Data Analysis; Digital Marketing; Digital Design; Customer Relationship Management Software; and Machining and Manufacturing Technology. Job seekers who develop skills in one or more of these clusters can qualify for many of the best-paying and fastest-growing jobs in today's economy.

Key Findings from the Research Include:

Digital skills are near-universal requirements: 'Baseline' digital skills such as Microsoft Office and other productivity software tools are commonly required in jobs across all skills levels and have become a ticket to entry in the labour market. When breaking the job market down by skill level into low-, middle-, and high-skill roles, we find that over 75% of job openings at each level request digital skills.

Digital skills carry a wage differential: Overall, roles requiring digital skills pay 29% (£8,300 per annum) over those roles that do not (£37,000 p.a. vs £28,700 p.a.). This difference is apparent at all skill levels, but the differential increases at higher levels. The salary differential for digital skills ranges from £2,700 for low-skill jobs (£24,000 vs £21,300), £5,800 for middle-skill jobs (£32,200 vs £26,400) and £11,300 for high-skill jobs (£45,300 vs £34,000).

Digital skills are in demand everywhere: Digital skills are required in at least 82% of online advertised openings across the UK but the precise skills demanded are not uniform across the country. For example, the capital region has the greatest demand with 87% of advertised roles, spread across almost all sectors while the West Midlands has a slightly lower demand at 82% of roles, but the well-developed manufacturing sector means that machining and engineering software skills are required

in 24% of those roles.

Specific digital skills may help workers avoid the risk of automation: By entering a role that requires specific digital skills, workers can reduce their risk of automation by a dramatic 59%. Specific digital skills commonly complement uniquely human skills such as design, writing or communication, which in combination are difficult to automate and critical to a firm's success

Specific digital skills promote career progression: To maximise chances of success in the digital economy, job seekers must go beyond baseline digital skills and develop more specific skills. Importantly, these specific digital skills are not solely required in the tech sector but are in demand across all sectors of the economy. This may include digital tools such as Adobe Photoshop for designers; computer-aided design for engineers and manufacturing workers; customer relationship management software for sales and marketing professionals; and computer programming and networking for IT professionals. These specific digital skills are required in 28% of low-skill jobs, 56% of

middle-skill jobs, and 68% of high-skill jobs.

Implications from this Research Include:

Job seekers need a complete package of skills for success in the economy, both digital and non-digital. Many of the specific digital skills described in this report serve to enable non-digital expertise. For example, software programs such as Adobe Photoshop serve to enable design work, and CRM software tools can make sales and marketing professionals more effective in communicating the messages they craft.

Digital skills policy should be driven locally: Digital skill requirements vary substantially from region to region, and so should efforts to train workers. For example, data and design skills are particularly important in London to meet the needs of the finance and creative industries, while engineering and advanced manufacturing skills are particularly important in high-tech engineering centres such as Cambridge and Bristol. In Northern Ireland, demand for baseline digital skills and lower paying roles account for a disproportionate share of demand compared to specific digital skills. Because of these different needs, each region should aim to develop a digital skills policy that matches the demand of local industries and develops the skills that may be needed to execute a human capital-based economic development policy.

Digital skills will change over time. Policy should be shaped to anticipate this dynamism. Many of the fastest-growing skills and software packages in areas such as data analysis and digital marketing hardly existed just a few years ago. Skills policy must be dynamic, continually re-evaluating the skills that are and will be in demand to train workers for the skills of the future while also ensuring they have the skills needed for success today.

Such an approach by employers allows them to build and shape their internal workforce in response to changing market and business needs. A dynamic approach to skills evaluation by educators consists of constantly re-evaluating content to ensure students have the particular sets of skills they need to get a job in their region.

Glossary

Baseline Digital Skills (i.e. productivity software): Digital literacy skills that employers ask for in the vast majority of jobs across all sectors in the UK labour market. Includes spreadsheet and word processing tools like Microsoft Excel and Microsoft Word, as well as enterprise management software like Oracle or SAP. These proficiencies are increasingly becoming a basic skill requirement for a majority of occupations.

Demand Concentration: Indicator to highlight differences in demand across locations by comparing shares of posting demand. It is based on a location quotient calculation.

Digital Occupation (an occupation requiring digital skills): An occupation is considered digital if a sufficient share of job ads mention digital skills in the skill requirements. The digital skills linked to an occupation can be one or more of the eight skill clusters listed in Table 1 of the report.

Digital Skills: Competences in and / or knowledge of IT tools including computer programs and programming languages.

Digitisation / Digitalisation of Jobs: Job automation by means of computer-controlled equipment.

Employability Skills: Generic skills that are useful across a variety of occupations and occur across many sectors. Examples are leadership, project planning, or building effective relationships. Also known as soft skills or transferrable skills.

Firm Size: Based on overall job demand where small includes companies having less than 25 job adverts per year, medium includes companies having 25-250 postings, and large includes any with more than 250 postings.

Industry Sectors: Based on the UK standard industrial classification (SIC), which groups firms by their economic activity.[5]

Job: Also role – a contracted piece of work, undertaken by an individual in exchange for payment. When a job is unfilled, it is a vacancy. In order to fill a vacancy, a job advert gets published online.

Job Advert: Also posting or job ad – an online advertisement posted by an organisation that describes a vacancy – a role for a person to fill.

Magnitude of Demand: Describes how often employers request this skill so job seekers and training programmes may

5. https://www.ons.gov.uk/methodology/classificationsandstandards/ukstandardindustrialclassificationofeconomicactivities/uksic2007.

focus on those skills that are most important to employers. Can be given in absolute number of job adverts or as a percentage share of the total number of (digital) postings.

Occupation: An occupation is a person's regular activity, performed in exchange for payment. Every job advert in Burning Glass Technologies' database has been assigned an occupation from the UK Standard Occupation Classification.

Percentage Share of Cluster: Number of job adverts in a given skill cluster that ask for a skill divided by the total number of all job adverts in that skill cluster.

Percentage Share of Digital Demand: Number of job adverts in digital occupations in a given group (e.g. location, digital skill cluster) divided by the total number of all job adverts in digital occupations.

Projected Growth: Describes projected future demand for each skill so that job seekers and training programmes may target emerging skills. Unless otherwise stated, projected demand figures refer to demand over the next five years from April 2018.

Regulatory Qualification Framework (RQF): A framework introduced by the UK government in 2015 to standardise size and level of qualifications regulated in England and Northern Ireland.[6]

Risk of Automation: Automation risk is a likelihood that a job can be automated by existing technology in the coming years.

Salary: Unless otherwise stated, all salary numbers are based on salary data extracted from Burning Glass's database of UK job postings.

Salary / Wage Differential: The absolute difference between wages of intervention groups. They are counterfactual at a moment in time.

Skill Cluster: Skills that often travel together in job postings grouped together.

Skill Level: Burning Glass categorised the UK SOC occupations into three qualification level requirements, low – middle – high skilled. The mapping is based on the Regulatory Qualification Framework (RQF) associated with an occupation.

6. An overview of the RQF can be found here: https://ofqual.blog.gov.uk/2015/10/01/explaining-the-rqf/.

Specific Digital Skills: Digital skill requirements for more technically oriented jobs in areas such as customer relationship management (CRM) software, computer networking, digital media & design software, social media tools, and search engine analysis.

UK SOC Occupations: UK Standard Occupation Classification[7] that classifies jobs based on skill level and skill content.

Versatility: A measure of how many different occupations frequently request a skill. A higher value indicates a more versatile skill. A highly versatile skill prepares a job seeker for a range of occupations.

7. A list of the U SOC codes can be found here: https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc.

Introduction

The government's 2017 UK Digital Strategy[8] set out the intention for the UK to be a world-leading and inclusive digital economy. The drive towards inclusion means ensuring everyone has access to the digital skills they need to fully participate in society.

Evidence suggests that while the UK does have a strong digitally enabled workforce, there remains a digital skill shortage[9,10] that holds back the UK economy. The 2017 Employer Skills Survey reported a third of all skill-shortage vacancies were attributed, at least in part, to a lack of 'digital skills'. Similarly, the Open University Business Barometer reported that about half of employers say they are struggling to attract talent with the right IT skills, despite the crucial role digital skills play in the UK economy.[11] Furthermore, this report found employers had been forced to inflate salaries to attract talent, costing at least £527 million over a 12-month period.

Digital businesses have demonstrated much faster growth than non-digital businesses, with one study estimating the growth rate for digital businesses in the UK to be more than twice that of their non-digital counterparts. The adoption of digital technology could boost UK manufacturing by £455bn over the next decade, increasing sector growth up to 3% per year, and creating a net gain of 175,000 jobs.[13]

The government aims to put skills at the heart of a world-leading digital economy that works for everyone. This means that everyone should be able to gain the basic digital skills they need to fully participate in an increasingly digital society; that the workforce is able to upskill and re-skill as new technology changes the way we work; and that digital education is prioritised and invested in to build a diverse pipeline of talent for the future.

This paper seeks to inform the development of skills policy. Its goal is to provide specific and nuanced evidence about which digital skills are in demand by employers, which are associated with wage differentials and which occupations require which digital skills. We achieve these insights by analysing online job postings from UK employers and reading the specific skills requested in those documents. This

8. DCMS, "Digital skills and inclusion – giving everyone access to the digital skills they need", Policy Paper, 2017, https://www.gov.uk/government/publications/uk-digital-strategy/2-digital-skills-and-inclusion-giving-everyone-access-to-the-digital-skills-they-need.

9. M. Winterbotham, D. Vivian, et al., "Employer skills survey 2017, Research report", Department for Education, 2018, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/733509/Employer_Skills_Survey-report.pdf.

10. DCMS and ECORYS UK, "Digital Skills for the UK Economy", 2016, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492889/DCMSDigitalSkillsReportJan2016.pdf.

11. The Open University, "The £2.2 Billion cost of the skills gap", 2017, https://www3.open.ac.uk/media/fullstory.aspx?id=31527.

12. Tech Nation,"Tech Nation Report 2018 – Growth of the UK's digital tech sector", 2018, https://technation.techcityuk.com/growth-tech/.

13. Prof Juergen Maier CEO Siemens UK commissioned by Department for Business, Energy & Industrial Strategy, "Made Smarter Review", 2017, https://www.gov.uk/government/publications/made-smarter-review.

approach allows us to interpret directly from employers which skills they most value and which skills they are explicitly targeting in their recruitment processes.

This paper demonstrates that while baseline digital skills are a near-universal requirement across a wide range of occupations and regions, specific digital skills – that is, specific technical packages that prepare people for higher salary digital roles – are critical for moving into the most stable and highest-paying jobs. These occupational, specific digital skills require targeted training, but are associated with a material salary boost.

Vitally, this paper will articulate the digital skills that matter most for the UK economy and highlight those skills that can most usefully be included in education, training, and workforce upskilling programmes.

1.

Methodology

This section provides an overview of the methodology and description of the key concepts used in this report. For a complete methodology, see the appendix.

Understanding the Market for Digital Skills

Burning Glass uses a novel big-data approach to assess the demand for digital skills in the job market: mining of employers' online job adverts to determine the digital skills they request of job seekers. This approach offers three unique advantages: Firstly, it allows us to understand the market for digital skills through the lens of hiring employers. Secondly, by mining millions of online job adverts, we are able to understand exactly which digital skills are in demand and for which roles. Thirdly, we can track the salaries employers are prepared to publicly offer and identify which skills are associated with salary differentials and their magnitude. In this way, we can understand the market in real time, as it evolves due to emerging technologies, and we can provide specific and actionable insights for the education and skills sector and policy makers who design and implement skills policy.

Burning Glass codes job postings to the four-digit UK SOC 2010 code level[14] based on the information extracted from a job posting. We assess digital skill demand by first determining which occupations commonly require proficiency in digital skills. Using skill requirements extracted from vacancy data, UK SOC occupations have been split into two groups – digital and non-digital according to the approach described below.

Our methodology differs from other reports on digital skills such as Ecorys' 2016 report that used an expert reviewer-based approach.[15] The Ecorys report results are based on a purely qualitative approach using literature reviews summarising the existing discussion on digital skills, the skills gap, and an assessment of existing skill frameworks. In addition, experts and stakeholders from public and private organisations were consulted regarding the existing literature and frameworks.

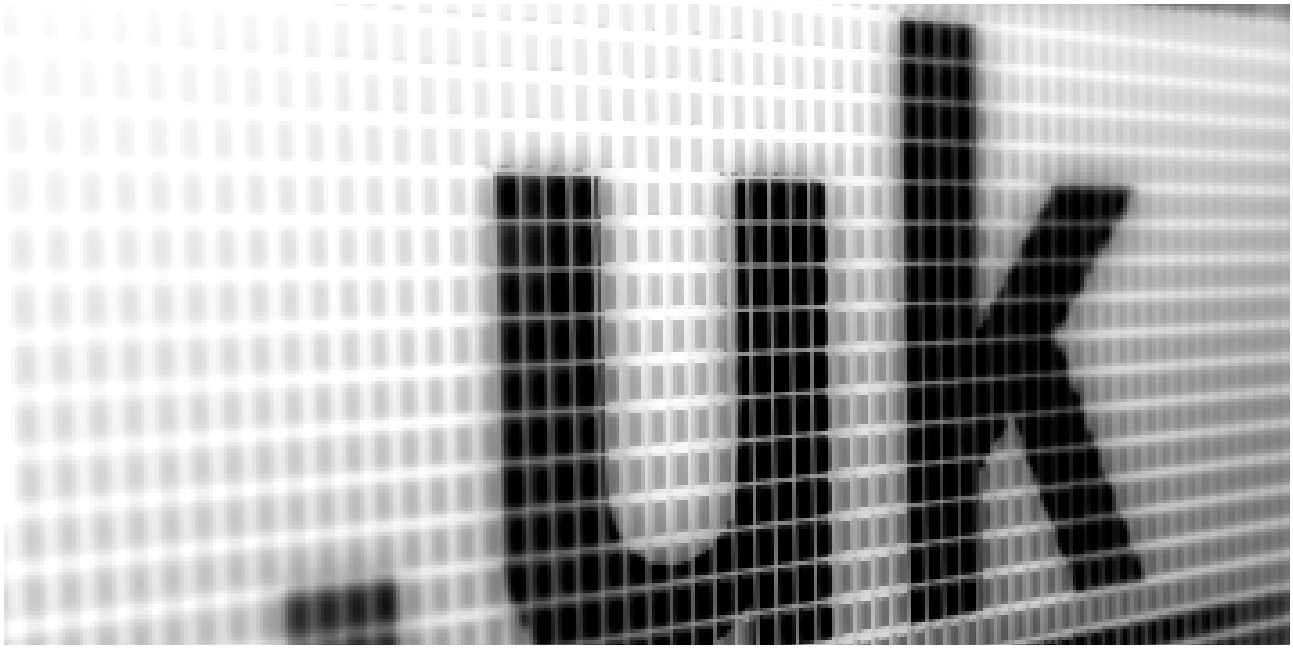
This report uses a quantitative analysis. We start from the question 'what are employers asking for?' to develop definitions and frameworks based on patterns of observed demand. This approach puts more emphasis on higher order digital skills as employers rarely ask for basic digital literacy in postings, as they typically are assumed to be present in all qualified applicants. Furthermore, vacancy data allows us to determine the skill needs of individual geographical regions at scale and in detail.

Using vacancy data for quantitative economic analysis has been explored by various researchers and organisations[16] such as Hershbein and Kahn[17], who analyse

technological change, or Deming and Kahn[18], who use posting data to analyse the relationship between skill requirements and salaries. Other initiatives that use online vacancy data include work from the Bank of England[19] and CEDEFOP[20]. Job posting data provides researchers with a rich data source on the labour market without significant delays and in large quantities and detail. To our knowledge, using job posting data to assess digital skills in the UK has not yet been fully explored. Muro, Liu, Whiton, and Kulkarni (2017) have used the O*Net database in combination with surveys to analyse the extent of digitalisation of the workforce in the US. Their overall findings align with ours – digitalisation is widely spread across the labour market; digital skills create continuously changing skill needs and are associated with higher salaries. However, their analysis lacks the granularity that job posting data can offer, especially for skills. Another study by Grinis (2016) has successfully used online job vacancies to identify STEM[21] jobs and related skill shortages[22]. Studies from Nesta and ESCoE have found online job postings to be a highly valuable source for labour market analysis and policy development, developing classifications and taxonomies for occupations[23] and skills[24] and determining the digital skills of the future[25].

We assign occupations as digital or non-digital based on the frequency of postings requesting one or more digital skills in each occupation. For example, by our definition, occupations such as sales supervisors and teachers fall just above the threshold and are considered digital roles based on the extent to which productivity software skills are requested. Sales and Retail Assistants and Welfare and Housing Associate Professionals are occupations that fall below our threshold and are considered non-digital. Please see page 90 in the appendix for a full methodology.

A broad view of our definitions in this context validates our core assumption about the importance of these skills. In the occupations tagged as digital, digital skills were on average the fifth most common skill cluster requested by employers. In non-digital occupations, digital skills were the 19th most common skill cluster in demand. Overall, an average of 42% of postings in digital occupations explicitly call for a digital skill; in the remainder of cases, digital skills are implicit requirements[26] or may provide job seekers with an advantage in the job market even if they were not specifically requested.



14. https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc.

15. DCMS and ECORYS UK, "Digital Skills for the UK Economy", 2016, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492889/DCMSDigitalSkillsReportJan2016.pdf.

16. The OECD blog "Measuring skills shortages in real time" provides a brief overview of examples for using vacancy data for economic analysis. F. Manca, 03/2016, OECD – Skills and Work, https://oecdskillsandwork.wordpress.com/2016/03/16/measuring-skills-shortages-in-real-time/.

17. B. Hershbein, L. B. Kahn, "Do recessions accelerate routine-biased technological change? Evidence from vacancy postings", American Economic Review 108, no. 7 (2018): 1737-72.

18. D. Deming, L. B. Kahn, "Skill requirements across firms and labor markets: Evidence from job postings for professionals", Journal of Labor Economics 36, no. S1 (2018): S337-S369.

19. A. Turrell, J.Thurgood et al., "Using online job vacancies to understand the UK labour market from the bottom-up", Bank of England, Staff Working Paper No.742, 07/2018.

20. H. Řihová, "Using Labour Market Information – Guide to Anticipating and Matching Skills and Jobs Volume 1", 2016, doi:10.2816/597770. More information on the project can be found here: http://www.cedefop.europa.eu/en/events-and-projects/projects/big-data-analysis-online-vacancies.

21. Science, technology, engineering, and mathematics.

22. I. Grinis, "The STEM Requirements of 'Non-STEM' Jobs: Evidence from UK Online Vacancy Postings and Implications for Skills & Knowledge Shortages", London School of Economics & Political Sciences, SRC Discussion Paper No 69,11 / 2016.

23. J. Djumalieva, A. Lima, C. Sleeman, "Classifying Occupations According to Their Skill Requirements in Job Advertisements", Nesta, ESCoE Discussion Paper 2018-04, ISSN 2515-4664, 03/2018. A. Lima, H. Bakhshi, "Classifying occupations using web-based job advertisements: an application to STEM and creative occupations", ESCoE Discussion Paper 2018-08, 07/2018, ISSN 2515-4664.

24. "An Open and Data-driven Taxonomy of Skills Extracted from Online Job Adverts", J. Djumalieva, C. Sleeman, Nesta, ESCoE Discussion Paper 2018-13, ISSN 2515-4664, 08/2018.

25. J. Djumalieva, C. Sleeman, "Which digital skills do you really need?", Nesta, 07/2018, https://media.nesta.org.uk/documents/Which_digital_skills_do_you_really_need.pdf.

26. Implicit requirements are commonly used by employers to hone the signals they send to job seekers. If there are skills and credentials that employers believe any well-qualified candidate would understand to be a part of the role, they may not be advertised in job adverts. For example, postings for nurses may not explicit list that a degree in nursing is required and rarely mention all of the list common to clinical skills that nurses perform such as inserting IVs, taking blood pressure measurement, and dressing wounds.

Digital Skill Categories

Our analysis of the digital occupations focuses on two main aspects of jobs – the type of digital skill requirements and the educational requirements of a position. For skill requirements, we have broken digital skills required by employers into two broad categories: baseline digital skills that open doors to digitally intensive jobs, and specific digital skills that allow people to advance along a digital career pathway. Given the wide spread of digital skills across all roles in the labour market, we found the distinction between baseline digital and specific digital skills useful to show that not all digital skills are the same. This helps to clarify which digital skills are commonly requested and therefore easily transferrable from one role to another and which digital skills are role- or sector-distinguishing, therefore functioning as a ticket to enter and progress on a particular career path.

Traditionally, digital skills have tended to be thought about through the lens of definitions and frameworks that are arrived at through consultations with experts[27]. These frameworks might start with a proposition of what the skills under a certain heading are for before seeking to identify what those skills might be. Importantly, this paper takes the opposite approach by beginning with the skills employers ask for.

The digital skills discussed in this report have been derived from employer needs expressed in job postings by grouping similar digital skills. Baseline digital skills, such as productivity tools, are the most common ones. They are considered a basic requirement and therefore don't necessarily provide a competitive advantage. To move ahead in a career, one should focus on what in this report are called 'specific digital skills'.

Baseline Digital Skills – We find that employers ask for a group of digital literacy skills in the vast majority of jobs across all sectors in the UK labour market. These are productivity software tools such as spreadsheets and word processing programs. In addition, they often serve as the foundation for more advanced digital positions and so are requested for jobs at all skill levels. The most common productivity software skills requested by UK employers are the Microsoft Office suite including Word, Excel, and PowerPoint. Because of their ubiquity, we have defined these as 'baseline digital skills'.

27. A good overview of a selection of these frameworks can be found in "Digital Skills for the UK Economy" (2016).

Specific Digital Skills – Other digital skills not found in the baseline category that are not required across the majority of jobs, but define or even dominate specific roles or sectors. Examples are software programs such as Adobe Photoshop for designers; AutoCAD for engineers and manufacturing workers; Salesforce for sales and marketing professionals; and computer programming and networking for IT professionals.

We have further broken down the specific digital skill category into seven clusters of related digital skills that are commonly required together to help job seekers qualify for jobs in a specific domain. The table below shows baseline skills and the seven clusters of specific digital skills along with sample skills and occupations related to each. All digital skills have been assigned to one of the clusters listed below.

Skill Levels

We have grouped all UK SOC occupations into three broad skill levels according to their educational requirements – low-skill, middle-skill, and high-skill jobs. These groups are based on the Regulatory Qualification Framework (RQF), a framework introduced by the UK government in 2015 to standardise size and level of qualifications regulated in England and Northern Ireland. Skill levels are defined as follows:

Table 1: Digital Skill Categories

Digital Skill Type	Digital Skill Cluster	Description	Common Occupations
Baseline	Productivity Software	Productivity software skills such as Word and Excel, Enterprise Resource Planning (ERP), Project Management Software, SAP	• Administrative Occupations • Customer Service
Specific	Software & Programming	Programming languages such as Java, SQL, and Python	• Programmers • Software Developers • Database Administrators
	Computer & Networking Support	Set up, support and manage computer systems and networks	• Network Administrators • Software Developers • IT User Support Technicians

Digital Skill Type	Digital Skill Cluster	Description	Common Occupations
Specific	Data Analysis	Data analysis tools like R or Stata, Big Data, Data Science	• Management Consultants • Economists • Statisticians • Business Analysts
	Digital Design	Digital production, graphic design, online advertising skills	• Marketing Associate Professionals • Graphic Designers
	CRM	CRM software, such as Salesforce or Microsoft Dynamics	• Sales Professionals • Marketing Associate Professionals • Customer Services Managers
	Digital Marketing	Digital marketing technologies, such as social media platforms and analytics tools, such as Google Analytics	• Sales & Marketing Professionals • Marketing Associate Professionals • HR Officers
	Machining & Manufacturing Technology	Machining and engineering software and tools such as CNC machining and computer-aided design	• Machine Operators • Civil Engineers • Quality Control and Planning Engineers

Table 2: Skill Levels

Skill Level	RQF Levels included	Example qualifications
Low-Skill	Entry level, Level 1, Level 2	Entry level certificate, GCSE, Level 1/2 certificate, intermediate apprenticeship, Functional Skills[28]
Middle-Skill	Level 3, Level 4, Level 5	A level, Advanced Apprenticeship, Higher National Certificate (HNC), Higher National Diploma (HND)
High-Skill	Level 6, Level 7, Level 8	Degree Apprenticeship, Bachelor's Degree, Master's Degree, Postgraduate Degree, PhD

28. UK Standard Occupation Classification that classifies jobs based on skill level and skill content. (https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc).

29. Jeremy Benson, "Explaining the RQF", The Ofqual blog, 2015, https://ofqual.blog.gov.uk/2015/10/01/explaining-the-rqf/.

30. Ofqual, "Criteria for Functional Skills Qualifications", Ofqual/12/5127, 2012, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/371128/2012-01-16-criteria-for-functional-skills-qualifications.pdf.

2.

The Importance of Digital Skills

Digital Skills Drive Career Advancement, Increase Pay and Better Prepare Workers for a Changing Labour Market.

Digital Skills are Important at Every Level

Digital skills are not only required for high-skill jobs. They are now called for across the full span of the labour market ranging from entry-level call centre workers to sophisticated information technology roles. The Government's Digital Strategy also recognises this important point, acknowledging that the benefits of digitalisation are not limited to the 'traditional tech sectors' and that digital transformation can make every business in every sector more productive.[31]

Digital skills are required by employers in occupations across all skill levels at similar frequencies. Even amongst low-skill jobs, three quarters of postings are in digital occupations, increasing to 85% of middle-skill jobs and 83% of high-skill jobs. Job seekers who do not possess in-demand digital skills risk consigning themselves to a narrow sliver of the job market.

Digital skills are found in a surprisingly broad range of roles. As an example, while spreadsheets are commonly viewed as the domain of consultants and financial professionals, the occupations most likely to explicitly call for Microsoft Excel skills are decidedly less analytical roles, such as administrative assistants and human resources assistants. Blue collar and service roles also commonly use digital skills; forklift drivers and warehouse workers often need to know how to use inventory

Table 3: Demand by Skill Level

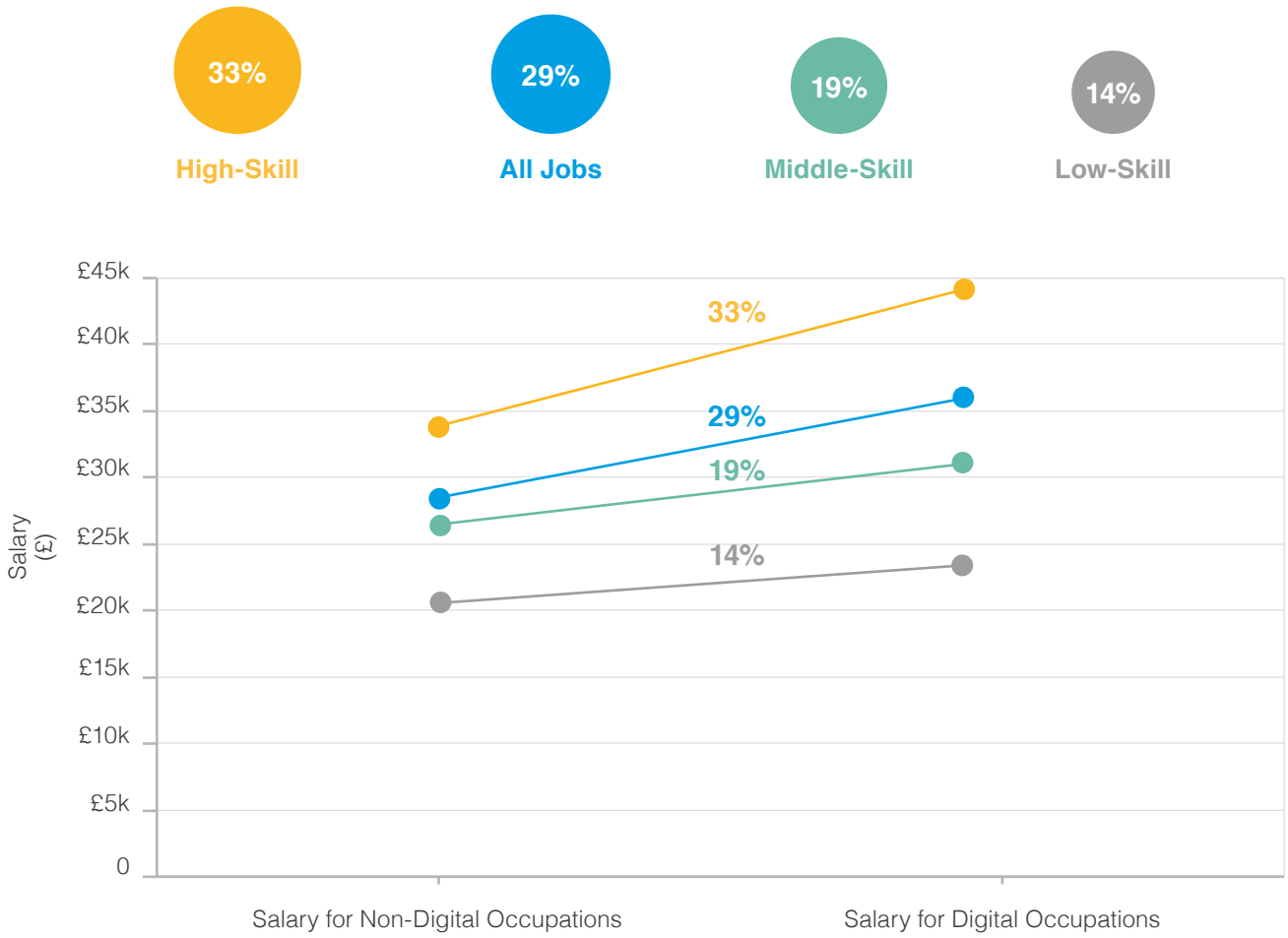
Skill Level	Total Number of Job Adverts	Job Adverts in Occupations Requiring Digital Skills	% of Job Adverts in Occupations Requiring Digital Skills
Low-Skill	2,111,889	1,629,017	77%
Middle-Skill	2,602,348	2,214,109	85%
High-Skill	4,685,953	3,873,377	83%
All Jobs	9,400,191	7,716,503	82%

31. DCMS, "4. The wider economy – helping every British business become a digital business", Policy Paper, 2017, https://www.gov.uk/government/publications/uk-digital-strategy/4-the-wider-economy-helping-every-british-business-become-a-digital-business.

management systems such as SAP, and retail workers need to use point-of-sale systems.

Further, job seekers with digital skills can command higher salaries. Overall, roles requiring digital skills pay 29% over those roles that do not. This difference is apparent at all skill levels with the differential growing at higher levels. The salary differential for digital skills ranges from 14% for low-skill roles, 19% for middle-skill roles and 33% for high-skill roles.[32]

Figure 1: Annual Salary by Skill Level



32. It should be noted that, although vacancy data shows a clear correlation between digital skills and higher salaries, this does not have to signify direct causation as there might, conceivably, be other factors playing a role in the wage gap that vacancy data is unable to explore, such as other educational backgrounds or specific experience or the location of the job.

Specific Digital Skill Clusters

Software & Programming

Computer & Networking Support

Data Analysis

Digital Marketing

Customer Relationship Management Software

Digital Design

Machining & Manufacturing Technology

While baseline digital skills are vital across all occupations, specific digital skills serve as a ticket to middle- and high-skill jobs. Their importance in increasing access to higher-skill jobs, better pay, and faster-growing jobs makes them a critical focus area for skills policy.

Many middle- and high-skill occupations have a key digital skill area that lies at the heart of the job. Designers need to be fluent in software programs like Adobe Photoshop; AutoCAD is a core skill for engineers; and Customer Relationship Management tools such as Salesforce and Microsoft Dynamics are an integral part of sales and marketing

Table 4: Annual Digital Demand by Skill Level

Skill Level	Baseline Digital (% of job adverts in occupations requiring baseline digital skills)	Specific Digital (% of job adverts in occupations requiring specific digital skills)	All Digital (% of of job adverts in occupations requiring digital skills in either category)
Low-Skill	74%	29%	77%
Middle-Skill	83%	59%	85%
High-Skill	75%	67%	83%
All Jobs	77%	56%	82%

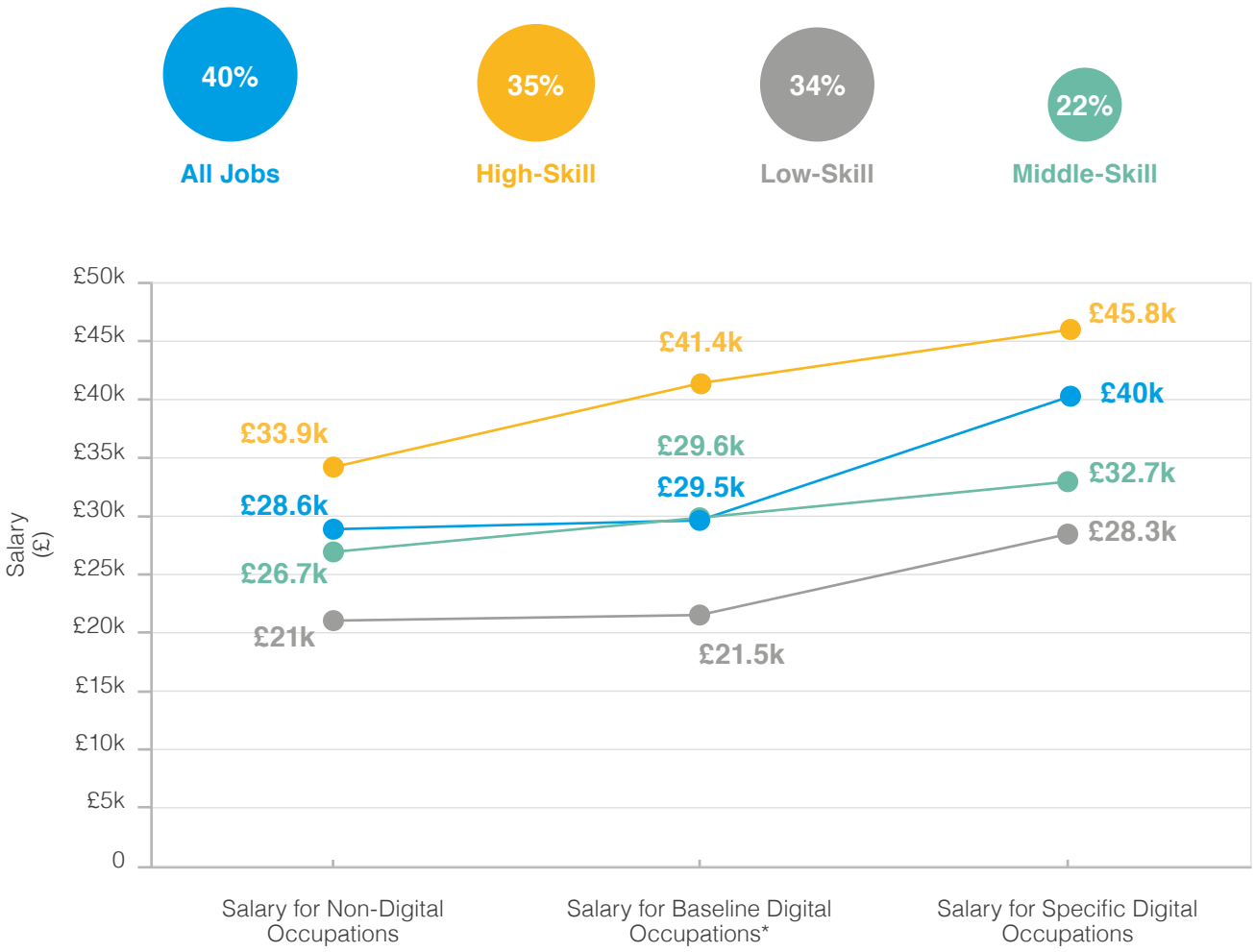
Note: The two categories 'baseline digital' and 'specific digital' are not mutually exclusive. An occupation can require both baseline and specific digital skills.

professionals' daily workflow. Using UK job adverts, Burning Glass has identified seven commonly requested clusters of specific digital skills, which are critical for job seekers looking to advance their careers and gain entry to higher-skill and higher-paying roles. One or more specific digital skills are required in 18% of low-skill jobs, 59% for middle-skill jobs and 67% for high-skill jobs.

In their job postings, employers express a willingness to reward job seekers equipped with specific digital skills. In an increasingly technical economy, these skills are critical to boosting earnings potential. Overall, jobs

Figure 2: Annual Salary by Skill Level, Baseline vs Specific Digital Skills

Specific Digital Salary Differential**



Note: Salaries given in the table represent weighted average salary per year based on the salary listed by employers in job adverts.
*Salary given is for occupations that only require baseline digital skills and no specific digital skills.
** Salary differential compares salaries for non-digital and specific digital occupations.

requiring specific digital skills offer salaries 40% higher over non-digital jobs (£40,000 vs £28,600). At individual skill levels, job seekers with specific digital skills can earn between a quarter and a third more.

Career advancement in the digital world is not exclusively for job seekers with specific IT or computer programming knowledge but can also be achieved through digital marketing skills or understanding customer relationship management software. In middle-skill jobs, a fifth of openings ask for digital marketing skills and 11% value CRM skills. The range of occupations calling for specific digital skills and the specific skills needed for advancement are discussed further in Part 3, which is designed to tactically inform skills policy development.

Specific Digital Skills and the Future of Work

The rise of technology in the job market has sparked intense debate about the future of work: Will digital technology create jobs, redefine them, or destroy them? On one hand, as this report shows, digital skills have become an unavoidable necessity for job seekers looking to get ahead. At the same time, automation and artificial intelligence are expected to disrupt the job market in the coming years. A seminal analysis by Oxford researchers Carl Benedikt Frey and Michael Osborne (2013) found that 47% of jobs in the US are at risk of being automated in the coming decades. Later analysis focused on the UK found a slightly lower proportion of jobs at risk, at 35%.[33] Frey and Osborne describe the risk of automation for given occupations as ones that "are potentially automatable over some unspecified number of years, perhaps a decade or two".[34] We apply Frey and Osbornes' occupation-based results to job posting data by mapping O*Net occupations to UK SOC occupations to assess the role of digital skills in understanding automation risk. We find that automation risk is influenced by two factors – skill level and digital skill category. Both are negatively correlated with risk of automation. Jobs with higher skill level requirements have lower automation risk. Jobs defined by 'specific digital skills' are at lower risk of automation compared to positions requiring baseline skills only.

33. C. B. Frey, M. A. Osborne, London Futures – Agiletown: The Relentless March of Technology and London's Response – Deloitte, 2014, https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/uk-futures/london-futures-agiletown.pdf.

34. While Osborne and Frey's analysis focuses on jobs in the US, the high degree of similarity between the US and UK labour markets allows us to infer that the automation risk in the UK is similar. ("The Future of Employment", C.B. Frey, M. Osborne, 2013, https://www.oxfordmartin.ox.ac.uk/downloads/academic/future-of-employment.pdf).

Table 5: Risk of Automation across Skill Levels[36]

Skill Level	All Jobs (Aggregated automation risk of all job adverts)	Baseline (Aggregated automation risk of job adverts in occupations requiring baseline digital skills)	Specific Digital (Aggregated automation risk of job adverts in occupations requiring specific digital skills)
Low-Skill	71%	80%	60%
Middle-Skill	43%	57%	38%
High-Skill	19%	37%	18%
ALL JOBS	37%	61%	29%

Note: Risk of automation score has been weighted by the size of demand for the respective group. Frey and Osborne (2013) found an overall automation risk of 47% of in their paper. The analysis of this paper is based on job openings and therefore represents the job market from the forward-looking employers' point of view. The overall automation risk is therefore lower.

The type of digital skills demanded in a job plays an important role. Advances in technology have automated tasks that were initially created by the dissemination of digital tools, in particular productivity software. Jobs requiring only baseline digital skills therefore have the greatest automation risk, with 80% of these roles potentially being automatable.[35] These include roles such as administrative jobs, basic finance positions such as bookkeepers, and front-office positions that apply digital skills to routine tasks, which are most easily automated.

At the middle- and high-skill level, the automation risk to workers declines by 33% and 51%, respectively, compared to jobs requiring only baseline digital skills. A job focused on specific digital skills at a high-skill level is least likely to be performed by a machine in the future. The increasingly automated future requires more digital skills, especially more specific ones. As discussed in the previous section, specific digital skills also make moving up the skill level ladder easier.

35. Automation risk is a likelihood that a job can be automated by existing technology in the coming years. The authors do not make a prediction about how many jobs will specifically decline due to the number of additional inputs into such a mode including labour costs, technology costs, regulations etc.

36. Automation risk in the tables above is calculated as a weighted average of the occupation level automation risk determined by Frey and Osborne.

Specific Digital Skills in Context

The importance of specific digital skills in decreasing automation risk is explained by the complementary nature between these skills and unique human skills which they activate. For example, software tools such as Photoshop and AutoCAD facilitate design and creativity, two skills which are not automatable. Programming and IT networking skills are the human side of firms' efforts to automate key tasks.

A recent analysis by David Deming of Harvard University found that over the last generation the fastest growing occupations are those which have both high social skill and high technical skill requirements.[37] Technical skills do not exist in isolation. Even roles which seem explicitly technical have robust demand for employability skills. A quarter of skills mentioned in IT postings are for employability skills and, among IT support staff, communication is the third most requested skill. Employers desire and demand entry-level workers with both the technical skills and the employability skills related to a given occupation.

37. D J. Deming, "The Growing Importance of Social Skills in the Labor Market", 2017, https://scholar.harvard.edu/files/ddeming/files/deming_socialskills_aug16.pdf.

3.

Digital Skill Demand Across Locations and Firms

Digital skills are important across the UK economy – locations, firms, and sectors. Here, we look at the distinctive skill profiles associated with each of these levels of analysis. These analyses, along with the complete set of tables in the appendices, can be used to inform thinking about skill needs at a local and industry-specific level.

Digital Skills are Required Everywhere, but the Specific Skills are Local

Government reports have linked specialisation of a region to economic growth.[38] The trend at a regional level across the UK over the last few years goes towards relative specialisation, according to an ONS report examining historical, regional growth. Our analysis of vacancy data highlights regional hubs across the UK. The skills in demand and therefore the potential focus areas of skill development vary substantially from place to place.

Unsurprisingly, urbanised areas have a greater intensity of digital skill demand. The Greater London region comes out on top as 87% (6% points above the UK average) of all jobs posted in the capital's region are in digital occupations. Among English regions, the West Midlands comes second with an intensity of digital skill demand of 81%.[39]

Looking at digital occupations across England, we find digital skills are of high importance in all regions and Local Enterprise Partnerships (LEPs). At least 75% of job openings in each of the regions are in digital occupations and at the LEP level, 34 of all 38 LEPs[40] meet this same threshold. Variation in the digital demand concentration by specific digital skill cluster across the LEPs is driven largely by the industrial composition of the local economy.

Greater London stands out due to the strong presence of digital design jobs in the creative economy and data analysis jobs related to the finance sector. Three industries that require digital skills: Finance and Insurance Activities; Information and Communication; and Professional, Scientific and Technical Activities account for 37% of London's gross value added (GVA)[41], more than double that of every other region except the South East. This specialisation may be key to the capital's success. The Krugman index, an indicator used to evaluate two geographical areas in terms of employment share across industries, illustrates that London's industry composition differs highly from every

38. C. Campos, "Examining regional gross value added growth in the UK: 1998 to 2016", ONS, April 2018, https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/compendium/economicreview/april2018/examiningregionalgrossvalueaddedgrowthintheuk1998to2016.

39. When including other nations, Northern Ireland comes in second after Greater London, ahead of the West Midlands.

40. There are 38 LEPs covering all of England. They are local business led partnerships between local authorities and businesses and play a central role in determining local economic priorities and undertaking activities to drive economic growth and the creation of local jobs.

41. T. Fenton, "Nominal and real regional gross value added (balanced) by industry", ONS data set, 12/2017, https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/nominalandrealregionalgrossvalueaddedbalancedbyindustry.

42. S. Chapman, Krugman index matrix, ONS data set, March 2017, https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/krugmanindexmatrix.

other area in the UK.[42] Correspondingly, job demand data shows that the London LEP leads the nation in terms of digital intensity, with 87% of job openings in digital occupations. Furthermore, London has a high concentration in nearly every specific digital skill cluster. The digital demand concentration is highest in data analysis, digital marketing, and software and programming, reflecting the high value of these skills in the high cost real estate of the capital. The digital demand concentration for machining and manufacturing technology is quite low in London. Given the unique composition of London's industry mix and labour market, digital skills training in the capital should differ substantially from other regions.

Just outside of London, Thames Valley LEP presents itself as an IT powerhouse. Centred around the tech hub of Reading, its IT industry is the largest contributor with 24% of local GVA – the largest IT sector share across all LEPs. It was also among the top five in terms of per capita GVA.[43] Digital demand is between 5% (software and programming skill cluster) and 16% (CRM skill cluster) above UK average and spread across six of the eight of the specific digital skill clusters defined in this report, illustrating how specialisation can help boost growth of a local area.

In the East of England, digital jobs cluster around Cambridge and Peterborough. Given its historical base as a university research centre and engineering hub, it's not surprising to find that the Greater Cambridge and Greater Peterborough LEP has 84.1% of job openings in digital occupations. With an annual average GVA growth rate of 4.1% between 1997 and 2015[44], placing it in the top five based on annual GVA growth, it is a well-established growing hub. The digital demand concentration within Greater Cambridge and Greater Peterborough LEP is distributed between computer and network support, machining and manufacturing technology, and data analysis – diverse demand reflecting the broad range of technologies represented by employers in this location. Silicon Fen (or the Cambridge Cluster) is home to a large cluster of high-tech businesses focusing on software, electronics and biotechnology. Many of these businesses have connections with the University of Cambridge, and the area is one of the most important technology centres in Europe.[45]

The West Midlands region owes a large part of its digital intensity to a high concentration of demand for machining tools used in manufacturing and engineering. West Midlands' mix of traditional and advanced manufacturing has had a yearly average

43. T. Fenton, “Regional gross value added (income approach), UK: 1997-2015, ONS Statistical Bulletin, 12/2016, https://www.ons.gov.uk/economy/grossvalueaddedgva/bulletins/regionalgrossvalueaddedincomeapproach/december2016

44. R. Prothero, “Gross value added for local enterprise partnerships in England: 1997 to 2015”, ONS, 02/2017, https://www.ons.gov.uk/economy/grossvalueaddedgva/articles/gvaforlocalenterprisepartnerships/1997to2015#interpreting-the-data

45. Cambridge Ahead, “Latest data from Cambridge Ahead reveals unabated growth of Cambridge companies”, 01/2017, http://www.cambridgeahead.co.uk/news-media/2017/latest-data-from-cambridge-ahead-reveals-unabated-growth-of-cambridge-companies/

46. C. Campos, “Examining regional gross value added growth in the UK: 1998 to 2016”, ONS, 04/2018, https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/compendium/economicreview/april2018/examiningregionalgrossvalueaddedgrowthintheuk1998to2016

47. R. Prothero, Percentage share of nominal GVA by industry and LEP calculations based on “GVA for Local Enterprise Partnerships”, ONS data set, 02/2017, https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/gvaforlocalenterprisepartnerships

48. https://siliconcanal.co.uk/

49. R. Prothero, “Gross value added for local enterprise partnerships in England: 1997-2015”, ONS, 02/2017, https://www.ons.gov.uk/economy/grossvalueaddedgva/articles/gvaforlocalenterprisepartnerships/1997to2015

50. http://www.mediacityuk.co.uk/

growth of 9% since 2010, the fastest post-recession growth of any UK region.[46] A more in-depth analysis of the West Midlands region reveals two local hotspots – Greater Birmingham and Solihull LEP, and Coventry and Warwickshire LEP.

In Coventry and Warwickshire, 86% of all job openings are in digital occupations. This importance is highlighted by Coventry and Warwickshire having by far the highest digital demand concentration for machining and manufacturing technology across all LEPs. The manufacturing industry has the largest nominal GVA in this LEP accounting for 16% (£3,636 million) of the total GVA, well over the national average of 13%.[47]

Reflecting Birmingham's manufacturing history, demand concentration in Birmingham is highest for machining and manufacturing technologies. However, over the last 10 years Birmingham has been reinvented as one of the UK's major digital hubs, with more than 6,000 tech firms employing some 38,300 people.[48] It was among the top three fastest-growing LEPs in 2014-2015 according to an ONS analysis of economic growth at LEP level. The financial sector contributed significantly to this boost as its nominal GVA value grew by 10% during that time period.[49] Digital demand concentration confirms that non-manufacturing digital sectors are all equally strong, providing a diverse and robust basis for economic growth. This likely contributed to Birmingham's rapid economic expansion over the last years.

Creative jobs are another hotspot for digital skills and are well represented in the Greater Manchester LEP in the North West of England by skill clusters like digital marketing, digital design, and CRM. The city owes part of its digital economy to 'MediaCityUK', which is promoted as one of most advanced broadcasting hubs in Europe.[50] A report from Nesta on the creative landscape in the UK identified Manchester as a creative hub with both high concentration and growth of creative businesses. Burning Glass vacancy data confirms this, with digital demand concentration for digital marketing and digital design 5% and 3% above UK average, respectively.

The specific digital skill clusters differ in how localised the demand for each is across the LEPs. The demand for machining and manufacturing technologies is very highly localised around several hubs, the most obvious being Coventry and Warwickshire; Black Country; Worcestershire; Gloucestershire; and Leicester and Leicestershire. It is perhaps unsurprising that the growth of digital technologies associated with manufacturing

will be concentrated in locations where there has been a history of (and infrastructure to support) manufacturing. In contrast, the demand for CRM skills is not particularly localised. There is only a relatively small difference between digital demand concentration for CRM in Thames Valley Berkshire, and Coventry and Warwickshire, the two LEPs that represent the highest and lowest demand for this specific digital skill cluster.

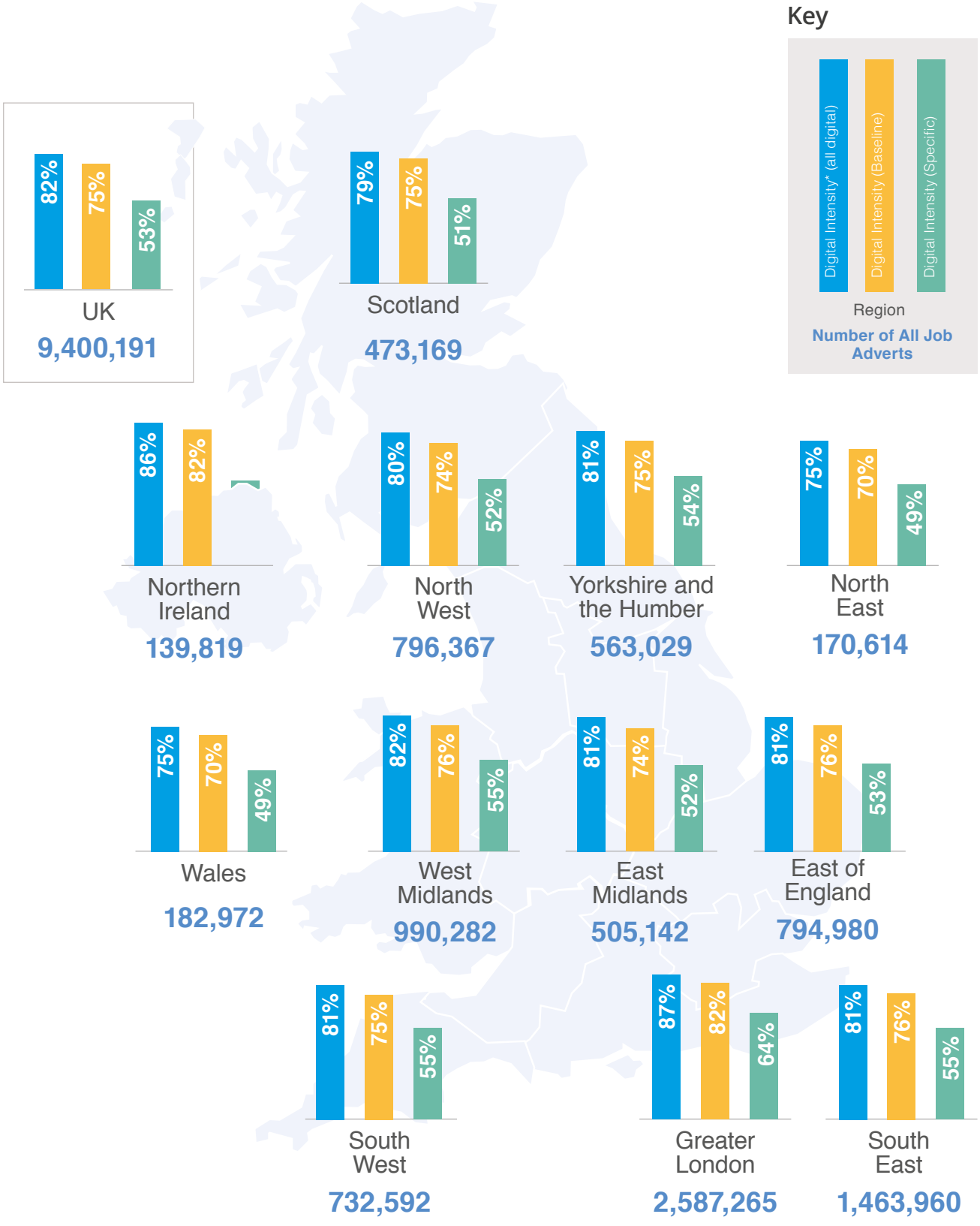
Looking beyond England, Northern Ireland presents itself with a strong overall digital intensity. Taking a closer look at the type of digital skills, however, shows that the local economy focuses on baseline digital skills and has relatively low demand in specific digital skills. This is in part due to the composition of the local economy where Public Administration and Defence and Human Health and Social Work Activities are overrepresented (18% of GVA, 50% higher than the overall UK share of 12%).[51] These industries are more likely to hire for baseline digital skills than advanced digital skills, leaving workers with less access to well-paying, high-growth digital roles and more exposed to the potential risk of automation.

More generally, regional variation can be exploited by educators and programme developers to prepare students for the distinctive skills in their region and by economic developers to create clusters of valuable talent to attract and retain employers. The implications section further discusses how this information can be used to develop and execute a localised skills policy aligned to regional labour market demand.

For full details on digital demand across the Local Enterprise Partnership areas, see data appendix.

52. T. Fenton, Regional gross value added (balanced), UK: 1998 to 2016, 12/2017, https://www.ons.gov.uk/economy/grossvalueaddedgva/bulletins/regionalgrossvalueaddedbalanceduk/1998to2016.

Figure 3: Digital Intensity by Region and Nation



*Digital Intensity indicates the percentage share of job adverts in digital occupations within the total number of job adverts for a region / nation.

Figure 4: Digital Demand Concentration by Digital Skill Cluster and Region/ Nation*

Greater London

Software & Program	1.12
Computer & Networking	1.04
Data Analysis	1.27
Digital Marketing	1.15
CRM	1.05
Digital Design	1.13
Machinery Tech	0.36
Productivity	1.01

South East

Software & Program	0.98
Computer & Networking	1.02
Data Analysis	0.96
Digital Marketing	1.01
CRM	1.06
Digital Design	0.95
Machinery Tech	0.94
Productivity	1.00

North West

Software & Program	0.94
Computer & Networking	0.97
Data Analysis	0.89
Digital Marketing	1.01
CRM	1.04
Digital Design	1.00
Machinery Tech	0.93
Productivity	1.00

West Midlands

Software & Program	0.95
Computer & Networking	0.96
Data Analysis	0.79
Digital Marketing	0.94
CRM	0.98
Digital Design	0.98
Machinery Tech	1.92
Productivity	0.99

East of England

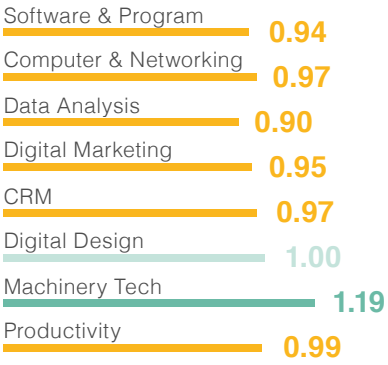
Software & Program	0.94
Computer & Networking	0.96
Data Analysis	0.87
Digital Marketing	0.92
CRM	0.97
Digital Design	0.95
Machinery Tech	1.23
Productivity	1.00

South West

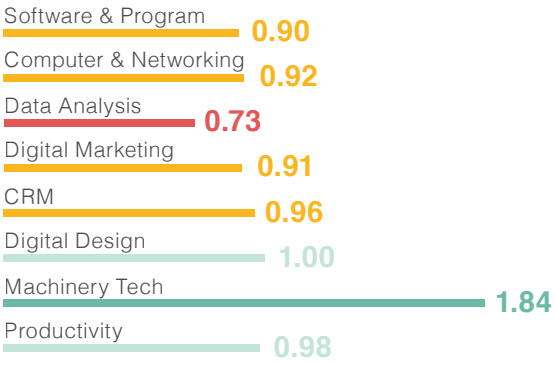
Software & Program	0.99
Computer & Networking	1.08
Data Analysis	0.97
Digital Marketing	0.87
CRM	0.92
Digital Design	0.98
Machinery Tech	1.37
Productivity	0.99

* Demand concentration shows how concentrated digital demand is within a geography in relation to the number of job adverts in digital occupations. UK-wide average digital demand equals 1.0; an LQ of 1.2, for example, indicates 20% higher demand for that digital cluster than the UK average (or 1.2 times the UK concentration).

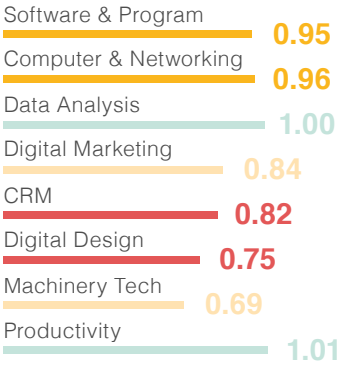
Yorkshire and the Humber



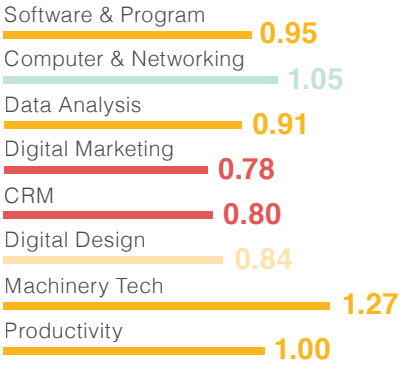
East Midlands



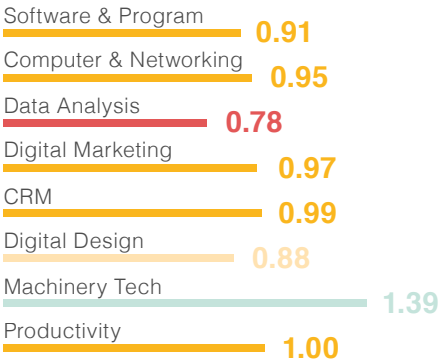
Scotland



Wales



North East



Northern Ireland

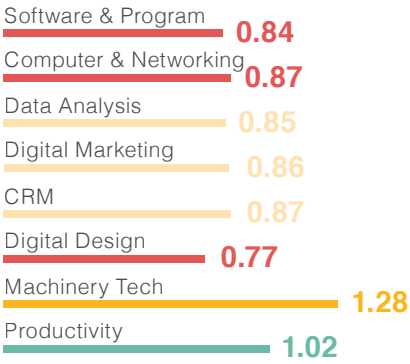


Table 6: Digital Intensity by Industry Sector

Industry Sector*	Total Number of Job Adverts	Only Baseline Digital (Percent of job adverts in occupations requiring only baseline digital skills)	Specific Digital (Percent of job adverts in occupations requiring specific digital skills)	All Digital (%)
Financial and Insurance Activities	590,427	29%	66%	95%
Manufacturing	1,343,704	26%	69%	95%
Electricity, Gas, Steam and Air Conditioning Supply	36,421	25%	71%	95%
Information and Communication	425,115	16%	79%	95%
Water Supply; Sewerage, Waste Management &	61,444	26%	69%	95%
Real Estate Activities	205,363	49%	45%	93%
Professional, Scientific and Technical Activities	1,110,747	29%	64%	93%
Agriculture, Forestry and Fishing	16,373	34%	59%	92%
Mining and Quarrying	26,692	20%	68%	88%
Administrative and Support Service Activities	343,033	21%	65%	86%
Transportation and Storage	204,950	36%	50%	85%
Public Administration & Defence; Compulsory Social Security	364,157	31%	51%	82%
Construction	182,236	31%	49%	80%
Activities of Households as Employers; Undifferentiated Goods-and Services-Producing Activities of Households for Own Use	47,603	23%	56%	79%

* (Percent of job adverts in occupations requiring only baseline digital skills).

Industry Sector*	Total Number of Job Adverts	Only Baseline Digital (Percent of job adverts in occupations requiring only baseline digital skills)	Specific Digital (Percent of job adverts in occupations requiring specific digital skills)	All Digital (%)
Wholesale and Retail Trade; Repair of Motor Vehicles & Motorcycles	848,226	32%	47%	79%
Other Service Activities	146,756	28%	48%	76%
Arts, Entertainment and Recreation	233,531	21%	34%	56%
Accommodation and Food Service	511,686	22%	27%	49%
Education	881,312	17%	21%	38%
Human Health & Social Work Activities	1,820,416	18%	16%	34%

* This table shows industry sectors at the 1-digit level. More detailed data at the 2-digit level can be found in the appendix.

Role of Digital Skills Across Sectors and Firm Sizes

We find digital skills are in demand across sectors with particularly intensive requirements in the technology and service industries. For example, firms in the Financial and Insurance and IT and Communication sectors almost exclusively hire for digital jobs. Both are large contributors to the economy in terms of GVA, which further highlights the importance of digital skills. Health Care has the largest share of UK demand but has a relatively low proportion of digital demand with only one-third of jobs being in digital occupations.

Digital skills are also in demand[54] across all sizes of firms. We categorised UK firms into small, medium and large based on overall job demand. Firms across all three categories demand digital skills in at least 70% of jobs. Digital skills, however, are more commonly requested by larger firms, which may be a result of increased digital and IT sophistication. As highlighted in the introduction, digital firms are growing faster than the economy overall. Developing the digital skills of workers in small- and medium-sized enterprises may be a strategy to increase growth of these entrepreneurial firms. However, this bottom up approach might not be enough. One could argue that the head of the company also needs to provide digital leadership to take full advantage of the benefits that come with digitalisation.

Table 7: Digital Intensity by Company Size

Company Size	Only Baseline Digital (Percent of job adverts in occupations requiring only baseline digital skills)	Specific Digital (Percent of job adverts in occupations requiring specific digital skills)	All Digital (%)
Small	56%	48%	72%
Medium	61%	55%	76%
Large	63%	57%	79%

54. Company size has been defined based on overall job demand where small includes companies having less than 25 job adverts per year, medium includes companies with 25 – 250, and large any companies with more than 250 postings.

4.

Key Digital Skills to Advance Careers

In order for job seekers to capitalise on the benefits of the digital economy, they must do more than focus on just developing baseline digital skills. Job seekers also need to identify the specific digital skills that are called for in their chosen career stream. Having the right skills can make the difference in gaining a job that launches a career.

In this section, we will address the specific digital skills that are needed to advance one's career. We will look at each of the digital skill clusters and provide a rich set of data that can inform the development of a skills policy specifically focused on skills that have the greatest impact for job seekers.

The table below provides a brief overview of how each of the digital skills clusters rank across the four dimensions we cover in this report: magnitude of demand; versatility; projected growth; and average advertised salary. These four dimensions allow us to create a profile of the digital skill clusters based on demand side data. This helps answer questions that can help inform skills policy decisions including (but not limited to): What are the core competencies in this field? In how many job openings do employers ask for these skills?

Table 8: Overview of Digital Skill Clusters

Skill Cluster	Total Number of Job Adverts	Percentage Share of Digital Demand	Versatility	Average Salary p.a.	Projected Growth (5 years)
Productivity Software	5,616,911	80%	Very high (0.92)	£34,700	Stable (+7%)
Programming	4,109,656	58%	Low (0.29)	£54,900	Stable (+4%)
Computer and Networking Support	2,261,307	32%	Average (0.43)	£47,600	Declining (-13%)
Data Analysis	1,786,948	25%	High (0.64)	£52,300	Fast (+33%)
Digital Marketing	1,380,020	20%	Average (0.51)	£34,100	Fast (+26%)
CRM	1,204,558	17%	Very high (0.84)	£37,600	Fast (+15%)
Manufacturing and Machining Technology	762,376	11%	Average (0.35)	£38,600	Stable (-8%)
Digital Design	663,045	9%	Average (0.56)	£37,400	Stable (-9%)

Note: Skill clusters are not mutually exclusive. Percentages therefore do not add up to 100%.
Percentage Share of Digital Demand is calculated as the number of job adverts in digital occupations focusing on the respective digital skill cluster divided by the total number of all job adverts in digital occupations. Versatility is a score based upon a Gini ratio of skill frequency and occupation / skill combination frequency. It indicates how broad the range of occupations is for which a skill is relevant. Average Salary is the mean advertised salary p.a. as specified across groups of job postings weighted with posting numbers. Projected Growth predicts future demand for skills based on an econometric model developed by Burning Glass. See methodology section for more details.

Are there any other skills (digital, non-digital, employability skills) that are needed to create a successful skill portfolio? Which skills can be applied across a large variety of occupations? What are emerging or trending skills that will be relevant in the future? How much are employers willing to pay for digital skills?

Productivity Software

5,616,911 postings

£34,700 average salary

80% of digital demand

25% low-skilled
28% middle-skilled
47% high-skilled

+7% stable project growth

0.92 very high versatility

Encompasses transferable or baseline digital skills that are not specific to any one role. Examples include the use of productivity software such as Microsoft Office suite, project management software or enterprise resource planning.

Productivity skills, which make up the baseline digital skills category[55], are in highest demand – requested in 5.6 million jobs annually or over 80% of all digital jobs. Not surprisingly, these skills are also the most versatile, which means they are relevant in the broadest set of occupations. Other skill clusters that are highly versatile include data analysis skills used in IT, finance, engineering and a broad range of other STEM and quantitatively oriented roles, and CRM skills that are used across sales and marketing roles. The highest-paying skill clusters – programming, data analysis, and computer networking and support – are commonly associated with technology jobs. The salary for the productivity software cluster is relatively

55. The baseline digital skill cluster consists of productivity software, some of which might be used in a more advanced way, e.g. Excel. We have included the subskills of Excel in the productivity category. Like many skills in the labour market, Excel is demanded at varying levels of proficiency in different roles. We have worked to highlight occupations where varying levels of productivity are required, but do not adjust the framework on that basis.

56. For details, see methodology section in the appendix.

high at £38,000 p.a. However, this includes both occupations that require only baseline digital skills as well as occupations that ask for both baseline and specific digital skills. The latter ones will boost the salary as specific digital skills have a higher value.

To assess future demand for skills, Burning Glass has developed a skills projections model.[56] This model identifies data analysis and digital marketing skills as the two clusters likely to grow fastest over the next five years. This highlights the increasing importance of data in the job market as data analysis skills are, of course, focused on analysing data directly, while digital marketing skills are becoming more important because of the increased usage of platforms such as Google Analytics to quantify marketing efforts.

The section below highlights key attributes of employer demand in each skill cluster and how demand for that skill fits within a broad occupational and labour market context. Tables containing detailed skills data can be found in the appendix.

Productivity software skills form the baseline digital skills category and include skills such as Microsoft Office, which are the largest and most versatile digital skills. Requests in job postings for these skills are a dual signal: they highlight that employers expect job seekers to know the specific software tools, and they serve as proxies for the ability to use digital tools in a professional context, such as using Microsoft Word to write professional memos, create well-formatted documents, and to use Excel as a way to organise information in tables and conduct basic manipulations of that data as part of project and process management.

Productivity software skills are requested for positions across a broad range of sectors. As described in the box above, they are required in 155 out of 369 SOC occupations, nearly two-thirds (63%) of online job adverts in the UK, and 80% of the job adverts for digital occupations. The higher the skill level, the less likely it is for a posting to ask for productivity skills as it is assumed that candidates possess these. Microsoft Excel is the most commonly requested productivity software skill, followed by other elements of the Microsoft Office Suite, and Enterprise Resource Software Systems such as SAP and Oracle. They are in demand across low-, medium-, and high-skill roles and are required at differing levels of proficiency based on the duties commonly associated with the role.

Productivity software skills are required across a broad range of roles including administrative positions such as executive assistants and human resource assistants

This includes use of Excel for light data tasks such as managing and sorting lists and small data sets. In these roles, Excel is a complementary tool to aid a role where organisation and planning are skills critical to success. By the same token, Microsoft Word is a tool to enable communication, another essential baseline skill in these roles.

For financial analysts, Microsoft Excel plays a different role where it functions as a tool to execute the core business analyses that are part of the role. A high degree of proficiency is required for success, as evidenced by additional requirements such as advanced subskills of Excel such as VBA and Pivot Tables. In this context, Excel enables skills such as analysis, problem-solving and other technical skills such as Pricing Analysis and Financial Modelling.

Regardless of the job function, fluency in productivity software tools allows job seekers to become more versatile and effectively communicate, problem-solve, and organise work in an increasing digital workforce.

Programming and Software Development Skills

4,109,656 postings

£54,900 average salary

58% of digital demand

3% low-skilled
26% middle-skilled
71% high-skilled

+4% stable project growth

0.29 low versatility

The programming and software development skill cluster relates to writing computer code for a range of activities such as developing websites, building software, video games development, or analysing data. It includes computer programming languages (such as C++ or JavaScript) along with software development, such as web development and mobile application development.

The programming and software development skill cluster represents the largest specific digital skill cluster, encompassing more than half of digital demand. The most popular skills in the cluster include Java, which is a common multi-purpose programming language; SQL, which is used for managing databases; and JavaScript, which is used for web development. Programming and software development is the highest paying skill cluster, with an average advertised salary of £54,900 p.a.

Importantly, programming skills are in demand outside of software developers and other similarly high-skill roles. In fact, 68% of postings for occupations focused on software and programming skills can be found in non-IT roles. A third of the roles where programming skills are required can be found in middle-skill occupations. These include Engineering Technicians and Graphic Designers. These roles pay £31,700 p.a. and £31,000 p.a., which places them in the 50th percentile of all middle-skill occupations in terms of salary, while accounting for 8% and 3% of middle-skilled jobs in the cluster.

Programming skills have value and versatility across a range of job categories, including many outside of IT. For example, SQL, the most common database programming language, is now among the top 20 skills for marketing analysts and financial analysts, which are not traditionally viewed as programming roles. Additionally, the skills offer a salary differential to users. Employers offer a 23% salary differential for marketing analysts positions requiring SQL skills (£43,200 p.a. vs £35,300 p.a. average salary overall). For financial analysts, the differential for knowing SQL is 25% (£51,900 p.a. vs £41,300 p.a. overall).

Programming skills are not required in isolation. In IT roles, 25% of the skills required are employability skills, such as communication, teamwork, and problem-solving.[57] Communication skills are the number one employability skill required in IT roles, and one in four software development related job adverts specify it.

We find that many of the largest and most important skills in this cluster today are at the peak of their demand and are expected to decline slightly in the coming years[58]

57. Burning Glass, "The Human Factor: The hard time employers have finding soft skills", 2015, https://www.burning-glass.com/wp-content/uploads/Human_Factor_Baseline_Skills_FINAL.pdf.

58. D. J. Deming, K. Noray, "STEM Careers and Technological Change", 09/2018, https://scholar.harvard.edu/files/ddeming/files/demingnoray_stem_sept2018.pdf.

because of the high pace of change in the IT industry. These skills, such as SQL and Java, will nevertheless remain important gateways into IT professions. The skills that add the most value to job seekers' portfolios are faster growing skills such as NoSQL databases (e.g. MariaDB) and DevOps skills (e.g. Ansible and Docker). Job seekers looking to stay ahead should make sure they possess a blend of core programming skills and newly emerging skills.

Computer and Networking Support

2,261,307 postings

£47,600 average salary

32% of digital demand

2% low-skilled
22% middle-skilled
77% high-skilled

-14% declining project growth

0.43 average versatility

Computer and networking support skills are used to maintain and manage computer networks. This cluster includes general networking skills involved in the building and maintenance of a computer network – configuration, systems, security, and the provision of technical support to network users.

Computer and networking support skills provide a valuable entry point into the IT workforce for middle-skill jobs seekers. 22% of job postings requesting these skills are in middle-skill occupations, the second largest of the digital skill clusters in this study. Compared to programming skills, fewer jobs in the network and computer support domain request a university degree (65% vs 78%). Certifications such as those by CompTIA, Microsoft, and Cisco provide alternative means of entry into these fields.

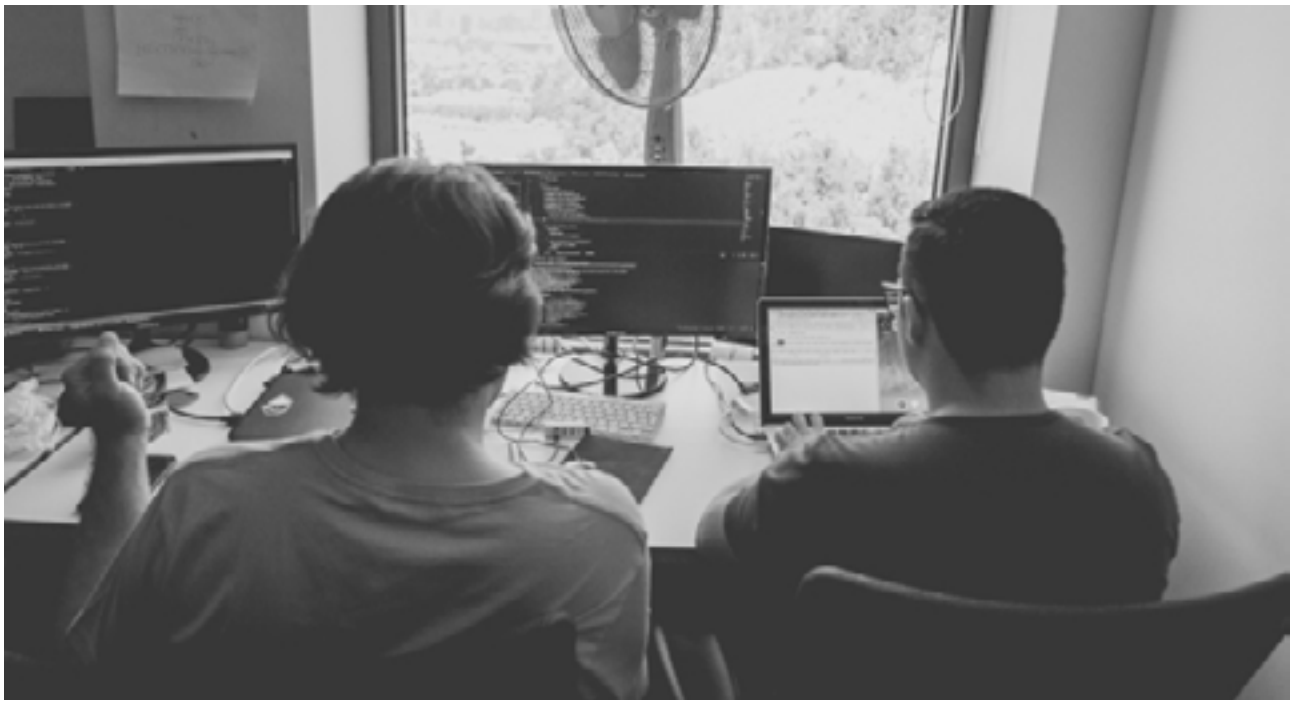
Employers value computer and networking support knowledge and programming skills alike as reflected by the average advertised salary of £50,000 p.a. Occupations that focus on computer and networking support skills feature IT support technicians, software developers, as well as IT business analysts.

IT support roles often require a unique blend of technical skills and interpersonal relationship management. Many IT support

roles are client facing. Customer service is the 11th most common skill among Computer Support Specialists. As a result, communication skills top the list of employability skills required alongside networking and support. In this context, communication skills are defined by a particular set of subskills. Technical writing is required to log problems and write technical documentation while clear, interpersonal writing and oral presentation skills are needed to communicate technical information to a non-technical audience.

The fastest growing and most valuable skills in the networking field relate to one or more emerging trends in IT and networking. DevOps skills such as Chef and Puppet combine traditional networking and development functions into new hybrid roles. These skills are each projected to grow by roughly 50% over the next five years. Cybersecurity skills are valuable to job seekers and in woefully short supply in the market. Cloud Security Infrastructure is the third highest paying skills in the market at over £87,000 per year. There is evidence of the undersupply of cybersecurity skills with the best estimates suggesting a shortfall of 2.93 million cyber security professionals globally in 2018.[59]

For example, the most commonly requested cybersecurity certification, the CISSP, has 4,455 annual openings but only 6,674 professionals in the UK have this credential,



59. ISC(2) 2018 Cyber Security Workforce Study, 2018, https://www.isc2.org/-/media/ISC2/Research/2018-ISC2-Cybersecurity-Workforce-Study.ashx?la=en&hash=4E09681D0FB51698D9BA6BF13EEABFA48BD17DB0.

Data Analysis

1,786,948 postings

£52,300 average salary

25% of digital demand

0% low-skilled
8% middle-skilled
92% high-skilled

+33% fast project growth

0.64 average versatility

Data analysis skills relate to the analysis of data to solve business challenges and scientific and technical problems. The cluster encompasses all the techniques required for data mining, data visualisation, data management, the use of statistical software as well as the applied analysis involved in producing business intelligence. The relatively new and emerging skills of machine learning, artificial intelligence, and natural language processing are also included in this cluster.

which is too small a supply for this market to effectively clear.[60]

Jobs with a focus on data analysis represent the third largest group of specific digital jobs in the UK, accounting for a quarter of digital demand. With an average advertised salary of £52,300 p.a., they are the second highest paid cluster, behind only positions requiring programming and software development skills. Most data analysis jobs are found at the high-skill level given the complex mathematical skills needed.

Critical skills in this domain include a combination of data analysis, data science,[61] and data visualisation, all of which are projected to grow rapidly over the coming years. As businesses become more data focused, data skills are required across an increasingly broad range of functions making data analysis the most versatile of the IT centric clusters (programming, networking and data analysis).

Data analysis skills are often part of hybrid roles. Hybridisation is a key trend in the

modern economy, skills that historically are not trained together have merged to create new jobs. Data Scientists blend software development and data analysis skills. In these roles, job seekers are expected to have strong data skills and also deep knowledge of Python, SQL, and other database and programming skills. Many of the fasting-growing and highest-paying skills in the field such as deep learning[62] are the domain of data scientists, one of the most important and fastest-growing jobs in business today.

Business Intelligence and Analyst roles combine database skills, data analysis skills, and data visualisation. Professionals in these roles are responsible for organising the available data and using it to address key questions about the performance of the business.

Data visualisation – the ability to communicate complex data sets in compelling charts, graphs, infographics and dashboards – is a hybrid skill among a set of hybrid jobs. It is a way that data analysts can connect the analyses that they have conducted to the needs of the business in which they operate. Demand for data visualisation is expected to grow by 68% in the next five years and is an increasingly critical skill in roles such as data analysts, marketing analysts and designers.

60. https://www.isc2.org/About/Member-Counts.

61. Data Analysis includes inspecting, cleansing, transforming, aggregating, and modelling data. Data Science combines scientific methods, processes, algorithms, and systems to extract knowledge and insights from data in various forms. (from Wikipedia).

62. G. Lewis-Kraus, "The Great A.I. Awakening How Google used artificial intelligence to transform Google Translate, one of its more popular services — and how machine learning is poised to reinvent computing itself", NY Times, 12/2016, https://www.nytimes.com/2016/12/14/magazine/the-great-ai-awakening.html.

Digital Marketing

1,380,020 postings

£34,100 average salary

20% of digital demand

35% low-skilled
38% middle-skilled
27% high-skilled

+27% fast project growth

0.51 average versatility

Digital marketing encompasses skills related to online marketing and advertising, including the use of social media in campaigns. Production of web content and analysis of web traffic are also included.

Digital marketing skills include the use of a set of online tools designed to help marketers reach increasingly narrow and targeted audiences with finely tailored messages. It is the third fastest-growing and second most versatile skill cluster, making it a particularly strong bet for job seekers. Jobs using these skills have fewer IT entry requirements making them a strong option for job seekers looking to place themselves in the centre of the digital economy, but for whom programming and other more traditional IT skills are not of interest.

Digital Marketing skills can be loosely divided into communication tools and analytics tools. Communication tools such social media platforms (e.g. LinkedIn, Twitter) and programs for emailing marketing and outreach (e.g. Mailchimp) are designed to help sales and marketing professionals more efficiently reach out to sales targets and to track those communications effectively. These tools can be viewed as extensions of productivity software tools to enable more efficient communication. These tools are used roughly equally by sales and marketing professionals and also on occasion by recruiters (who are in effect selling their company to job seekers).

The highest-paying digital marketing skills are analytics platforms such as HubSpot, Marketo, and Google Analytics. These are used by marketers to generate hard data and insights about the effectiveness of

their marketing efforts. As in many fields throughout the job market, analytics skills and the tools that enable effective data analyses are the fastest-growing and most valuable skills. Analytics platforms are more often used by marketers, particularly those at large firms with sophisticated sales and marketing operations.

Customer Relationship Management (CRM)

1,204,558 postings

£37,600 average salary

17% of digital demand

37% low-skilled
22% middle-skilled
41% high-skilled

+15% fast project growth

0.84 high versatility

CRM software is a tool for managing a company's interaction with current and potential customers. Users analyse data on customers' history with a company to improve business relationships with those customers, specifically focusing on customer retention and ultimately driving sales growth. Examples include Salesforce, SAP AG, Oracle, and Microsoft Dynamics.

Over the last several years, sales and marketing have increasingly become quantitative and data-driven disciplines. With this change, we have seen the rise of customer relationship management software that allows sales and marketing professionals to track contact and automate interactions with customers.

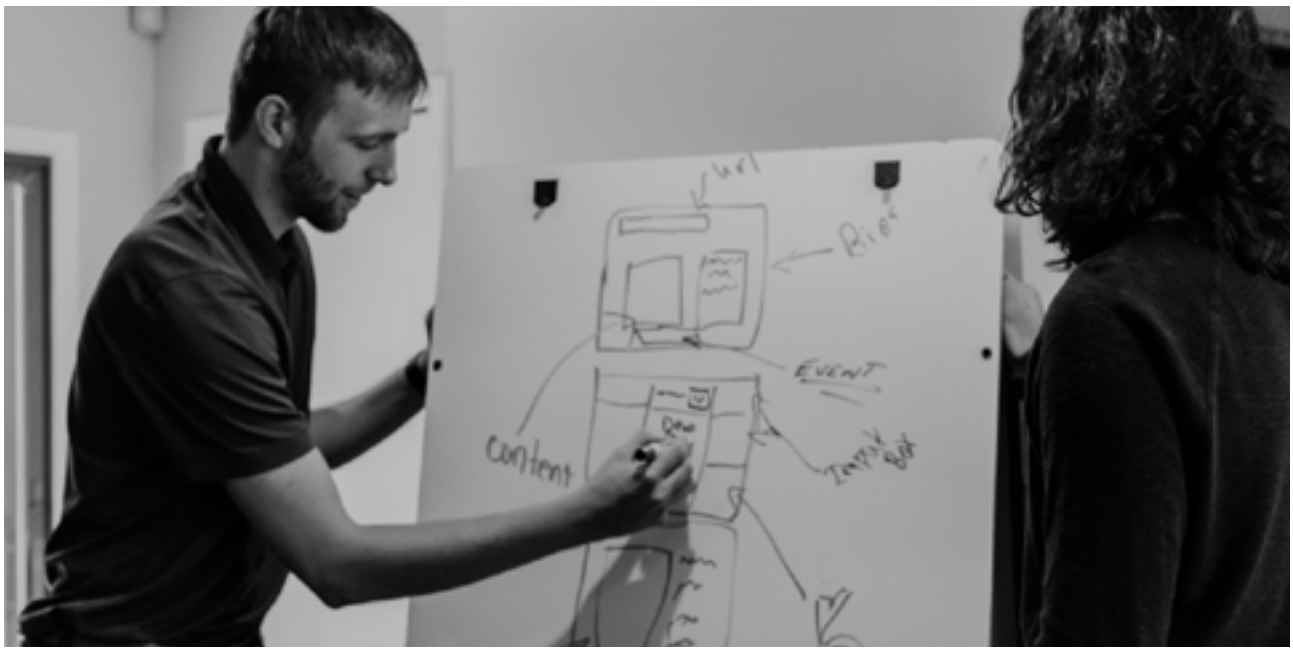
An understanding of customer relationship management and use of the platforms that support it, such as Salesforce or Microsoft Dynamics, are key to success in sales and marketing roles, especially in technology and other industries that run sophisticated large-scale marketing campaigns. CRM accounts for 17% of demand for digital occupations in the UK and offers an average advertised salary of £37,600 p.a. Unlike other specific digital skill clusters, jobs are distributed across the three skill levels – almost a quarter of job adverts fall in the group of low credential requirements, making this an important set of skills for job seekers to learn in workforce training contexts.

In sales and marketing roles, use of CRM systems is becoming an expected and required skill. Since 2014, the share of sales and marketing postings calling for CRM skills generally has increased by 50% and the percentage calling for Salesforce, the most common CRM platform, has doubled. Positions calling for Salesforce offer an 11% differential, advertising salaries of £41,900 p.a. compared to £37,600 p.a. for the field overall.

In addition to technical skills related to CRM systems such as managing data, job seekers need domain skills such as sales, marketing and communication skills. The CRM systems are tools that allow individuals and firms to scale their sales and marketing expertise and talent. Job seekers learning CRM skills should also ensure they develop strong technical sales and marketing skills.

Those sales and marketing skills will likely be door openers for employers, while digital CRM skills can help to close the deal in the application process.

There is also an emerging specialised technical job market around CRM skills. As firms look to build ever more sophisticated and customised implementations of CRM systems and automate their marketing, efforts roles such as Salesforce Administrators have grown dramatically. Since 2014, these positions have grown 50% faster than the overall labour market. Salesforce Administrators are a useful starting point for entry-level sales and marketing professionals; 71% require less than two years of experience compared to half of all sales and marketing roles.



Machining & Manufacturing Technology

762,376 postings

£38,600 average salary

11% of digital demand

6% low-skilled
39% middle-skilled
55% high-skilled

-8% stable project growth*

0.35 average versatility

*A projected growth value between -10% and +10% is considered 'stable'. See appendix for further details.

Production and manufacturing increasingly use computer numerically controlled (CNC) systems – replacing traditional manual machining systems. This cluster encompasses the skills required by engineers and technicians to programme, operate and maintain these CNC systems in a modern manufacturing environment.

In recent decades, manufacturers have seen remarkable productivity increases, producing more goods with the same labour inputs. This growth is largely driven by increased digitisation of the manufacturing workforce and automation of many production and engineering processes. The digital revolution in manufacturing has also impacted the level of education required moving from low-skill towards the middle- and high-skill level. AutoCAD – or computer aided drafting and design – are key digital skills for Engineers and Draughtspersons, and Computer Numeric Controlled (CNC) machine skills are critical among machinists and production workers. While less versatile than other digital skills, digital machining and manufacturing are transforming the profile of the engineering and production workforce.

Production roles such as machinists are becoming digitised and show increased importance of digital skills. CNC and Programmable Logic Control (PLC) are used to program manufacturing machines and automate industrial processes. Machinists are increasingly expected to understand how to program machines as well as operate them. G-code, a machine programming language, is expected to grow by 60% over the next five years.

Engineers are expected to build their designs and models in AutoCAD and other

digital modelling software. AutoCAD is an expected skill for the majority of engineering and engineering technician roles. Engineers can make themselves more valuable to employers by developing fluency in niche modelling tools such as Altium for designing circuit boards, CANape, for designing automotive parts, and MathWorks' Stateflow for programming industrial machines.

Digital Design

663,045 postings

9% of digital demand

-9% stable project growth*

£37,400 average salary

0% low-skilled
47% middle-skilled
53% high-skilled

0.56 average versatility

*A projected growth value between -10% and +10% is considered 'stable'. See appendix for further details.

Digital design skills are used by graphic designers and industrial designers with software design tools. It also includes User Interface and User Experience Design skills – the design of software products. Specific digital design skills include using tools such as Adobe Photoshop or computer-aided design software.

Design is an increasingly important part of today's digital economy. In 2017, TechCrunch reported that the ratio of designers to developers at major technology firms has increased by 2.5x over the last five years.[63] Digital design skills are required intensively among a range of design professionals and are complementary skills for marketing professionals and other roles with a creative orientation. Digital design skills such as Adobe Photoshop and computer-aided design software are the tools by which the distinctly human skill of creativity is translated into our increasingly digitised workplaces.

Digital design skills are definitional skills for a range of design occupations, which include graphic designers who design print and web graphics often using Adobe Photoshop, industrial designers who create

3D models of physical products using computer-aided design software, and User Interface and User Experience Designers who create software products using a range of web technologies.

The most common of these roles are Graphic Designers (20,732 postings in the last 12 months) who use Adobe Photoshop photo editing, InDesign for print, and other tools for animation, video editing, illustration, and web design. This is the most accessible design occupation, with 80% of postings that express an experience requirement requesting two years or less. Graphic Designers who can add web programming skills such as HTML5, JavaScript or PHP to their portfolio can transition from designers to web developers, a substantially higher-paying role (£49,200 p.a. vs £33,700 p.a.).

Industrial Designers (5,433 postings in the last 12 months) design physical products using computer-aided design software and play a key role in manufacturing industries. As a result, they are overrepresented in engineering hubs such as Cambridge and Bristol, where demand is nearly twice the per capita national average.

User Experience Designers use digital design tools to create software products. This is the highest-paying and most senior design profession. Average salaries are £61,200 p.a., compared to £41,200 p.a. for industrial designers, and £33,700 p.a. for graphic designers. Key skills for user experience designers include interaction design and user interface design. These roles require a hybrid of design skills to create pleasing interfaces, programming skills to build software prototypes, and psychology skills to understand how users will react to products and interfaces.

Digital design skills are complementary skills for marketing roles. Marketing specialists are commonly expected to know Adobe Photoshop and other design tools to create marketing content for print and web. Design skills allow entry-level marketers to make themselves more versatile to employers, offering a broader range of in demand and relevant skills.

63. D. Field, "6 major tech companies have doubled their design hiring goals in the last half decade", Tech Crunch, 05/2017, https://techcrunch.com/2017/05/31/here-are-some-reasons-behind-techs-design-shortage/.

5.

Implications

Eight in ten online advertised job openings in the UK are for occupations that demand digital skills - clear and convincing evidence of how digital skills are not merely important, but central to the labour market.

Employers demand digital skills across occupations, industries, and locations. The challenge for policy makers is to develop a skills policy which takes this diverse and pressing demand into account. The findings of this paper yield the following implications for policy makers and educators who shape and implement skills policy:

Baseline digital skills will get you a job, specific digital skills will power a career

Baseline digital skills are the ticket to entry, but it takes more than that to take full advantage of the digital economy. Specific digital skills define career fields, and propel workers into roles that pay more, offer advancement, and are less vulnerable to being automated. Programming skills are the most in demand cluster of digital skills whereas digital marketing and customer relationship management software tools are the fastest growing, changing the way that business hire for and execute these important functions.

Digital skills are driving changes in the job market

Many of the specific digital skills in this report redefine the skill requirements in the job market, even in well-established fields like marketing. For example, database and analytics skills are now required for marketing analyst positions. Possession of in-demand digital skills will help job seekers adapt as the job market changes.

Specific digital skills have spread far beyond the realm of IT

In fact, 68% of postings requesting these skills are outside of IT roles. The fastest growing specific digital skills are in the data analysis cluster and digital markets clusters. In each case, the roles calling for these skills are not traditional IT roles, but instead are becoming increasingly digitised as available data and tools increase in volume and sophistication.

Digital skills build resilience for workers in a turbulent, technology-driven labour market

Developing digital skills offers job seekers a salary differential in the short run. More importantly, perhaps, specific digital skills also reduce the risk that their roles will be made obsolete by automation in the future and give workers transferrable skills which allow them to progress to higher-paying careers or transition to new roles.

Job seekers need a complete package of skills for success in the economy, both digital and non-digital

Many of the specific digital skills described in this report serve to enable non-digital expertise. For example, software programs such as Adobe Photoshop serve to enable design work, and CRM software tools can make sales and marketing professionals more effective in communicating the messages which they have crafted.

Digital skills policy should be driven locally

Digital skill requirements vary substantially from region to region, and so should efforts to train workers. For example, data and design skills are particularly important in London to meet the needs of the finance and creative industries, while engineering and advanced manufacturing skills are particularly important in high tech engineering centres such as Cambridge and Bristol. Because of these different needs, each region should aim to develop a digital skills policy that matches the demand of local industries and develops the skills which may be needed to execute a human capital based economic development policy.

Digital skills will change over time. Policy should be shaped to anticipate this dynamism

Many of the fastest growing skills and software packages in areas such as data analysis and digital marketing hardly existed just a few years ago. A skill policy must be dynamic, continually re-evaluate the skills which are in demand and aim to train workers in the skills of the future while also ensuring that they have the skills needed for success today. Such an approach by employers allows them to build and shape their internal workforce in response to changing market and business needs.
A dynamic approach to skills evaluation by educators consists of the constant revaluation of content address to ensure that students have the particular sets of skills that they need to get a job in their region.

6.

Appendix:

Supplementary Skills Tables

The analysis of this report uses an occupation-based model developed by Burning Glass to estimate the scope of digital skill demand in the UK. Using skill requirements extracted from vacancy data, UK SOC occupations have been split into two groups – digital and non-digital. This approach allows us to capture demand for specific skills in real time. For the purposes of this analysis, an occupation is considered 'digital' if a sufficiently large share of the job postings for this occupation request digital skills from at least one of the eight digital skill clusters listed in Table 1 of the report. This approach ensures we capture the full range of employer demand for digital skills, including implicit demand. It also lets us include occupations where digital skills may not be required in some cases but are likely to offer candidates who possess those skills a substantial advantage in the application process and a positive impact on their salary.

Using this methodology, we can assess the importance of digital skills in the UK labour market using intelligence gathered from a key source on the demand side – job adverts written by UK employers. In addition to this high-level view, we can get insight into detailed information on the underlying skills requirements. To allow readers to track skill demand, we've included the data used to inform the report here. For simplicity's sake, the data in the tables are not based on the above model but show actual posting numbers. This helps readers understand how many employers explicitly express the need for a skill as opposed to implicit demand.

How to Interpret the Skill Cluster Tables

For each cluster (and for most highly demanded skills in that cluster) we include the following data elements. All tables mentioned below refer to the tables shown in each skill cluster section:

Magnitude of demand (Table 1): How many job openings request these skills? In general, skills in higher demand are more important for job seekers to demonstrate and educators to focus on. Typically, the highest demanded skills in a given occupation represent the core competencies that job seekers need and without these have dramatically weaker chances to get a job in their chosen field. 'Percentage Share of Cluster' indicates the percentage share of job postings in this skill cluster that ask for a skill. The column 'percentage share of digital demand' indicates the size of each of the digital skill clusters within the digital economy (i.e. all job postings in digital occupations).

Co-occurring skills (Table 2): What other skills are relevant for jobs that focus on this cluster? In order for job seekers to be competitive, they must present a full portfolio of skills to employers. This includes the digital skills which this report focuses on, non-digital technical skills and the baseline skills (or employability skills) that employers require. This section allows job seekers to understand what skills are needed to complement digital skills to make them most appealing to employers.

Often, we find that complementary skills are needed to activate digital skills – for example, problem solving is needed alongside network configuration and troubleshooting skills and communication is needed alongside data visualisation

Skills presenting the greatest opportunity for job seekers (Table 3): For each of the metadata elements below, we show the top skills within each cluster for which demand was at least in the 70th percentile within the cluster in the last 12 months.

- **Versatility:** How broad is the range of occupations for which this skill is relevant? Some digital skills such as Salesforce have broad relevance across a range of jobs (sales, marketing, IT) while others such as G-code programming language (which is used

to program manufacturing machines) are much narrower. In a changing economy, versatile skills can help job seekers more easily make career transitions and adapt as skill requirements change.

- **Projected growth:** How will demand for each skill change over time? Burning Glass has developed a set of skill projections that predict future demand for skills. We include these metrics so that job seekers and educators can focus on the skills that will be most relevant in the future.
- **Average salary:** How much is this skill worth to job seekers? Salary information showcases which skills are most valuable to job seekers and contribute to career advancement.
- **Associated occupations (Table 4):** What are the main occupations that require the skills in this cluster? In the labour market skills existing in the context of specific jobs. This section helps job seekers to identify which jobs are the best targets for each of the skill clusters discussed in this report.

Productivity Cluster Table 1: What are the most important skills in this cluster?

Skill	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand	Advertised Salary	Versatility	Projected Growth (5 years)
Microsoft Excel	810,239	14.4%	11.5%	£31,300	Very High 0.98	Fast +23%
Microsoft Office	463,117	8.2%	6.6%	£29,800	Very High 0.99	Stable +3%
Microsoft PowerPoint	185,619	3.3%	2.6%	£34,300	Very High 0.98	Stable -5%
Microsoft Word	175,513	3.1%	2.5%	£27,900	Very High 0.99	Stable +2%
SAP	164,034	2.9%	2.3%	£39,200	Very High 0.93	Fast +24%
Oracle	127,817	2.3%	1.8%	£44,200	High 0.71	Declining -32%
Enterprise Resource Planning (ERP)	101,257	1.8%	1.4%	£47,600	Very High 0.90	Fast +25%
Spreadsheets	100,349	1.8%	1.4%	£28,400	Very High 0.97	Fast +47%
Microsoft Outlook	54,712	1.0%	0.8%	£27,100	Very High 0.98	Fast +12%
Microsoft SharePoint	54,375	1.0%	0.8%	£40,900	High 0.78	Declining -69%

Productivity Cluster Table 2: What other skills are important for jobs that focus on this cluster?

Co-Occurring Skills	Employability Skills
Customer Service (13.5%)*	Communication Skills (31.7%)
Budgeting (10.3%)	Organisational Skills (13.9%)
Sales (10.1%)	Planning (12.2%)
Project Management (9.3%)	Detail-Oriented (12.1%)
Accounting (7.7%)	Problem-Solving (8.8%)

Productivity Cluster Table 3: Skills Presenting Great Opportunities

Which skills are projected to grow most / pay the highest salary / are most versatile?

Fastest-Growing Skills (5-year projected growth)	Highest-Paying Skills (advertised annual salary)	Most-Versatile Skills (widely used skills)
NetSuite (97%)	SAP Basis (£78,200)	MIcrosoft Office (0.99)
Microsoft Office 365 (82%)	SAP Netweaver (£72,900)	Microsoft Word (0.99)
Spreadsheets (47%)	Advanced Business Application Programming (ABAP) (£68,900)	Microsoft PowerPoint (0.98)
Electronic Document Management System (37%)	SAP Implementation (£65,200)	Microsoft Excel (0.98)
Pivot Tables (30%)	Oracle Fusion (£62,100)	Microsoft Outlook (0.98)

Productivity Cluster Table 4: What occupations are associated with this cluster?

Occupation (3-digit SOC)	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand
Other Administrative Occupations	582,084	10.4%	2.7%
Administrative Occupations: Finance	527,959	9.4%	2.4%
Customer Service Occupations	489,102	8.7%	2.2%
Functional Managers and Directors	482,901	8.6%	2.2%
Business, Research and Administrative Professionals	458,095	8.2%	2.1%

Note: The table shows occupations that only require productivity skills (i.e. baseline digital skills) and no specific digital skills. Individual occupations counts are therefore lower.

Programming Cluster Table 1: What are the most important skills in this cluster?

Skill	Total Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand	Average Salary	Versatility	Projected Growth (5 years)
SQL	453,690	11.0%	6.4%	£46,700	Average 0.44	Declining -23%
JavaScript	325,118	7.9%	4.6%	£50,800	Low 0.18	Stable +7%
Software Development	292,047	7.1%	4.1%	£50,400	Average 0.36	Fast +18%
Microsoft C#	281,342	6.8%	4.0%	£51,100	Low 0.24	Declining -16%
Java	271,858	6.6%	3.9%	£54,000	Average 0.27	Stable -8%
.NET	201,961	4.9%	2.9%	£52,300	Low 0.12	Declining -40%
Software Engineering	171,858	4.2%	2.4%	£53,900	Low 0.23	Fast +22%
Python	169,092	4.1%	2.4%	£53,300	Average 0.49	Very Fast +71%
SQL Server	156,871	3.8%	2.2%	£51,300	Low 0.22	Declining -43%
Web Development	122,497	3.0%	1.7%	£46,000	Low 0.22	Stable -7%

Programming Cluster Table 2: What other skills are important for jobs that focus on this cluster?

Co-Occurring Skills	Employability Skills
LINUX (4.6%)	Communication Skills (27.2%)
Technical Support (4.4%)	Planning (12.2%)
Social Media (3.5%)	Teamwork / Collaboration (11.4%)
Oracle (2.8%)	Problem-Solving (10.0%)
Data Analysis (2.7%)	Organisational Skills (9.1%)

Programming Cluster Table 3: Skills Presenting Great Opportunities

Which skills are projected to grow most / pay the highest salary / are most versatile?

Fastest-Growing Skills (5-year projected growth)	Highest-Paying Skills (advertised annual salary)	Most-Versatile Skills (widely used skills)
Kubernetes (293%)	Play Framework (£88,300)	Robotics (0.91)
Spring Boot (278%)	Spring Integration (£84,500)	Database Management (0.90)
Data Lakes / Reservoirs (235%)	Spring Data (£84,500)	Electronic Data Interchange (0.87)
Docker Software (209%)	OpenShift (£82,700)	Database Software (0.85)
Ansible (195%)	Sybase Database (£80,300)	Data Security (0.85)

Programming Cluster Table 4: What occupations are associated with this cluster?

Occupation (3-digit SOC)	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand
Information Technology and Telecommunications Professionals	1,340,001	32.6%	19.0%
Business, Research and Administrative Professionals	381,555	9.3%	5.4%
Functional Managers and Directors	333,702	8.1%	4.7%
Engineering Professionals	324,330	7.9%	4.6%
Information Technology Technicians	258,255	6.3%	3.7%

Computer Support and Networking Cluster Table 1: What are the most important skills in this cluster?

Skill	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand	Advertised Salary	Versatility	Projected Growth (5 years)
LINUX	175,410	7.8%	2.5%	£51,400	Average 0.37	Stable -9.7%
Technical Support	150,611	6.7%	2.1%	£35,000	Very High 0.9	Stable -5%
Microsoft Active Directory	85,661	3.8%	1.2%	£40,600	Average 0.31	Declining -30.6%
IT Support	75,284	3.3%	1.1%	£32,000	Average 0.51	Fast +25.1%
Windows Server	63,976	2.8%	0.9%	£45,500	Average 0.32	Declining -44.1%
UNIX	62,401	2.8%	0.9%	£54,100	Average 0.44	Declining -77.7%
Cisco	61,341	2.7%	0.9%	£48,300	Average 0.46	Declining -37.3%
Transmission Control Protocol / Internet Protocol (TCP / IP)	41,030	1.8%	0.6%	£49,400	Average 0.36	Declining -21.7%
Information Security	40,335	1.8%	0.6%	£50,700	Average 0.65	Fast +25%
Domain Name System (DNS)	40,077	1.8%	0.6%	£47,700	Average 0.33	Stable 1.3%

Computer Support and Networking Cluster Table 2: What other skills are important for jobs that focus on this cluster?

Co-Occurring Skills	Employability Skills
SQL (16.9%)	Communication Skills (24.4%)
JavaScript (13.8%)	Problem-Solving (11.5%)
Microsoft C# (11.8%)	Teamwork / Collaboration (10.7%)
Software Development (11.5%)	Planning (9.3%)
Java (11.3%)	Writing (7.2%)

Computer Support and Networking Table 3: Skills Presenting Great Opportunities

Which skills are projected to grow most / pay the highest salary / are most versatile?

Fastest-Growing Skills (5-year projected growth)	Highest-Paying Skills (advertised annual salary)	Most-Versatile Skills (widely used skills)
Cyber Security Knowledge (120%)	Public Key Infrastructure (PKI) (£68,600)	Technical Support (0.90)
Threat Intelligence and Analysis (87%)	Chef Infrastructure Automation (£66,900)	Systems Management (0.90)
Chief Infrastructure Automation (63%)	COBIT (£65,600)	System Maintenance (0.84)
Puppet (48%)	Solaris (£65,500)	Troubleshooting Technical Issues (0.84)
Information Governance (40%)	Single Sign On (SSO) (£65,000)	Information Governance (0.82)

Computer Support and Networking Cluster Table 4: What occupations are associated with this cluster?

Occupation (3-digit SOC)	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand
Information Technology and Telecommunications Professionals	1,340,001	59.3%	14.8%
Engineering Professionals	260,343	11.5%	2.9%
Information Technology Technicians	258,255	11.4%	2.9%
Science, Engineering and Production Technicians	135,843	6.0%	1.5%
Electrical and Electronic Trades	51,263	2.3%	0.6%

Data Analysis Cluster Table 1: What are the most important skills in this cluster?

Skill	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand	Advertised Salary	Versatility	Projected Growth (5 years)
Data Analysis	79,791	4.5%	1.1%	£40,300	Very High 0.93	Fast +12%
Big Data	50,489	2.8%	0.7%	£55,800	Average 0.61	Very Fast +59%
Business Intelligence	46,268	2.6%	0.7%	£48,300	Average 0.71	Stable -6%
Machine Learning	35,434	2.0%	0.5%	£53,100	Average 0.58	Explosive +122%
Data Science	33,276	1.9%	0.5%	£52,200	Average 0.50	Explosive +114%
Data Management	32,175	1.8%	0.5%	£45,000	Very High 0.96	Fast +13%
Apache Hadoop	32,062	1.8%	0.5%	£62,600	Average 0.39	Fast +48%
SAS	29,871	1.7%	0.4%	£51,900	High 0.82	Stable +5%
Tableau	24,157	1.4%	0.3%	£56,200	Average 0.62	Fast +79%
Data Quality	21,936	1.2%	0.3%	£46,300	High 0.89	Stable +8%

Data Analysis Cluster Table 2: What other skills are important for jobs that focus on this cluster?

Co-Occurring Skills	Employability Skills
SQL (20.0%)	Communication Skills (25.2%)
Software Development (12.9 %)	Teamwork / Collaboration (11.3%)
Java (12.8%)	Problem-Solving (10.9%)
Microsoft C# (12.4%)	Planning (10.6%)
JavaScript (10.5%)	Research (9.1%)

Data Analysis Cluster Table 3: Skills Presenting Great Opportunities

Which skills are projected to grow most / pay the highest salary / are most versatile?

Fastest-Growing Skills (5-year projected growth)	Highest-Paying Skills (advertised annual salary)	Most-Versatile Skills (widely used skills)
Deep Learning (192%)	Sentiment Analysis / Opinion Mining (£83,000)	Data Collection (0.99)
Pandas (147%)	Pandas (£78,200)	Data Capture (0.99)
Pipeline (Computing) (143%)	Sqoop (£76,800)	Data Management (0.96)
Alteryx (139%)	YAML (£76,100)	Statistical Analysis (0.94)
YAML (134%)	AWS Elastic MapReduce (EMR) (£73,900)	Data Analysis (0.93)

Data Analysis Cluster Table 4: What occupations are associated with this cluster?

Occupation (3-digit SOC)	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand
Information Technology and Telecommunications Professionals	1,129,296	63%	16%
Business, Research and Administrative Professionals	272,521	15%	4%
Information Technology Technicians	117,517	7%	2%
Business, Finance and Related Associate Professionals	113,428	6%	2%
Natural and Social Science Professionals	43,961	2%	1%

Digital Marketing Cluster Table 1: What are the most important skills in this cluster?

Skill	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand	Advertised Salary	Versatility	Projected Growth (5 years)
Social Media	163,209	11.8%	1.8%	£30,585	High 0.85	Fast +29%
Digital Marketing	66,953	4.9%	0.7%	£33,249	Average 0.40	Very Fast +52%
Google Analytics	30,215	2.2%	0.3%	£34,579	Average 0.45	Fast +31%
Email Marketing	27,967	2.0%	0.3%	£32,188	Average 0.44	Fast +21%
Social Media Platforms	16,662	1.2%	0.2%	£30,322	Average 0.65	Very Fast +60%
Google AdWords	15,793	1.1%	0.2%	£35,928	Low 0.28	Fast +29%
Email Campaigns	14,553	1.1%	0.2%	£36,700	Average 0.46	Fast +30%
Online Marketing	13,348	1.0%	0.1%	£36,100	Average 0.43	Fast +12%
Content Marketing	13,001	0.9%	0.1%	£40,100	Average 0.37	Very Fast +54%

Digital Marketing Cluster Table 2: What other skills are important for jobs that focus on this cluster?

Co-Occurring Skills	Employability Skills
Sales (42.4%)	Communication Skills (32.9%)
Business Development (17.5%)	Organisational Skills (16.7%)
Customer Service (14.7%)	Creativity (16.6%)
Marketing (12.8%)	Teamwork / Collaboration (13.2%)
Business-to-Business (10.0%)	Building Effective Relationships (12.5%)

Digital Marketing Cluster Table 3: Skills Presenting Great Opportunities

Which skills are projected to grow most / pay the highest salary / are most versatile?

Fastest-Growing Skills (5-year projected growth)	Highest-Paying Skills (advertised annual salary)	Most-Versatile Skills (widely used skills)
Adobe Analytics (+151%)	Eloqua (£52,000)	Social Networking (0.90)
Salesforce Marketing Cloud (+136%)	Adobe Analytics (£51,300)	YouTube (0.88)
HubSpot (+135%)	Salesforce Marketing Cloud (£50,700)	Social Media (0.85)
Mailchimp (+81%)	Omniture (£49,600)	Digital Media (0.72)
Social Content (+71%)	Marketo (£45,700)	Digital Advertising (0.62)

Digital Marketing Cluster Table 4: What occupations are associated with this cluster?

Occupation (3-digit SOC)	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand
Sales-Related Occupations	418,434	30.3%	5.9%
Functional Managers and Directors	312,156	22.6%	4.4%
Sales, Marketing and Related Associate Professionals	261,688	19.0%	3.7%
Public Services and Other Associate Professionals	154,983	11.2%	2.2%
Media Professionals	51,105	3.7%	0.7%

CRM Cluster Table 1: What are the most important skills in this cluster?

Skill	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand	Advertised Salary	Versatility	Projected Growth (5 years)
Customer Retention	77,242	6.4%	1.1%	£37,400	Very High 0.98	Stable +1%
Customer Relationship Management (CRM)	51,143	4.2%	0.7%	£31,800	High 0.81	Fast +31%
Salesforce	27,235	2.3%	0.4%	£41,900	High 0.79	Fast +37%
Customer Acquisition	12,227	1.0%	0.2%	£46,700	Average 0.72	Fast +26%
Account Development	11,576	1.0%	0.2%	£39,500	Average 0.60	Stable +9%
Consumer Behaviour	3,775	0.3%	0.1%	£47,400	High 0.76	Stable +1%
CRM Software	2,688	0.2%	0.04%	£36,900	Average 0.67	Fast +21%
Sales Database	1,487	0.1%	0.02%	£30,400	Average 0.42	Declining -16%
Account Consultations	1,418	0.1%	0.02%	£45,700	Average 0.64	-
Microsoft CRM	1,224	0.1%	0.02%	£43,000	Average 0.49	Declining -16%

CRM Cluster Table 2: What other skills are important for jobs that focus on this cluster?

Co-Occurring Skills	Employability Skills
Sales (47.0%)	Communication Skills (31.4%)
Business Development (19.8%)	Organisation Skills (14.6%)
Customer Service (16.4%)	Building Effective Relationships (12.8%)
Marketing (13.2%)	Creativity (12.7%)
Sales Management (11.2%)	Teamwork / Collaboration (12.7%)

CRM Cluster Table 3: Skills Presenting Great Opportunities

Which skills are projected to grow most / pay the highest salary / are most versatile?

Fastest-Growing Skills (5-year projected growth)	Highest-Paying Skills (advertised annual salary)	Most-Versatile Skills (widely used skills)
Salesforce Administration (+62%)	Salesforce Administration (£54,300)	Customer Retention (0.98)
Sales Automation Software (+46%)	Consumer Behaviour (£47,400)	Sales Automation Software (0.94)
Salesforce (+37%)	Customer Acquisition (£46,700)	-
Customer Acquisition (+26%)	Microsoft CRM (£43,000)	-
-	Salesforce (£42,000)	-

CRM Cluster Table 4: Which Occupations are linked to this Cluster?

Occupation (3-digit SOC)	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand
Sales-Related Occupations	448,430	37.2%	5.9%
Functional Managers and Directors	309,378	25.7%	4.1%
Sales, Marketing and Related Associate Professionals	255,941	21.2%	3.4%
Legal Professionals	61,801	5.1%	0.8%
Customer Service Managers and Supervisors	49,679	4.1%	0.7%

Machining and Manufacturing Technology Table 1: What are the most important skills in this cluster?

Skill	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand	Advertised Salary	Versatility	Projected Growth (5 years)
AutoCAD	71,016	9.3%	1.0%	£38,500	Average 0.64	Declining -11%
Computer Numerical Control (CNC)	47,093	6.2%	0.7%	£28,700	Average 0.50	Fast +10%
Engineering Drawings	36,419	4.8%	0.5%	£30,400	High 0.70	Fast +19%
Mechanical Design	30,982	4.1%	0.4%	£45,900	Low 0.22	Stable +4%
Technical Drawings	19,176	2.5%	0.3%	£30,900	High 0.87	Stable +10%
Engineering Design and Installation	17,207	2.3%	0.2%	£47,700	High 0.70	Declining -72%
3D Modelling / Design	16,524	2.2%	0.2%	£44,000	Average 0.65	Declining -16%
Engineering Design	15,934	2.1%	0.2%	£48,000	Average 0.68	Declining -30%
Computer-Aided Draughting / Design (CAD)	13,085	1.7%	0.2%	£39,400	High 0.73	Declining -28%
CATIA	8,884	1.2%	0.1%	£48,600	Average 0.37	Declining -30%

Machining and Manufacturing Technology Table 2: What other skills are important for jobs that focus on this cluster?

Co-Occurring Skills	Employability Skills
Project Management (10.8%)	Communication Skills (24.8%)
Mechanical Engineering (9.1%)	Planning (11.8%)
Budgeting (8.5%)	Problem-Solving (11.5%)
Customer Service (7.8%)	Teamwork / Collaboration (9.9%)
Quality Assurance and Control (7.1%)	Organisational Skills (8.0%)

Machining and Manufacturing Technology Table 3: Skills presenting great opportunities

Which skills are projected to grow most / pay the highest salary / are most versatile?

Fastest-Growing Skills (5-year projected growth)	Highest-Paying Skills (advertised annual salary)	Most-Versatile Skills (widely used skills)
CANape (+72%)	Altium (£50,600)	3D Printing / Additive Manufacturing (0.90)
Mastercam (+65%)	CANape (£50,100)	Technical Drawings (0.87)
Civil 3D (+37%)	MathWorks Stateflow (£50,000)	Computer-Aided Draughting / Design (CAD) (0.73)
STEP7 PLC (+34%)	CATIA V5 (£49,900)	Building Information Modelling (0.69)
3D Printing / Additive Manufacturing (+32%)	STEP7 PLC (£49,800)	3D Modelling / Design (0.65)

Machining and Manufacturing Technology Table 4: What occupations are associated with this cluster?

Occupation (3-digit SOC)	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand
Engineering Professionals	324,330	42.5%	4.6%
Science, Engineering and Production Technicians	126,571	16.6%	1.8%
Architects, Town Planners and Surveyors	47,836	6.3%	0.7%
Metal Machining, Fitting and Instrument Making Trades	42,785	5.6%	0.6%
Quality and Regulatory Professionals	42,552	5.6%	0.6%

Digital Design Cluster Table 1: What are the most important skills in this cluster?

Skill	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand	Advertised Salary	Versatility	Projected Growth (5 years)
Adobe Photoshop	70,601	10.6%	0.8%	£33,200	Average 0.69	Declining -36%
Adobe InDesign	48,599	7.3%	0.5%	£32,500	Average 0.69	Stable +3%
Adobe Acrobat	32,875	5.0%	0.4%	£34,200	High 0.71	Stable +2%
Adobe Creative Suite	31,970	4.8%	0.4%	£34,200	Average 0.63	Stable +9%
Adobe Illustrator	31,807	4.8%	0.4%	£33,900	Average 0.61	Stable +9%
Graphic Design	26,137	3.9%	0.3%	£32,600	Average 0.59	Stable +1%
Digital Design	16,293	2.6%	0.2%	£40,900	Average 0.50	Declining -14%
User Interface (UI) Design	13,940	2.1%	0.2%	£54,000	Average 0.32	Declining -37%
UX Wireframes	9,818	1.5%	0.1%	£53,400	Low 0.17	Stable +9%

Digital Design Cluster Table 2: What other skills are important for jobs that focus on this cluster?

Co-Occurring Skills	Employability Skills
Marketing (11.9%)	Communication Skills (24.7%)
Web Development (11.5%)	Creativity (23.2%)
Social Media (11.3%)	Writing (12.4%)
Hypertext Preprocessor (PHP) (8.1%)	Teamwork / Collaboration (12.0%)
HTML5 (8.0%)	Detail-Orientated (11.1%)

Digital Design Cluster Table 3: Skills presenting great opportunities

Which skills are projected to grow most / pay the highest salary / are most versatile?

Fastest-Growing Skills (5-year projected growth)	Highest-Paying Skills (advertised annual salary)	Most-Versatile Skills (widely used skills)
Videography (+53%)	Interaction Design (£57,300)	Media Production (0.90)
Adobe Premiere (+31%)	Graphical User Interface (GUI) (£57,300)	Multimedia (0.88)
Video Editing (+21%)	Interface Design (£57,200)	Microsoft Visio (0.87)
Human Machine Interface (HMI) (+20%)	Microsoft Visio (£56,200)	Video Production (0.75)
SketchUp (+20%)	User Interface (UI) Design (£54,000)	Adobe Acrobat (0.71)

Digital Design Cluster Table 4: What occupations are associated with this cluster?

Occupation (3-digit SOC)	Number of Job Adverts	Percentage Share within Cluster	Percentage Share of Digital Demand
Information Technology and Telecommunications Professionals	203,648	30.7%	2.9%
Sales, Marketing and Related Associate Professionals	163,126	24.6%	2.3%
Engineering Professionals	94,699	14.3%	1.3%
Design Occupations	45,794	6.9%	0.7%
Artistic, Literary and Media Occupations	40,154	6.1%	0.6%

7.

Appendix:

Methodology

The data informing this report is produced by Burning Glass Technologies, a global labour market analytics software firm with deep expertise and experience developing skill taxonomies used by public sector agencies across the globe, leading multi-national firms, educational institutions, and academic and policy researchers.

About Real Time Jobs Data and Its Representativeness

Real-time labour market information is based on analysis of the millions of job listings posted every day by employers to give a more up-to-date and detailed portrait of employers' demand for jobs and skills than is possible through surveys. By analysing job listings, researchers can find out which companies and sectors are hiring, which skills are in demand, how hard they are to find, and which jobs and skill sets are emerging.

In addition, real-time data can break down the job market to a precise level of detail. Traditional labour market data are structured around broad job categories, and all jobs within those categories are presumed to be identical in terms of the skills, experience and education they require. By contrast, real-time job market data can be much more specific, reflecting how jobs differ within and across industries and geographies.

While not every job description is a complete description of the skills employers need, when aggregated across thousands of postings for a given occupation, a clear and accurate portrait of skill demand emerges. By its very nature, a job description means an employer has had to spell out the specific skills and qualifications they need to get a particular job done. Employers also have every incentive to get job descriptions right (poor or delayed recruiting can be costly in both time and money). However, there might be some occupation miscodes in the database. Uncommon, ambiguous, misspelled job titles can confuse the model used to assign an occupation. Internal evaluation of the accuracy of our occupation coding has found that over 85% of postings are coded correctly.

Not all jobs are posted online, so Burning Glass frequently benchmarks the data against national statistics. A comparison of the Annual Survey of Hours and Earnings (ASHE) employment data and Burning Glass postings data for the UK showed a 93% correlation between ASHE and Burning Glass occupational distributions. The Burning Glass posting data overestimate the proportion of professional and associate professional occupations (+11% points), while underestimating the proportion of elementary occupations (-7% points) and caring, leisure and other services occupations (-5% points).

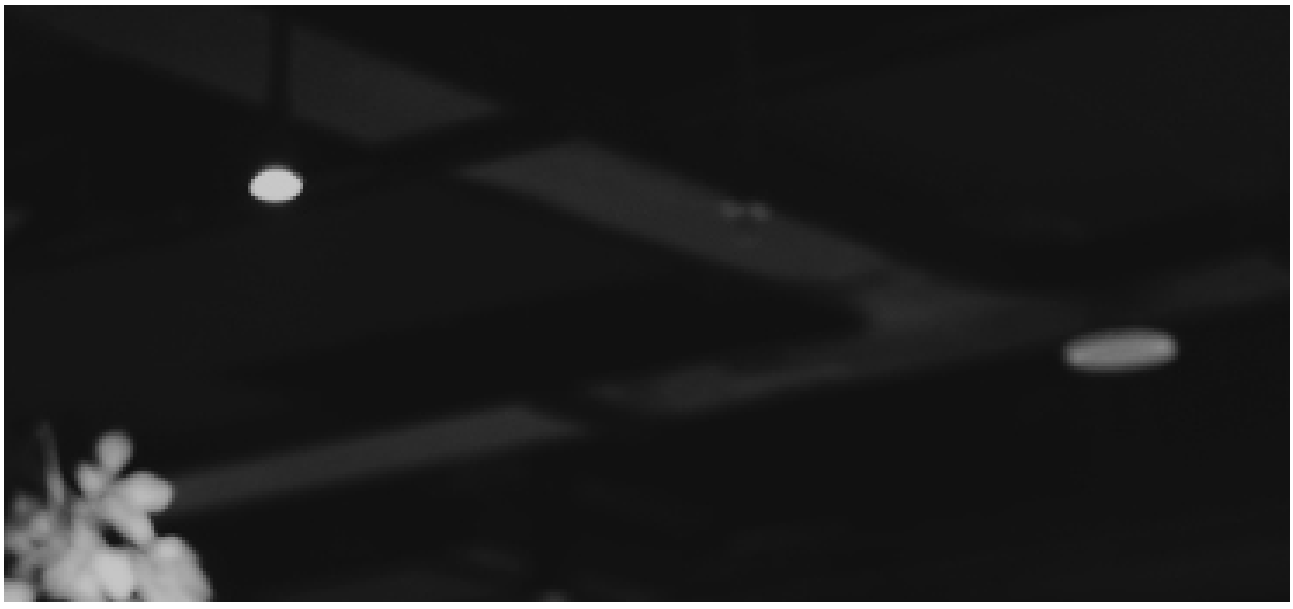
Data Collection Approach

The methodology used to obtain job advertisements from online job boards

and company websites is based on Burning Glass Technologies' advanced 'spider' technology. Once Burning Glass identifies an online site as a valid source of employment opportunities, a dedicated spider is programmed, tested and activated. The spider visits the site regularly and pulls job information for all jobs posted; the information is then stored in a temporary database. The sites with the newest jobs or with the highest frequency of change in postings are visited most frequently. Burning Glass spiders more than 40,000 sites worldwide, of which over 6,000 are in the UK.

Once postings are collected, Burning Glass parses, extracts and codes dozens of data elements, including job title (which is used to map to an occupation), employer (which is used to assign an industry code), and the specific skills, skill clusters, educational credentials, certifications, experience levels and work activities required for a specific job, as well as data about salary, number of openings, and job type. Burning Glass codes occupation and skills using a combination of machine learning techniques and expert-generated rules to appropriately assign a job posting into an occupation and tag the specific skills employers require. This includes complex disambiguation procedures, for example classifying jobs with a broad title of project manager into IT project managers, construction project managers, etc.

Burning Glass uses a robust approach to the collection of data, using almost 7,500 job advertisement sources in the UK (including direct employer sites as well as job boards, aggregators, government and free sites), which ensures data provided are representative actual openings. Additionally,



Burning Glass has strong mechanisms in place to de-duplicate job advertisements. Roughly 80% of all postings collected are discarded as duplications, which ensures that the data used for analysis reflects unique opportunities rather than the broad-brush posting activity undertaken by recruiting and staffing agencies.

Unless otherwise noted, all data on employer demand for jobs and skills in this report is sourced from the Burning Glass database on online job postings and reflects the 12-month period from 01/04/2017 to 31/03/2018. In the period between April 2017 and March 2018, Burning Glass collected and parsed 9.4 million unique job postings from employers in the UK. The data used in the report depend on the level of detail employers apply when advertising vacant positions online. For the purposes of this analysis, we excluded any job adverts without sufficient information to draw conclusions from.

Occupation Coding

Where possible, all job adverts in the Burning Glass database are mapped to an occupation. For this report we have used the UK SOC classification. The mapping is performed by a logical rules-based system that assigns a UK SOC code based on the job title and skills found in a posting. Each job advert is assigned to one occupation. The rules system compares the information found in a job posting against a list of prioritised criteria, such as the content of the clean title, the skills, and the certifications mentioned in the job text. It is a linearised decision tree with rules that takes the following format: 'if condition 1 and condition 2 and condition 3 […] then outcome'. Every rule uses at least one condition, which is usually based on the job title. Other conditions that are based on skills, certifications, or industry are optional.

Defining Digital Occupations

One of the characteristics of job posting data is that not every posting contains the same information. Every employer uses slightly different wordings. One employer might specify every single skill they think is needed for the job or only mention a few. Other skills are inferred from the job title. At the individual record level, Burning Glass skills data is only based on information extracted from the job text and does not infer any skills beyond what is explicitly mentioned. To understand digital demand in the labour market, we want to use a definition that captures all jobs where digital skills are either a necessity to perform the job or play a core role for certain aspects of the position.

To determine whether an occupation can be considered digital, we looked at the frequency of demand for digital skills within each UK SOC occupation. Here, an occupation is considered digital if at least 10% of its job postings mention digital skills from one of the eight skills cluster defined in Table 1 of the report (Baseline Digital Skills; Software and Programming; Networking Systems; CRM; Data Analysis; Digital Marketing; Digital Media; Productivity Software). An occupation is therefore considered digital only if more than 10% of job postings request skills from at least one of these clusters, rather than any combination of digital skills. The categorisation of occupations does not differentiate between baseline digital or specific digital skills.

To illustrate this, we can look at the Sales and Retail Assistants occupation, which is considered a non-digital occupation applying the 10% threshold. Here, 9.9% of postings require skills from the productivity skill cluster. Among the specific digital clusters, 2.8% of the postings for this occupation mention software and programming skills, 4.7% mention CRM, and 6.4% list digital marketing skills. Counting all postings mentioning digital skills from any of these clusters towards the number of digital postings within an occupation would result in Sales and Retail Assistants being marked as a digital occupation. Individually, however, none of the clusters meets the condition of being mentioned in at least 10% of the postings. Carpenters and joiners are an example where one of the digital skill clusters – machining and manufacturing technology – is just above the 10% threshold (11.3%) and is therefore considered a digital one. The approach ensures we only capture occupations where there is a clear focus on one of the digital skill clusters. This condition also makes it slightly harder for an occupation to be considered digital as opposed to counting any combination of digital skills. As we use percentages rather than absolute numbers, the number of postings looked at per occupation does not have an impact on whether an occupation is digital or not.

The threshold used (10%) has been set after analysing the relationship between the percentage of postings in digital occupations and the threshold for digital occupations. Figure 1 and Table 12 illustrate the intuitive, inverse relationship between the two – a higher threshold translates into fewer postings in digital occupations. It highlights the differences in content of job ads within occupations.

Figure 5: Size of Digital Demand at Various Thresholds

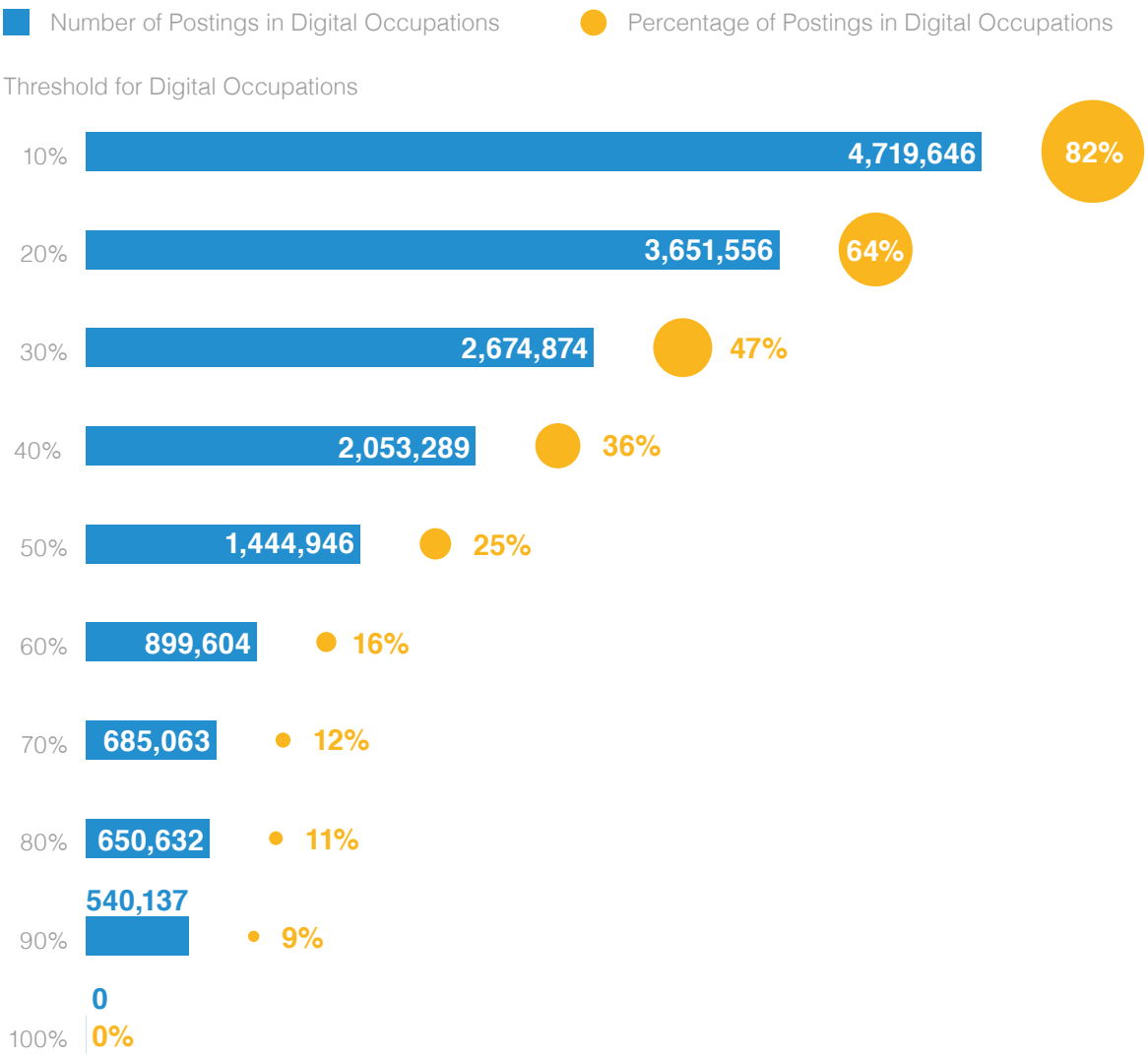


Table 9: Comparison of Digital Threshold Values

Digital Threshold Value	Digital if >= 90%	Digital if >= 50%	Digital if >=15%	Digital if >= 10	Digital if >= 5%
Number of digital occupations	2	29	221	270	320
Percentage of postings in digital occupations	9%	25%	78%	82%	87%
Number of postings in digital occupations	540,137	1,444,946	4,487,030	4,719,646	5,015,105

There is no occupation where every single job posting mentions skills from any one digital skill cluster. This translates to a threshold of 100%. Using a threshold of 90%, only two occupations would be considered digital, accounting for 9% of the UK labour market. This would exclude several IT occupations from the sample, including IT User Support Technicians, IT Operations Technicians, and IT and Telecommunications Directors. Out of all job ads for Web Design and Development Professionals, which as per the UK SOC definition is an IT occupation, 94% mention software and programming skills. Only 34% of all postings for IT Specialist Managers state a requirement for software and programming skills, and 20% networking skills. To understand the spread of digital skills across the UK labour market, we need to look beyond IT occupations. There are no occupations where every single job ad requires the same set of skills.[64]

If we included only occupations where at 50% of the postings mention digital skills, the number of digital occupations would reach 29, accounting for 25% of the UK labour market. The sample would include all IT occupations from the UK SOC list. However, no profession where the skills profile is dominated by skills from the data analysis skill cluster would be represented. The highest percentage of digital skills any occupation has for this cluster is 32%. Research and development managers are an example for an occupation that requires someone who can supervise and lead a team of researchers who work with digital tools daily. Posting data shows that only 14% of the postings explicitly mention data analysis skills, 12% require productivity skills, and only 8% mention software and programming skills. Furthermore, the sample of 29 digital occupations would mostly consist of high-skilled jobs covering only IT occupations. The analysis would therefore not include middle- and low-skills jobs and digital skills outside of software and programming skills.

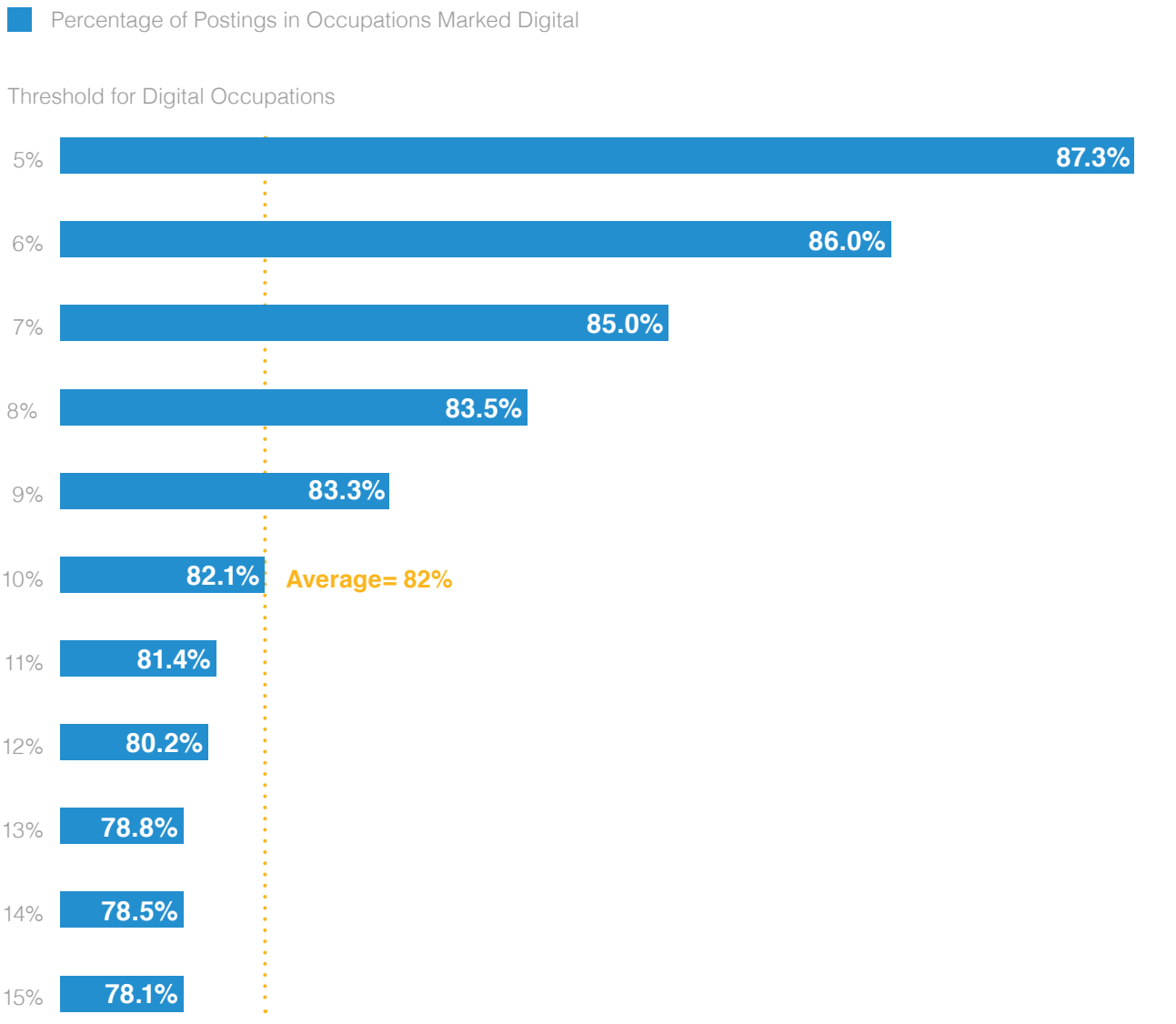
Another digital skill cluster that would not be represented when using a high threshold is the customer relationship management tools cluster. Burning Glass projections estimate that demand for CRM tools will grow around 15% until 2023. Tracking occupations that utilise these tools should therefore be part of the sample that represents the digital labour market. Telephone salesperson is the occupation with the highest percentage of postings mentioning CRM skills, accounting

64. One could argue that Burning Glass's parsing systems might not be able to extract all skills listed in a job posting which drives down the percentage of postings mentioning certain skills. Internal analysis of recall and accuracy of our systems has shown that we capture over 90% of the skills mentioned in postings, of which more than 95% are coded accurately.

for 19%. In addition, 14% of the postings mention baseline digital skills, and 11% list social media tools.

The threshold that makes an occupation digital based on its job adverts can therefore be set relatively low. Figure 2 shows results from an analysis of the percentage of job ads in digital occupations for various thresholds between 5% and 15%. The proportion ranges from 78% at the 15% threshold to 87% for the 5% threshold. Within this range, an average of 82% of postings are found in digital occupations. Around the chosen threshold of 10%, it ranges from 80% at the 12% threshold to 84% at the 8% threshold.

Figure 6: Size of Digital Demand by Digital Threshold (5% - 15%) Sensitivity Analysis Results



To understand the occupations behind the numbers, we identified which occupations would not be tagged as digital if we selected a higher threshold, for example 15%. Using the higher threshold, occupations such as Sales supervisors are an example where 12% of the postings ask for productivity software skills. Supervision or managing jobs require tracking people and projects, which is done via digital tools. Hotel and Accommodation Managers who use booking tools, or Pharmaceutical Technicians would also not be included in the definition.

After evaluating these results, we found that 10% is the optimum threshold to estimate which occupations are digital as accurately as possible. Using 5% as a threshold would overestimate digital demand, while 15% is too conservative and would not represent growing digital skill areas.

Further, it should also be noted that even a slight overestimation of the extent of digitalisation would not impact the broad themes discussed in this report. The fact that digital skills are widely spread across all jobs is a well-established finding[65]. This report aims to provide detailed information on what 'digital' means in the UK labour market, what kind of skills are requested (using the specific digital skill clusters), and, on a very granular level, which digital skills are most frequently asked for by UK employers. All analysis provided highlights the largest trends in each area. Policy measures based on it are therefore unlikely to be at risk of investing in small or potentially irrelevant skills.

The main research question of the report was "which individual digital skills are in greatest demand across the UK labour market". Grouping occupations into digital and non-digital allowed us to obtain an estimate of the spread of digital skills within the occupation classification. To aid in the clarity of the analysis and ease of interpretation by non-technical audiences, the definition of digital occupations used for this report is binary, i.e. an occupation is either digital or non-digital.

While other analyses have used continuous scales to measure digital intensity such as a report on digitalisation in the American workforce by the Brookings Institution[66], we opted for a more straight-forward approach that would make the story easier to follow for the reader without changing the primary story highlighted in the data. These core

65. For examples of reports about digitalisation in the UK see introduction of the report.
66. M. Muro, S. Liu, et al., "Digitalization And the American Workforce", Metropolitan Policy Program, Brookings, 11/2017, https://www.brookings.edu/wp-content/uploads/2017/11/mpp_2017nov15_digitalization_full_report.pdf.

findings do not change meaningfully given various approaches to assessing digitalisation.

Measuring the digital intensity of an occupation also depends on the occupation classification used, i.e. the UK SOC. Highly digital jobs such as Data Scientists (who combine data analysis with programming skills) are not represented in the list of UK SOC occupations. This concurrent focus on specific skills (alongside occupations) helps us identify relevant digital competences, tools, and knowledge required in today's labour market without being restricted by the list of occupations used to determine the sample.

Skills Data

The Burning Glass advanced text analytics identify the skills requested in each job advertisement. This allows users to conduct frequency analysis on the number of jobs requesting a particular skill, and to refine this analysis by occupation, region, industry or any combination of such metrics.

Burning Glass maintains a propriety dictionary of more than 17,000 skills and a wide range of metadata features about each skill. In the section below, we describe our hierarchical taxonomy and several additional analytical approaches we used in the report to ensure that analysts and users can communicate information about skill requirement and their content in the labour market as clearly as possible.

Burning Glass' Skill Taxonomy:

Burning Glass has developed a taxonomy of more than 500 skill clusters by grouping skills that often travel together in job postings. Clustering has been focused on the most frequently occurring skills across a range of industries, in addition to skills in emerging areas.

Burning Glass labour market analysts used the following three criteria to group skills:

- Related skills – e.g., the skill cluster "Statistical Software" includes skills such as R, SAS, and SPSS
- Skills that travel together – e.g., the skill cluster "Administrative Support", includes skills such as meeting planning / facilitation, calendar management, travel arrangements and appointment setting.
- Skills that are trained together – e.g., the skill cluster "Lean Manufacturing" includes skills such as Kanban, Kaizen, Six Sigma, and Lean Six Sigma.

Skills are grouped for ease of analysis of broader talent requirements; for example, structuring and organising the skill-level

information so it can be mapped to learning and training objectives in education. Burning Glass' skill hierarchy and grouping has been created using a combination of hierarchical clustering algorithms[67] and skill similarity[68] based on job postings. Using a variety of distance metrics including Cosine, Dice, Jaccard, and others, the similarity of all skills combinations is determined. If two skills are very close based on the similarity measures, they get assigned to the same skill cluster. The final step included manual reviews of the clusters to resolve any unclear cases.

For the purposes of clarity in this report and to provide a framework that represents the digital skills landscape, skills groups were further clustered into eight digital skill clusters: Baseline digital skills and seven categories of specific digital skills. These are broad categories of skills that each have a unifying digital theme and are based on the skill requirements listed by employers in UK job adverts. The clusters are based on the above-mentioned skill groups of Burning Glass's skills taxonomy.

Additional Metadata Associated with Skills:

Burning Glass maintains a rich set of metadata on each skill, which can be used to identify how skills relate to one another and to track which skills are most important overall and in specific occupations. Our skill metadata includes:

Demand: Describes how often employers request this skill, so job seekers and training programmes may focus on those skills that are of most importance to employers. As we describe below, demand can be segmented by a number of dimensions including industry, experience, and education level so users can track skill importance within relevant subsectors of the market.

Projected Growth: Burning Glass Technologies has developed a methodology for projecting growth of demand for skills, utilising real-time labour market data from Burning Glass as well as external data. Here we explain the methodology used to

67. Hierarchical clustering is an unsupervised learning technique that groups skills that are closest together and merges them. These steps are repeated until all clusters are merged together and can be represented in a dendrogram which illustrates the hierarchical relationship between them.
68. Skill similarity is obtained using a GenSim Doc2Vec model on a large number of documents, i.e. job postings, containing skills and occupations as input. Doc2Vec is an adaptation of word2vec which represents each word in a vector. Doc2Vec generates vectors for the entire document. The algorithm can be used to return the most similar output given the input list, i.e. the most similar skills based on their occurrence in the text from the job ads. Gensim Doc2Vec is a python library designed to train Doc2vec models.

project labour demand, the data sources used, and the levels at which these are available for various projects.

Data Input: Powered by the world's largest and most sophisticated database of labour market data, Burning Glass tracks skill demand as the frequency of skills being required in job postings within specific geography and time span. In addition to Burning Glass labour market data, the model uses statistics from external data sources (including, but not limited to, Google Trends data), which indicate how many people have been searching for information regarding specific skills. The external data is combined with Burning Glass postings information to create a composite input to the econometric model. Combining several data sources has the benefit of smoothing inherent time series trends in the raw postings data and improving the robustness of the model where postings information is infrequent, incomplete or sparse.

Time Series Modelling and Forecasting: Both Burning Glass data and external data are standardised and normalised into time series for skills. We use an econometric time series model to capture features representing the seasonality, long-term trends, and other patterns in job posting data. A machine learning model (support-vector machine) is built on these features to make projections for future postings for skills. The model is trained and validated with historical data, then applied to the latest job market data to make future predictions. The model reports predicted number of postings and rate of growth for each skill 1 year, 5 years, and 10 years into the future.

Model Evaluation and Performance: The projection model is evaluated by comparing our predicted skill demand with actual number of postings requiring certain skills. Specifically, we use mean relative deviation (MRD) to measure prediction accuracy, which measures by what proportion our prediction approximates the actual value. The prediction accuracy of the projection model has consistently been over 90% for all geographical units we cover. In other words, our predicted number of postings requiring certain skills on average has less than 10% of error compared with the actual postings.

For ease of use, values have been grouped into five categories:

Declining – Declining projected by more than 10%

Stable – 10% projected decline – 10% projected growth

Fast growth – 10% - 50% projected growth

Very fast growth – 50% - 100% projected growth

Explosive growth – More than 100% projected growth

Average Salary: Based on job postings, highlights how much employers typically pay for a given skill. Does this skill provide job seekers and incremental salary increase over similar profiles without this skill? Salary is calculated for each job posting that specifies the salary. The mid-point is used when a range is specified, and the mean salary across groups of postings is used for aggregated salary by occupation figures weighted with posting numbers.

Skill Versatility: Burning Glass has developed a skill versatility score, based upon a Gini ratio[69] of skill frequency and occupation / skill combination frequency. It is a measure of how many different occupations frequently request the skill where a higher value indicates a more versatile skill. A highly versatile skill prepares a job seeker for a range of occupations. The score combines the Gini ratio for a skill within one occupation and the Gini for a skill in an occupation group comprising several similar occupations. It therefore accounts for the fact that a skill asked for in equal recall in five occupations that share an occupation group is less versatile than a skill with equal recall in five occupations and five different occupation groups. A high versatility therefore does not necessarily imply very high demand for a skill. For ease of use, the versatility score has been grouped into five categories:

69. Gini ratio, or Gini coefficient - a measure of statistical dispersion. For more information see https://en.wikipedia.org/wiki/Gini_coefficient.

For ease of use, the versatility score has been grouped into five categories:

<0.1 Very low

>=0.1 Low

>=0.3 Average

>=0.7 High

>=0.9 Very high

Skill Level (low / middle / high): Burning Glass categorised the UK SOC occupations into three qualification level requirements, based upon the Home Office immigration rules – Codes of practice for skilled work[70]. Each SOC code is assigned a Regulated Qualifications Framework (RQF) level. These are then bracketed into low (up to and including RQF Level 2), medium (RQF Level 3, 4 and 5) and high skilled (RQF Level 6 and above). For example, SOC 1132 Marketing and sales directors are mapped to RQF Level 6 and are categorised as "high skilled". SOC 3111 Laboratory technicians are mapped to RQF Level 3 and are therefore categorised as "medium skilled" or "middle skilled"

Concentration of digital demand: The concentration of demand, used to illustrate differences in demand for digital occupations across different locations in the UK, is based upon a location quotient calculation. Location quotients are a convenient way of quantifying how concentrated skill demand is within a

The calculation is:

$$\frac{\text{Number of job adverts in occupations focused on a given digital skill cluster in a particular location}}{\text{Number of job adverts in digital occupations in that location}} \Big/ \frac{\text{Number of job adverts in occupations focused on a given digital skill cluster across the UK}}{\text{Number of job adverts in digital occupations across the UK}}$$

The UK-wide average is 1.0, and the output reveals locations where demand for certain specific digital skill clusters is especially high or low, compared to that of the national average. An LQ score of 1.2, for example, indicates 20% higher demand than the UK average (or 1.2 times the UK concentration). Similarly, an LQ score of 0.8 indicates that demand is 20% lower than the UK average.

Risk of Automation: A seminal analysis by Oxford researchers Carl Benedikt Frey and Michael Osborne (2013) found that 47% of jobs are at risk of being automated in the coming decades. Frey and Osborne describe the risk of automation for given occupations as ones that "are potentially automatable over some unspecified number of years, perhaps a decade or two".[71] Automation risk is a likelihood that a job can be automated by existing technology in the coming years. The authors do not make a prediction about how many jobs will specifically decline due to the number of additional inputs into such a mode, including labour costs, technology costs, regulations, etc. We extend the methodology used by Frey and Osborne to assess the role of digital skills in understanding automation risk. Frey and Osborne's analysis uses the O*Net occupation descriptions laying out related skills and tasks for each individual occupation. If all associated tasks could be automated, i.e. "performed by state-of-the-art computer-controlled equipment", an occupation has been labelled as automatable. In order to draw conclusions for the UK labour market, US O*Net occupations have been mapped to UK SOC occupations. This allows us to combine the automation score with detailed information on UK employer demand extracted from job adverts. The probabilities of automation have been calculated as weighted averages for each aggregated group. The overall risk of automation percentage given in this paper varies slightly from the one described in Frey and Osborne's paper. Our analysis is based on job openings and therefore represents the job market from the forward-looking employers' point of view. The overall automation risk is therefore lower.

70. https://www.gov.uk/guidance/immigration-rules/immigration-rules-appendix-j-codes-of-practice-for-skilled-work.
71. C. B. Frey, M. Osborne, "The Future of Employment", Oxford Martin School Working Paper, 09/2013, https://www.oxfordmartin.ox.ac.uk/downloads/academic/future-of-employment.pdf.

About

About Burning Glass

Burning Glass Technologies delivers job market analytics that empower employers, workers, and educators to make data-driven decisions. The company's artificial intelligence technology analyses hundreds of millions of job postings and real-life career transitions to provide insight into labour market patterns. This real-time strategic intelligence offers crucial insights, such as which jobs are most in demand, the specific skills employers need, and the career directions that offer the highest potential for workers. For more information, visit burning-glass.com.

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