CEPS SPECIAL REPORT

Thinking ahead for Europe

Demand for Digital Skills in the US Labour Market: The IT Skills Pyramid

Miroslav Beblavý, Brian Fabo and Karolien Lenaerts

Abstract

This exploratory study assesses the information technology (IT) skill requirements in the 30 most frequently advertised occupations in the United States. On the basis of approximately two million job advertisements, we examine the IT skill requirements of each occupation, making the distinction between basic or general, intermediate and advanced IT skills. For each of these categories, we consider a range of IT skills, such as general computer skills, word processing and spreadsheets, programming and data management. For most occupations only a few of these skills are relevant, but there are exceptions. One particularly interesting finding is that clear patterns emerge: the share of vacancies that refer to each of the IT skills increases as occupations become more complex. At the same time, there is a hierarchy when different IT skills are compared to each other: general computer skills, for example, are more frequently listed than more complex or specialised skills. The IT requirements listed in vacancies are highly consistent with the skills and tasks associated with the corresponding occupations in occupational classifications such as ISCO or O*NET.

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Demand for Digital Skills in the US Labour Market: The IT Skills Pyramid

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Executive summary

This paper assesses the demand for basic, intermediate and advanced digital skills in the US using a sample of about two million vacancies. This sample was obtained from Burning Glass Technologies and covers the 30 most frequently advertised occupations, of which only one is an 'IT profession'. Among the 30 occupations, there are low-, medium and high-skilled occupations. Our focus is on transversal and highly specialised skills, from general 'IT or computer skills', the use of 'text processing' and 'spreadsheets' to 'database management' and 'programming languages'. Between these sets of IT skills there is a clear hierarchy, with basic and general skills being a prerequisite for intermediate skills and intermediate skills being a prerequisite for advanced skills. For each occupation, we calculate the share of vacancies that refer to one or more IT skills with differing levels of complexity. Our work is inspired by a recent report by Burning Glass Technologies, which examines the demand for digital skills in middle-skilled jobs.

Our main conclusions are that:

- IT skills are demanded in occupations of all skill levels. Basic, rather generic IT skills such as the ability to work with computers or the internet, are frequently requested.

- Intermediate IT skills that go beyond basic computer literacy, such as being able to use Microsoft office packages, are also highly demanded but only for middle- and high-skilled jobs.

- We found the vacancies-based assessment of IT requirements in individual occupations to be highly consistent with an assessment inferred from an expert-based definition of the skills and tasks associated with occupations.

- This could enable the use of this resource as an economical and up-to-date source of IT skill requirements for occupations.

Introduction

In the United States, **skill gaps** have been high on the agenda in recent years. After the Great Recession, much attention was devoted to the economy's slow, weak recovery, and concerns were raised about the high unemployment rate and the lack of job creation (Arias & Wen, 2015). At the same time, a substantial number of vacancies remained unfilled, also for high-paying jobs. This paradox has been attributed in a number of contributions to skill gaps: despite an abundance of available workers, many applicants do not meet employers' educational and skill requirements (National Academies of Sciences, 2007; Manpower, 2016). Other research, Cappelli (2014) for example, argues that the issue is a skills mismatch rather than a skills shortage.

The issues of skill gaps and mismatches are also particularly relevant in light of **technological progress**, which creates new occupations and transforms existing ones. The introduction of computers and new technologies has greatly affected many jobs (Autor et al., 2001; Autor et al., 2006; Goos et al., 2009; Cowen, 2013; Ikenaga & Kambayashi, 2016). Much research has pointed to job polarisation, supporting the view that that technological change especially affects middle-skilled jobs (rather than low- or high-skilled jobs). Other work focuses more on 'routinisation' and computerisation. Related to this is rising inequality: while technological change is associated with growing wage inequality in the US (Katz & Murphy, 1991), in Europe it tends to lead to growing unemployment (Weiss & Garloff, 2011).

Against this background, much attention has been devoted to identifying what skills are needed in the labour market. Even though STEM skills seem to be a frequent answer, Bessen (2014) recently shifted attention to IT skills. To identify the supply of IT skills, one could use surveys (Hargittai, 2010). As for skill demand, efforts have been made to identify such skills on the basis of online vacancies (Kureková et al., 2012; Beblavý et al., 2016). When it comes to the categorisation of IT skills, the European Skills, Competences, Qualifications and Occupations (ESCO) classification is a very relevant example, as it distinguishes about 550 different IT skills. Nonetheless, IT skills are considered "job-specific" rather than "transversal", despite growing evidence that computer-related skills are commonly demanded even in the so-called 'low skill' jobs (Kureková et al., 2012).

Our main research questions are therefore: *how important are computer skills in the United States? Which computer skills are demanded most and how does this differ across occupations*? We do not aim to create an extensive skill taxonomy but instead aspire to identify *transferable* computer skills needed in a variety of occupations across all sectors of the economy (not limited to IT jobs or the IT sector). In order to answer these questions, we rely on a dataset of approximately two million job advertisements published on Burning Glass. These vacancies cover the 30 most frequently advertised occupations. This research note is part of a larger series of studies that aim to identify skill requirements in common occupations on the basis of vacancy data.

Burning Glass Technologies recently also produced a report on this topic, with a focus on middle-skill jobs[1] (BGT, 2015). In the report, three clusters of digital skills were identified: productivity software skills, advanced digital skills and occupationally specific digital skills. The productivity software skills lay the foundation for the advanced digital skills (which generally are highly specialised, workers who do not possess these skills would not qualify for jobs that call for them). In this study, we also start

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[1] In the study, middle-skill jobs are defined as occupations for which fewer than 80% of the vacancies require a bachelor's degree and that offer a median hourly wage above the national living wage.

from the idea that there are different sets of IT or digital skills, of differing levels of complexity. While the demand for some of these skills is relatively widespread across occupations, other skills are only relevant for specific occupations or industries. Another dimension is the complexity of some IT skills, which could imply that they require a set of other IT skills as a prerequisite. We set out to examine these relationships more closely. In our work, we consider the demand for productivity software and advanced digital skills for 30 occupations (of which only one could be regarded as an IT job). The occupationally specific digital skills that were also identified by Burning Glass are beyond the scope of this study.

We report the results of our analysis in the form of a **research note**. We chose this format because it allows us to introduce our ideas and present our initial findings, on which we can build in other contributions on this topic. In this note, we mainly focus on the empirical work and only briefly refer to the related literature. The remainder of the note is organised as follows. In the first section, we explain why we concentrate on the case of the United States. In the following section, we introduce our dataset and methodology.

Methodology and data

Why focus on the United States?

In the US, the number of people with internet access at home has grown enormously over the last few decades. In 2014, there were over 300 million mobile-cellular telephone subscriptions, about 100 million fixed-broadband subscriptions and close to 130 million fixed-telephone subscriptions (as shown in Figure 1). In the same year, more than 87% of the population used the internet (Figure 2). Globally, 43.6% of households owned a computer in 2014 and 43.9% had internet access at home (according to data from the International Telecommunication Union). In both cases, 79% of households in developed countries had a computer or internet access, while this number only reached 31% for developing countries. When we consider the share of individuals using the internet in the same year, we note that it is 43.4% globally, 82.2% in developed countries and 35.3% in developing countries. At 87%, the US is therefore performing well. Last year, the PEW Research Center devoted a study to Americans' internet adoption over the previous 15 years (Perrin & Duggan, 2015). While for some groups internet adoption is fully saturated, other groups are lagging behind (especially older adults, those with lower educational attainment and in lower-income households). Digital divides appear to persist.

Figure 1. Number of fixed-telephone, mobile-cellular and fixed-broadband subscriptions in the US (in millions)
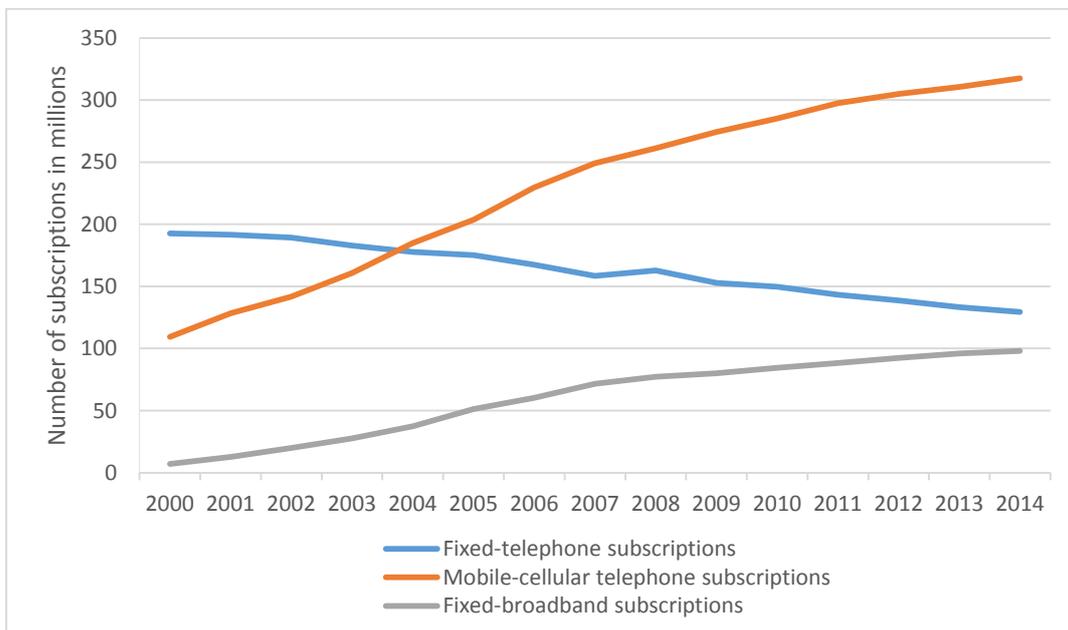
Source: International Telecommunication Union, World Telecommunication/ICT Indicators database).

Figure 2. Percentage of internet users in the United States
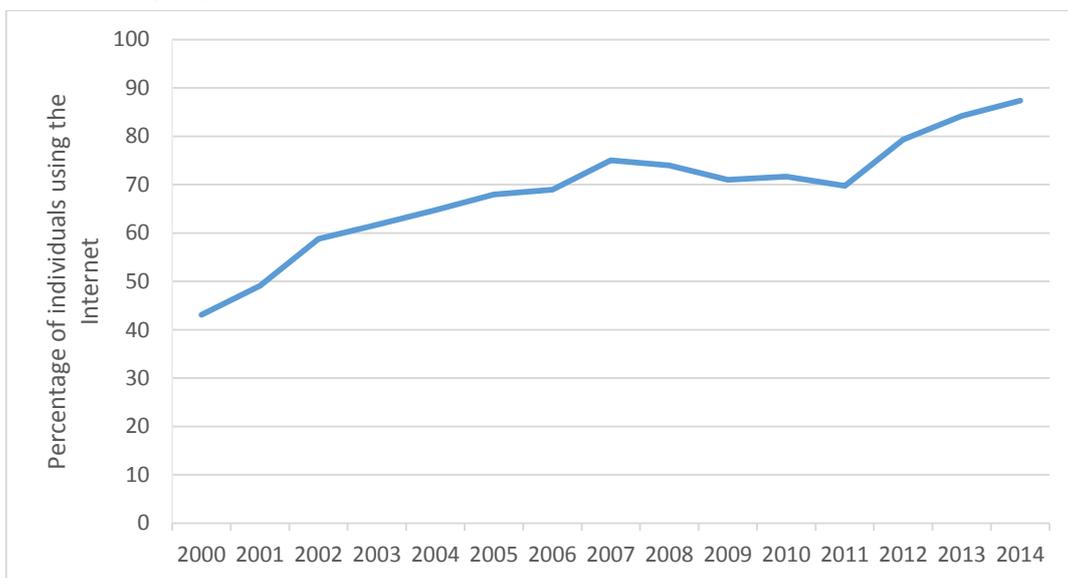
Source: International Telecommunication Union, World Telecommunication/ICT Indicators database).

Use of a computer in the workplace has become highly widespread since the boom of late 1990s and is associated with expectations of a massive productivity boost. In the words of Nobel Prize winner in economics, Robert Solow: "You can see the computer age everywhere but in the productivity statistics". Nonetheless, while computers have had a huge impact on the structure of the economy – and irreversibly changed the skills requirements across occupations, the aggregate effect on growth has been limited at best - an anomaly often referred to as 'Solow's paradox' (Jorgenson & Stiroh, 1999; Peters et al., 2004; Beblavý et al., 2012). Regardless of societal outcomes, a knowledge of

computer skills seems to be a prerequisite for employment in the US, to a degree where the minority of Americans without digital skills could face serious labour market exclusion (Smith, 2015; Horrigan, 2016).

In 2013, a survey was conducted among US citizens aged 16-65yrs in the framework of the OECD's Survey of Adult Skills (PIAAC).[2] In comparison to the other countries examined, the US performs poorly on literacy, very poorly on numeracy and slightly lower than average for problem-solving in technology-rich environments. These results are particularly striking given the relatively high educational attainment of US adults. In addition to these basic skills, the survey also has questions on the use of skills in the workplace and ICT skills, which include the use of e-mail, internet, spreadsheets, word processors, and programming languages, participating in online discussions, and performing online transactions. The results are discussed in more detail in the OECD Skills Outlook and Digital Economy Papers series. This research shows that the US is among the leading companies in ICT usage at home and at work. ICT skills are needed in jobs in all sectors of the economy, yet nearly 20% of all ICT-related positions in the US cluster are in the healthcare and social assistance sector. The 2013 Skills Outlook revealed that in all participating countries, including the US, there is a reasonably large proportion of adults who have either no experience in the use of computers or at most a very low level of familiarity with computer devices and applications. From PIAAC, it is clear that 5.2% of US adults surveyed had no computer experience (OECD average is 9.3%). In another study from the PEW Research Center, Purcell & Rainie (2014) survey a representative sample of adult internet users. Among the employed internet users, e-mail and internet are the main communication and information tools, especially for white-collar office-based occupations. Some 61% and 54% of the respondents indicate that these tools are "very important" to perform their job (respectively).

One of the chapters of the 2015 E-Skills Manifesto, published by the European Schoolnet as part of the European Commission's eSkills for Jobs 2015 campaign, covers digital skills in the US. Because the US is a leader in many technology fields, the chapter argues that the country will need to ensure that its workforce has broad overall digital competencies and advanced skills in computer science and engineering. Yet, a long road lies ahead. Although efforts have been made, primary and secondary schools fall behind in teaching computer skills.

Several recent contributions have therefore pointed to a digital skills gap in the United States, as the demand for digital skills outstrips the supply of these skills. Given the amount of attention that has been devoted to this topic in recent years, we aim to delve deeper into the issue of how important digital skills are in the US labour market and, along with this, which digital skills, and at what level of complexity are in high demand.

What do we investigate?

Our focus is on the prevalence of basic, intermediate and advanced digital skills in job vacancies published online for the 30 most frequently advertised occupations in the US. Our research is inspired by a recent report by Burning Glass Technologies, in which three types of digital skills were identified: *productivity software skills*, *advanced digital skills* and *occupation-specific digital skills* (BGT, 2015). In the report, it becomes clear that there is a hierarchy between the first two types:

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[2] The Survey of Adult Skills provides information on the supply of, and the demand for, information-processing and generic skills in labour markets, how they are developed and maintained over a lifetime, and how they translate into better economic and social outcomes.

having acquired productivity software skills is a prerequisite for being able to acquire advanced digital skills. The study revealed that advanced digital skills are less prominent in vacancies for middle-skilled jobs than productivity software skills.

In our analysis, we take the Burning Glass report as a starting point but add an additional layer of skills and broaden the different skills sets examined. More specifically, we distinguish between three levels of skills: *basic or general digital skills*, *intermediate digital skills* and *advanced digital skills*. Occupation-specific digital skills are not considered in our work. The first level, basic and general skills, is not mentioned in the Burning Glass report. We include it in our analysis, however, because we want to have a better understanding of how important basic skills such as computer skills, internet and e-mail are. Moreover, adding this layer also allows us to look into some general concepts, such as software. The second level, intermediate digital skills, corresponds to what the Burning Glass report labels 'productivity software skills'. It mainly considers word processing and spreadsheets (identified with keywords like MS Office, SAP and Oracle).[3] We include word processing, spreadsheets, PowerPoint, office packages and SAP in the intermediate digital skills category, and further examine different programmes that are associated with them (e.g. Microsoft Word, Excel). The third level represents advanced digital skills. In the Burning Glass study, these skills can be seen as higher-end computer networking skills. Jobs that call for such skills are not accessible to workers who do not possess them. Among the advanced digital skills in the study, there are four groups: customer relationship management (CRM), computer and network support (e.g. SQL, Linux), digital media and design (e.g. Adobe Acrobat), and social media tools and search engine analysis (e.g. blogs).[4] In our work, we start from the skills examined by BGT (2015) and again broaden this category. We distinguish between nine categories (CRM, databases and data management, data analysis and statistics, programming and programming languages, digital media and web design, desktop publishing, CMS, social media and blogging, and SEO) and further examine buzz words like big data, cloud computing, etc. We are aware that our research is not exhaustive, but hope to capture several concepts and sets of skills in this way.

How do we investigate this?

In order to examine employers' demand for digital skills in the United States, we first **collect a sample of job advertisements** published online (on the Burning Glass platform).[5] These vacancies, found by means of web-crawling or 'web-spidering', is a technique whereby a web bot crawls the internet to extract data (Capiluppi & Baravalle, 2010; Kuhn & Shen, 2013 and Carnevale et al., 2014). The data obtained are parsed into smaller fragments and coded. Vacancies with a clear content and

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[3] The report concludes that productivity software skills are listed in 67% of the vacancies for middle-skill jobs and come with a wage premium of 13% (see BGT, 2015).

[4] BGT (2015) reports a wage premium of 38% for the advanced digital skills (in comparison to middle-skill occupations without any digital skill demands) and of 22% (vis-à-vis middle skill occupations that only refer to productivity software skills).

[5] Burning Glass Technologies is a labour market research company that provides researchers with high-quality micro-level data on the US labour market. On the company's website, job advertisements from about 15,000 online job portals and company websites are aggregated. These advertisements are coded and categorised, with occupational and industry codes, company names and locations. Furthermore, many vacancies list education, skills and experience requirements.

structure are much easier to process than vacancies that lack one or both. As the data provided by Burning Glass are highly structured, it is an excellent data source.

We developed a computer program that is capable of going through all these job advertisements and in each case evaluates whether or not a defined regular expression is found within the text. With these regular expressions, we aim to capture keywords that reflect different computer skills, such as MS Word, programming, social media, and data management. We **calculated the share of vacancies that contain these keywords, in total and by occupation**. Our list of keywords to examine includes over 80 entries, or combinations thereof, which correspond to basic and general, intermediate or advanced digital skills. Throughout this report, we will indicate which keywords have been searched for specific skills. We explore combinations of keywords as well as different versions of keywords (e.g. both small and capital letters). Our list of keywords is inspired by other academic and policy-relevant publications on this topic, as well as trade publications, information from specialised job portals, newspaper articles, blog posts and a variety of other sources.

Our algorithm was developed in a rather stringent way, to avoid picking up common words. For example, we are interested in the prevalence of the software package Microsoft Excel. We therefore search for Microsoft Excel, MS Excel and Excel. The latter keyword is potentially problematic, because 'excel' is a common word in the English language and moreover very likely appears in a high number of job advertisements. Employers may look for candidates who 'excel at' certain tasks or have 'excellent' skills. Therefore, we restrict our algorithm to look for 'Excel' or 'excel', followed by a non-alphanumeric character. We use the Python programming language to perform our analysis.

Benefits and limitations of using online job boards and vacancies as a data source

Our study contributes to a rapidly advancing research field that uses vacancies published online to explore labour market dynamics. This field is strongly embedded in earlier work that relied on **printed job postings** to study these dynamics (Jackson et al., 2005; Jackson, 2007; Dörfler & van de Werfhorst, 2009). Job advertisements have always been regarded as an interesting data source because responding to an advertisement is usually the first step in selection and recruitment. Vacancies reflect the skills and qualifications that employers are looking for in their employees. Moreover, they shed light on the types of jobs that arise or re-surface in the economy.

In comparison with printed job advertisements, vacancies published online are easier to collect, have a clear structure, are available in real time, and provide more detailed information as well as information that may not have been available before. Online data also allow researchers to compile larger and more diverse samples in a flexible way. Another advantage is that information can also be derived from the job board where the vacancies are published (Kureková et al., 2015a; Carnevale et al., 2014; Kuhn, 2014; Kuhn & Mansour, 2014).

Nevertheless, one also has to be aware of the limitations of online vacancy data, especially when it comes to **data representativeness** (de Pedraza et al., 2007; Steinmetz et al., 2009; Leithart, 2013; Carnevale et al., 2014; Kureková et al., 2015a). Not all vacancies are published online and for some job openings, no vacancies are published at all. In addition, not all vacancies correspond to actual jobs. Previous research has also suggested that online job portals may target specific candidates, positions or sectors. Until now, no robust methodology to infer labour market statistics from job advertisements has been developed. In this study, we use a very large sample of vacancies for the 30

most frequently advertised occupations in the United States. We are aware of the caveats of this data source and of the fact that our results are not 'generalisable'.

Despite these caveats, an increasing number of scholars have started to use published online job vacancies as a data source, often with a specific focus (Kureková et al., 2012). Researchers have circumvented representativeness issues by concentrating on skill requirements for individual occupations, without passing judgement on the importance of specific skills in the labour market as a whole.

Burning Glass data

Our empirical analysis is based on a sample of 1,998,000 job advertisements that were published on the Burning Glass platform between September 2013 and August 2014. [6] Vacancy data were obtained for the 30 most frequently advertised occupations within the US labour market. In Table 1, we list these 30 occupations as well as the number of job postings that we collected for each of them. On average, we obtained 66,292 vacancies for an occupation. For the five most frequently advertised occupations, we have over 100,000 vacancies.

Table 1. Overview of the 30 most frequently advertised occupation in the United States, their ISCO and O*NET codes and the number of vacancies collected for each of these occupations

ISCO	O*NET	Occupation	Number of vacancies
1	11102100	General and Operations Manager	30,641
2	15115100	Computer Support Specialist	37,705
2	13107100	HR Specialist	36,243
3	43303100	Bookkeeping, Accounting, Auditing Clerk	43,445
3	43101100	First-Line Office Supervisor	35,841
3	31909200	Medical Assistant	40,127
3	13112100	Meeting, Convention, Event Planner	32,204
3	31101400	Nursing Assistant	96,937
4	41201100	Cashier	29,722
4	43405100	Customer Service Representative	197,232
4	43601300	Medical Secretary	35,263
4	43906100	Office Clerk	42,948
4	43601400	Secretary	114,918
4	43307100	Teller	68,339
5	35302100	Combined Food Preparation Worker	46,912
5	35201400	Cooks, Restaurant	30,252
5	27102600	Merchandise Displayer	60,100
5	39902100	Personal Care Aid	38,106
5	41203100	Retail Salesperson	233,851
5	41101100	Sales Worker Supervisor	164,298

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[6] By using a 12-month period, we avoid issues regarding the seasonality of certain occupations.

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5	41303102	Sales Agent, Financial Services	36,172
5	41401200	Sales Representative, Wholesale	111,177
5	33903200	Security Guard	66,122
5	35101200	Supervisor of Food Preparation, Serving Workers	45,957
7	49909900	Installation, Maintenance, Repair Worker	43,157
7	49907100	Maintenance Worker	94,066
8	53303200	Heavy Truck and Tractor Driver	33,180
8	53303300	Light Truck, Delivery Service Driver	38,405
9	37201100	Janitors and Cleaner	33,779
9	53706200	Labourer	71,669

In the first two columns of Table 1, we report the ISCO-08 classification code and the O*NET code of each occupation. O*NET is the *Occupational Information Network* (of the US Department of Labor – the Employment and Training Administration). O*NET is an important tool for policymakers, researchers and career centres in the United States, because the information provided is highly detailed and updated regularly. ISCO, which is short for *International Standard Classification of Occupations*, is the International Labour Organization's occupational classification. We use the most recent edition, published in 2008. In ISCO, occupations are classified on the basis of the skill level and specialisation required. In other words, the ISCO classification uses the complexity of an occupation as a classification criterion.

ISCO-08 consists of **nine classes of occupations** (ranked from most to least complex): 1 managers, 2 professionals, 3 technicians and associate professionals, 4 clerical support workers, 5 service and sales workers, 6 skilled agricultural, forestry and fishery workers, 7 craft and related trades workers, 8 plant and machine operators, and assemblers, and 9 elementary occupations (when 0 armed forces occupations is not considered). Other studies have used the ISCO-08 classification to distinguish low-skilled, medium-skilled and high-skilled occupations (Kureková et al., 2015b). Generally, occupations with ISCO codes 1-3 are regarded as high-skilled, occupations with codes 4-8 as medium-skilled and occupations with code 9 as low-skilled. In our sample, we count one occupation with ISCO code 1, two with ISCO code 2, five with ISCO code 3, six with ISCO code 4, ten with ISCO code 5, and two each with ISCO codes 7, 8 and 9 (i.e. 8 high-skilled, 20 medium-skilled and 2 low-skilled occupations). Besides ISCO code 6, occupations of all ISCO classes are represented in our study.

Findings

Comparison of vacancies and tasks lists

As a first step in our analysis, we take a broad perspective and aim to outline the skills and other requirements that are associated with each of the occupations examined. To this end, we use a list of tasks that commonly belong to each occupation and compare it with 'word clouds' that are created on the basis of the full sample of vacancies for each occupation. The list of tasks is derived from existing occupation classifications, such as O*Net,[7] ISCO or ESCO (Tijdens et al., 2013; Fabo & Tijdens,

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[7] Note that one of the analysed occupations, 49-9099.00 - Installation, Maintenance, and Repair Workers, All Other, does not have any defined tasks, thus task analysis covers only 29 occupations.

2014; Visintin et al., 2015). The objective of this comparison is to understand what types of skills and requirements are associated with the occupations in our sample and to see to what extent this is reflected in the vacancies.

The word clouds presented below were created with the R programming language. For each of the occupations, we scanned through all available vacancies and kept track of the 100 most frequently mentioned words. We excluded stopwords (i.e. commonly used words in the English language, such as 'my' or 'me') and other common words (e.g. 'this') and corrected for punctuation, stemming, etc. In Figure 3, we compare the list of common tasks with the word clouds generated on the basis of the vacancies in our sample for one low-skilled, one medium-skilled and one high-skilled occupation. For the low-skilled occupation, janitors and cleaners, we notice that the list of tasks makes no reference to IT-related skills. A similar picture emerges from the word cloud; it reflects the list of common tasks very well. Common words are experience, cleaning, clean, wipe, sweep, mop, sanitation etc. No IT-skills are found. We then turn our attention to a medium-skilled occupation. In this case, we focus on medical secretaries. This occupation was selected because it is a middle-skill job that does require IT skills: when we look at the list of tasks, we notice that text processing is among the tasks mentioned (e.g. compiling reports, documents and correspondence, completing forms, maintaining files, records and technical library). Many of these tasks are also likely to involve spreadsheets (e.g. preparing financial statements, billing, drafting budgets). Other tasks that can be expected to be performed on a computer are scheduling and confirming appointments, communication with patients and staff (which could entail using scheduling software and e-mail). Tasks related to data management and data entry seem likely as well. These tasks are also reflected in the word cloud. In the cloud, we first notice the emphasis on the medical dimension of the job, with words such as health, medical, patient, care, hospital, etc. A second dimension that jumps out is secretarial work, with words like clerical, billing, scheduling, administrative, communication, forms and office. The computer-related skills are reflected in computer, systems, data and programs. Finally, we consider a high-skilled occupation and in this case we selected the computer support specialists. This occupation is a typical IT-job and could have the highest demand for IT-skills of all occupations. Moreover, it is likely that any specialised IT skills (or advanced digital skills) will also show up here. Among the list of tasks, we indeed spot several advanced digital skills, such as management of operating systems and programming. We also find a number of general concepts, like hardware and software. The list of tasks seems rather general and does not include details such as specific programming languages. When we look at the word cloud, we find words such as computer, electronics, online, equipment, systems, software, access, technology, etc. We also find a number of words that highlight the customer-related dimension of this job, such as client, support, services, etc.

Figure 3. Comparison of the list of tasks and the most frequent keywords in the vacancies

Janitor & Cleaner (low-skilled)	
List of tasks • Sweeping or vacuum-cleaning, washing and polishing floors, furniture and other fixtures in buildings, coaches, buses, trams, trains and aircraft • Making beds, cleaning bathrooms, supplying towels, soap and related items • Cleaning kitchens and generally helping with kitchen work, including dishwashing • Picking up rubbish, emptying garbage containers and taking contents to waste areas to removal	

Medical Secretary (medium-skilled)	
List of tasks • Scheduling and confirming medical appointments and communicating messages for medical staff and patients • Compiling, recording and reviewing medical charts, reports, documents and correspondence • Interviewing patients to complete forms, documents and case histories • Completing insurance and other claims forms • Maintaining medical files and records and technical library • Preparing financial statements and billing procedures • Assisting in the preparation of budgets, drafting of contracts and purchasing or acquisition orders • Supervising the work of office support workers and other office staff	

Computer Support Specialist (high-skilled)	
List of tasks • Answering user enquiries regarding software or hardware operation to resolve problems • Entering commands and observing system functioning to detect errors • Installing and performing minor repairs to hardware, software, or peripheral equipment, following design or installation specifications • Overseeing the daily performance of communications and computer systems • Setting up equipment for employee use, performing or ensuring proper installation of cables, operating systems, or appropriate software • Maintaining records of daily data communication transactions, problems and remedial actions taken, or installation activities • Reproducing technical problems encountered by users • Consulting user guides, technical manuals and other documents to research and implement solutions	

In addition to the word clouds, we coded all relevant tasks defined for the occupation (i.e. from ISCO and O*Net) as follows: for each of the tasks (about 25 defined tasks for an occupation), we determined whether it clearly requires IT skills (e.g. use computers to produce signage), possibly requires IT skills (e.g. maintain records of daily data communication transactions) or clearly does not require IT skills (e.g. loading and unloading vehicles, trucks and trolleys). The second group entails all tasks that do not clearly imply the use of IT skills (which would make them fall under the third group), but at the same time could be performed in such a way that they would require IT skills. Coding was performed by two independent coders.

Table 2 summarises the share of tasks requiring IT skills and contrasts them with the share of vacancies requiring any IT skill. We find decent (r ~= 0.6) correlation for both the share of tasks possibly and certainly requiring an IT skill. This tells us that the lessons learned from vacancies are largely consistent with experts' conceptualisations of individual occupations. Another result is that some occupations, which rank high in IT skill demand, are not necessarily associated with IT-related tasks in the same way as e.g. computer support specialists. Instead, they perform a range of tasks, e.g. maintaining correspondence or records, which do not necessarily require IT skills but are typically performed using the IT technologies on the contemporary job market.

Table 2. Share of vacancies requiring IT skills and share of tasks associated with occupations that require IT skills

Occupation	IT skill requirement in vacancies (%)	Task possibly requiring IT skills (%)	Task certainly requiring IT skill (%)
General and Operations Managers	32	59	0
HR Specialists	39	63	17
Meeting, Convention, Event Planners	57	82	0
Computer Support Specialists	62	25	75
Merch Displayers	22	10	3
Nursing Assistant	24	8	0
Medical Assistants	19	21	25
Security Guards	11	17	0
Supervisors Of Food Prep, Serving Workers	11	22	0
Cooks, Restaurant	3	15	0
Combined Food Prep Workers	8	14	0
Janitors And Cleaners	5	7	0
Personal Care Aides	9	30	0
Sale Worker Supervisors	14	54	4
Cashiers	11	40	3
Retail Salesperson	20	48	0
Sales Agents, Financial Services	22	79	0
Sales Repr Wholesale	26	63	0
First-Line Office Supervisors	38	51	3
Bookkeeping, Accounting, Auditing Clerks	45	63	31
Tellers	25	62	21

CS Representatives	35	55	5
Medical Secretaries	38	63	17
Secretaries	53	53	30
Office Clerks	44	52	32
Maintenance Worker	24	16	0
Installation, Maintenance, Repair Workers	23	23	3
Heavy Truck And Tractor Drivers	5	3	5
Light Truck, Delivery Service Drivers	6	23	0
Labourers	13	0	0
Correlation with skill requirement		**0.59**	**0.66**

Note that in this exercise we combined tasks from two sources – ISCO and O*NET. The difference between these sources, however, is limited. The tables in the Appendix shows that correlations are indeed very similar to one reported in Table 2 when only the O*NET tasks are considered. Interestingly, when the 'possibly' and 'certainly required' categories are merged, the correlation with IT skills requirement measures in occupations is high, suggesting that the IT skills presence in vacancies can be used as a very good predictor of IT intensity of occupations as understood by experts who define the tasks associated with occupations.

Demand for basic digital skills: general results

In Table 3, we list the number and the percentage of job advertisements in which basic and general IT skills are mentioned. In 690,922 of the 1,988,768 job advertisements in our sample, **computer skills** are requested (this is captured by the keyword 'computer'). This corresponds to **34.74% of the vacancies**. Across the occupations, this number varies from 5% (personal care aides) to 92% (meeting, convention, event planners). Other occupations with a rather low demand for computer skills are cooks (8%), cashiers (11%), janitors and cleaners (12%) and combined food preparation workers (13%). Other occupations with a high demand for such skills are the computer support specialists (65%), medical secretaries (58%) and merchandise displayers and office clerks (54%).

Besides computer skills, we further consider how many advertisements include general concepts such as **software** or **hardware**. Some **9.45%** of the vacancies mention the keyword software, while **2.75%** refers to the keyword hardware. The three occupations with the highest counts for 'software' are the computer support specialists (37%), the secretaries (30%) and the bookkeeping, accounting and auditing clerks (24%). The three occupations with the highest percentages for 'hardware' are the meeting, convention and event planners (37%), the computer support specialists (23%) and the merchandise displayers (8%). Especially for this keyword, results should be interpreted with caution because 'hardware' can also refer to non-computer related features. In this regard, the difference in percentage between the second and third occupation is striking.

The table further presents the number and percentage of vacancies that demand internet and e-mail skills. Some 379,021 of the vacancies demand **internet or web skills**, which is equal to **19%**. This number varies between 6% and 60%. These skills appear to be the least important for the combined food preparation workers, cooks, nursing assistants, labourers, and supervisors of food preparation and serving workers. At the other end of the distribution, we find the merchandise displayers (60%),

computer support specialists (44%), meeting, convention and event planners (45%), security guards (29%) and retail salespersons (28%). After obtaining these results, we went back to the vacancy data to manually check their validity, to ensure that we are picking up internet skills rather than references to the employers' web pages (where applicants can find more information e.g.). We focused on the occupations with high counts for these keywords and did not see many references to employers' websites that would be picked up by our algorithm.

Finally, Table 3 also reports the number and percentage of job advertisements that contain the keywords **e-mail** or **Outlook** (in all three cases several variations are considered, e.g. Outlook, MS Outlook, Microsoft Outlook, etc.). We find that 6% of the vacancies refer to Outlook, while 17% mentions e-mail. If we consider the number of vacancies that mention e-mail, Outlook or both, we notice that this is equal to about 22%. This number ranges from 7% to 93% across occupations. Again, some caution is needed for similar reasons as for the keywords 'internet' and 'web' (that is why we also count how many vacancies refer to Outlook specifically).

Table 3. Number and percentage of vacancies in which general IT-related concepts such as computer, software, hardware, internet / web and e-mail are demanded

	Number of vacancies	Percentage of vacancies	Max. across occupations (%)	Min. across occupations (%)
Computer	690,922	34.74	92.34	4.99
Software	187,850	9.45	37.46	1.51
Hardware	54,607	2.75	36.72	0.04
Internet / Web	379,021	19.06	59.55	6.02
E-mail / MS Outlook	434,975	21.87	93.05	7.07
* E-mail/Email	344,147	17.30	40.56	6.27
* MS Outlook	119,513	6.01	52.86	0.46

Table 4 shows the five occupations with the highest demand for basic or general computer skills examined: computer, software, hardware, internet and e-mail. In the table, the percentage of vacancies for a specific occupation that refers to these keywords is mentioned. There is great variation, both across occupations for individual keywords (e.g. while 92% of the advertisements for meeting, event and convention planners request computer skills, this number is 54% for office clerks and merchandise displayers) and across keywords (e.g. software and hardware appear in no more than 37% of the vacancies, while these numbers exceed the 90% cut-off for computer skills and e-mail). Interestingly, some of the occupations appear in the top five for multiple keywords: computer support specialists, office clerks, secretaries and combined food preparation workers appear three times, cooks (restaurant), janitors and cleaners and CS representatives twice.

Table 4. The occupations with the highest demand for computer, software, hardware, internet / web and e-mail knowledge or skills (number between brackets is share of vacancies that comprises the keyword in the column header)

	Computer	Software	Hardware	Internet / Web	E-mail / MS Outlook
1	Meeting, Convention, Event Planners (92%)	Secretaries (37%)	Combined Food Preparation Workers (37%)	CS Representatives (60%)	Combined Food Preparation Workers (93%)
2	Computer Support Specialists (65%)	Cooks, Restaurant (30%)	Secretaries (23%)	Combined Food Preparation Workers (45%)	Cooks, Restaurant (41%)
3	Medical Secretaries (58%)	Computer Support Specialists (24%)	CS Representatives (8%)	Secretaries (44%)	Office Clerks (33%)
4	Office Clerks (54%)	Office Clerks (21%)	Retail Salesperson (7%)	Tellers (29%)	Computer Support Specialists (31%)
5	Merchandise Displayers (54%)	Janitors And Cleaners (17%)	Installation, Maintenance, Repair Workers (6%)	Personal Care Aides (28%)	Janitors And Cleaners (28%)

Demand for basic digital skills: results for low-, medium- and high-skilled occupations

How do results vary according to the complexity of the occupations? In Table 5, we compare our findings for three types of occupations: low-skilled, medium-skilled and high-skilled. In Table 5, a clear pattern emerges: the number of job advertisements that refer to basic or general computer skills is lower for the low- than for the medium-skilled occupations and lower for the medium- than for the high-skilled occupations (in each case, with the exception of hardware, this is due to the dual meaning of the word, as explained above, which calls for caution).

Table 5. Demand for basic digital skills and general IT-related concepts for three groups of occupations

	Low-skilled occupations (ISCO 9) (%)	Medium-skilled occupations (ISCO 4-8) (%)	High-skilled occupations (ISCO 1-3) (%)
Computer	22.25	33.58	43.51
Software	3.69	8.97	13.23
Hardware	2.51	1.90	6.47
Internet / Web	9.87	19.38	20.39
E-mail / MS Outlook	17.04	20.78	28.03

This information is then transformed into an IT-skills pyramid for occupations of different levels of complexity, as depicted in Figure 4. The pyramid has five horizontal slices, reflecting different skills, and three vertical slices, reflecting different sets of occupations (low-skilled on the left, medium-skilled in the middle, and high-skilled on the right). Horizontal slices show the share of vacancies that demand a certain skill or a set of skills, such as e-mail and MS Outlook in the second slice. From a comparison of the occupations, it is clear that the same skills appear in the same order: in all cases

general computer skills are demanded the most, while software and hardware are only referred to in a handful of vacancies.

Figure 4. The basic IT skills pyramid for occupations of different levels of complexity
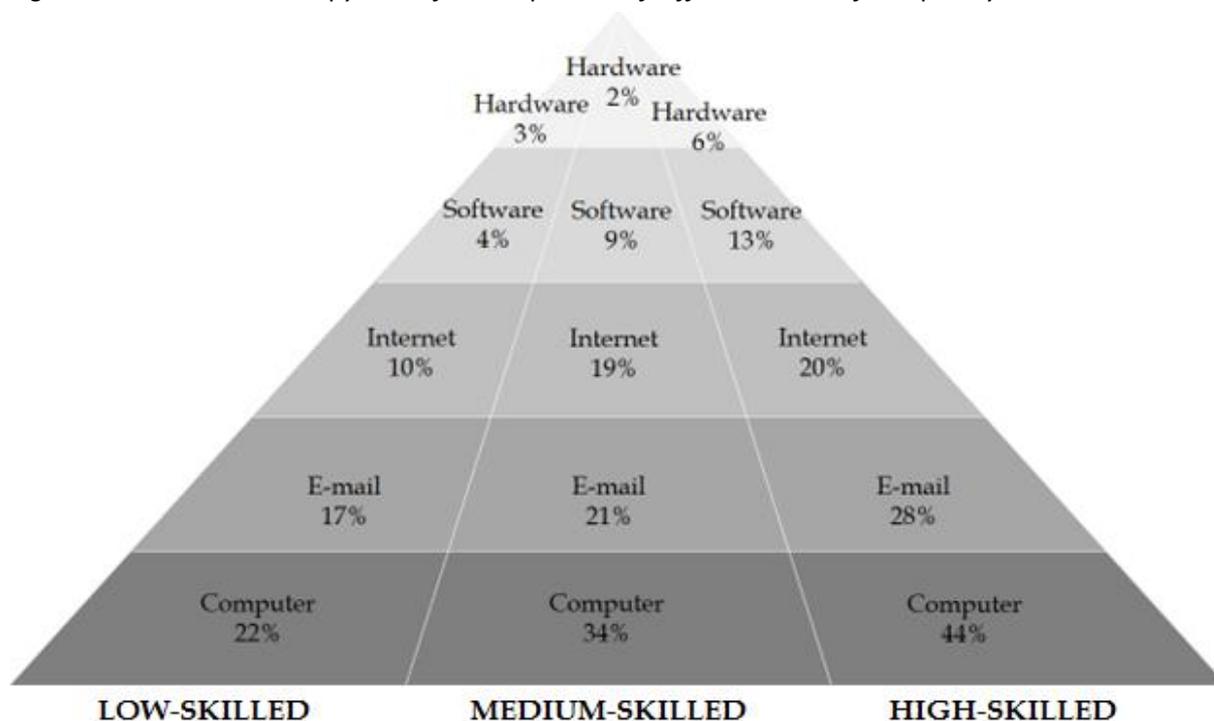
Demand for intermediate digital skills: general results

We now turn to the second layer, the intermediate digital skills. Following the report of BG (2015), this layer of skills coincides with the productivity software skills, which in our work comprises five categories: word processing, spreadsheets, PowerPoint, office and SAP. Table 6 presents an overview of the intermediate digital skills studied as well as the number and share of job postings across all occupations in which they are found, and the maximum and minimum levels.

A first set of productivity software skills are those related to word or text processing and the programmes that are commonly used to perform such tasks. We therefore search the vacancies for keywords such as word processing, text processing, Microsoft Word, MS Word, Word, and combinations thereof.[8] The results of this search are reported in the first line of Table 6 and show that in total almost 13% of the vacancies refer to word processing. Across occupations, this varies from 1% to more than half of all vacancies. When we turn to the second set of skills, entailing spreadsheets, MS Excel, Microsoft Excel or Excel or a combination of these keywords, we notice that they appear in 14% of all job advertisements (again ranging from less than 1% to about 55% when individual occupations are considered). The third row of Table 6 displays counts for keywords related to Microsoft PowerPoint, MS PowerPoint, etc. (here, we did not search for words such as present, presenting or presentations, because these very likely appear in nearly all vacancies). In total, about 3% of the vacancies call for such skills. For individual occupations, this number varies between less than 1% and 20%. All of the aforementioned skills are office packages, and therefore we extend our

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[8] We always use both Microsoft and MS as search keys.

search to capture keywords such as MS Office, Open Office, Libre Office and so on. In 170,747 of the vacancies, or 9%, an explicit reference to office packages is made. This number is as high as 31% for some occupations, and less than 1% for others. Note that 428,594 vacancies, or 21.55%, refer to at least one of the following keywords: Text Processing, Spreadsheets, MS PowerPoint, or Office. To avoid double counting, we do not simply add the individual counts but instead go through all vacancies and include them when at least one of the keywords is found. Some 68% of the job advertisements comprises at least one of the keywords mentioned so far. Finally, we examine SAP skills, which appear in 1% of the vacancies when all advertisements are considered together.

Table 6. Overview of the intermediate digital skills

	Number of vacancies	Percentage of vacancies	Max. across occupations (%)	Min. across occupations (%)
Word Processing / Text Processing / MS Word	255660	12.86	54.30	1.02
* Word Processing / Text Processing	47794	2.4	16.37	0.11
* MS Word / Word	255638	12.85	54.30	1.02
Spreadsheet / MS Excel	287848	14.47	54.53	0.47
* Spreadsheet	52995	2.66	18.07	0.04
* MS Excel / Excel	256906	12.92	54.27	0.44
MS PowerPoint	53540	2.69	19.88	0.03
MS Office / Open Office / Libre Office	170747	8.59	31.39	0.38
SAP	20171	1.01	5.39	0.01

Table 7 presents for each of the intermediate digital skills the five occupations with the highest demand, i.e. the five occupations with the highest shares of job advertisements that call for these skills. Note that the categories considered are identical to those in Table 6 (despite their slightly different names). Interestingly, for low-skilled occupations like janitors and cleaners, employers mention these intermediate digital skills explicitly in their vacancies.

Table 7. The occupations with the highest demand for different intermediate digital skills (number between brackets refers to the share of vacancies that comprise the keyword in the column header)

	Text Processing	Spreadsheets	PowerPoint	Office	SAP
1	Combined Food Preparation Workers (54%)	Combined Food Preparation Workers (55%)	Cooks, Restaurant (20%)	Cooks, Restaurant (32%)	Computer Support Specialists (5%)
2	Cooks, Restaurant (51%)	Cooks, Restaurant (51%)	Janitors And Cleaners (8%)	Office Clerks (22%)	Labourers (3%)
3	Office Clerks (37%)	Computer Support Specialists (47%)	Office Clerks (7%)	Janitors And Cleaners (21%)	Cooks, Restaurant (2%)
4	Computer Support Specialists (33%)	Office Clerks (34%)	Bookkeeping, Accounting, Auditing Clerks (5%)	Computer Support Specialists (21%)	Janitors And Cleaners (2%)

| 5 | Janitors And Cleaners (26%) | Janitors And Cleaners (28%) | General and Operations Managers (5%) | Cashiers (19%) | Medical Secretaries (2%) |

Demand for intermediate digital skills: results for low-, medium- and high-skilled occupations

We then distinguish between three groups of occupations, low-skilled, medium-skilled and high-skilled, to verify whether any differences can be detected in terms of productivity software requirements. This comparison is again presented in a table and a skill pyramid. Table 8 reveals a similar pattern to before: the percentage of vacancies that request specific productivity software skills is the highest for the high-skilled occupations and the lowest for the low-skilled ones, while medium-skilled occupations are found in the middle. This pattern is found for text processing, spreadsheets and office packages. On the other hand, SAP is mentioned most frequently among the low-skilled occupations – although the differences with the other groups are minor. For PowerPoint, again the differences are minor but here we detect the highest demand for the medium-skilled occupations.

Table 8. Demand for intermediate digital skills for three groups of occupations

	Low-skilled occupations (ISCO 9) (%)	Medium-skilled occupations (ISCO 4-8) (%)	High-skilled occupations (ISCO 1-3) (%)
Text processing	4.55	12.10	18.59
Spreadsheets	4.16	13.87	20.17
PowerPoint	0.40	2.86	2.64
Office	3.27	8.48	10.62
SAP	2.07	0.87	1.33

When these results are presented in the form of an IT skills pyramid (where vertical slices separate occupations of different skill levels), we notice that the order of the horizontal slices has shifted (Figure 5). For low-skilled occupations, text processing seems more relevant than spreadsheets while the opposite holds for medium-skilled and high-skilled occupations. Also, SAP and PowerPoint have changed positions with regards to the medium- and high-skilled occupations.

Figure 5. The intermediate IT skills pyramid for occupations of different levels of complexity
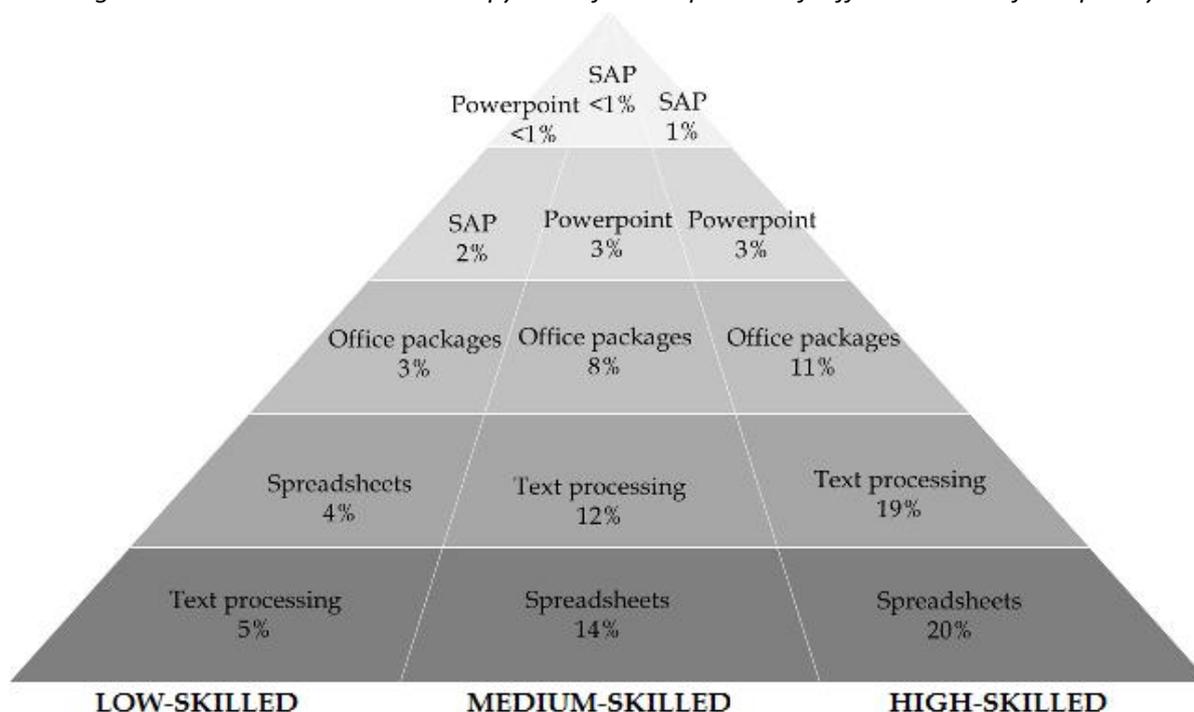
Demand for advanced digital skills: general results

In the final section of this paper, we focus on advanced digital skills. These skills build upon other IT skills of lower levels of complexity. As in the Burning Glass report, those who do not possess the advanced digital skills required in the job postings would not qualify for positions that call for them (BGT, 2015).

In our study, we investigate nine classes of advanced digital skills: CRM (customer relationship management), databases and data management, data analysis and statistics,[9] programming and programming languages, digital media and web design, desktop publishing, CMS (content management system), social media and blogging, and SEO (search engine optimisation.) The list of keywords used to identify each of these categories is presented in Figure 6. For each category, we search for the general concepts (e.g. social networks) and for specific programs that are commonly used in each case (e.g. Twitter). This list of keywords is based on the results from Burning Glass Technologies (BGT, 2015), as well as on a high number of online sources that were consulted (such as blog posts, newspaper articles, trade publications, and specialised job boards) in the process. With this list, we aimed to capture relatively well-known concepts and programs that require advanced digital skills rather than trying to capture all skills mentioned. The scope of our paper is to analyse the demand for different types of IT skills in the 30 most frequently advertised occupations, not to capture every single IT skill that is mentioned in the vacancies.

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[9] Note that we also examined the prevalence of the statistical program 'R' in the vacancies, but decided not to include these results in the study because of the risk that these counts are biased upwardly due to the prevalence of the letter R in the English language.

Figure 6. List of keywords used to identify advanced digital skills (left name of aggregated category, right keywords associated with it)

CRM	• CRM • customer relationship manangement
Databases & data management	• Database, data base, database management, data base management, data management, data entry, data warehouse • SQL, Microsoft Acces, MS Access, Access
Data analysis & statistics	• Data analysis, data processing, statstics • Stata, EViews, SAS, SPSS, Matlab
Programming & programming languages	• Programming, programming language • C++, C+, C++ program, C+ program, Python, Java, Ruby, Perl, PhP, Fortran, Visual Basic, VBA.net, Javascript
Digital media & web design	• Digital media, digital design, web design, we page design, web development • Illustrator, InDesign, Photoshop, CSS
Desktop publishing	• Desktop publishing • Microsoft Publish, MS Publish, Visual Studio
CMS	• CMS, content management system, client mangament system, customer relationship management, contact management system • Drupal, Plone, Joomla
Social media & blogging	• Social media, social network, Facebook, Twitter, LinkedIn • Blog, WordPress
SEO	• SEO, search engine optimisation • Google Analytics

Table 9 reports for each category of the advanced digital skills the number and percentage of job advertisements that list them, as well as the minimum and maximum shares across occupations. One of the most striking results presented in the table is that very few vacancies refer to advanced digital skills: for five of the categories, less than 1% of the vacancies refer to any of the keywords. For three other categories, the share is below 3%. Only for one category: **databases and data management**, do over 10% of the job advertisements make reference to any of the keywords examined (12% to be more precise). By listing both the counts for the aggregated categories and for individual keywords, we gain more insight into the composition of these categories. Note that aggregated categories are constructed by counting all job advertisements that refer to at least one of the keywords mentioned in the subgroups.

Another important result is that for some of the advanced digital skills, the **variation across occupations is huge**. This applies particularly to databases and data management (the minimum

value is 1%, the maximum is equal to 39%) and programming and programming languages (the minimum is 1%, the maximum is 21%). For the other advanced digital skills, smaller divergences are detected. Examples are data analysis and statistics (0.15%-8.94%), social media and blogging (0.41%-6.71%).

Table 9. Overview of the advanced digital skills. The keywords in bold refer to aggregated categories

Advanced digital skills	Number of vacancies	Percentage of vacancies (%)	Max. across occupations (%)	Min. across occupations (%°
CRM	**17639**	**0.89**	**4.08**	**0.03**
Databases & data management	**232160**	**11.67**	**38.63**	**1.25**
* Database, data base, data / database / data base management, data entry, data warehouse	173315	8.71	34.25	0.32
* MS Access	70504	3.55	36.21	0.11
* SQL	2405	0.12	3.30	0.01
Data analysis & statistics	**39662**	**1.99**	**8.94**	**0.15**
* Data analytics/processing, statistics	39242	1.97	8.86	0.14
* EViews	2	0.00	0.00	0.00
* Stata	33	0.00	0.01	0.00
* SAS	423	0.02	0.11	0.00
* Matlab	20	0.00	0.01	0.00
* SPSS	117	0.01	0.06	0.00
Programming & programming languages	**31127**	**1.57**	**21.19**	**0.17**
* Programming language, programmer	679	0.03	0.47	0.00
* Programming	18272	0.92	5.76	0.00
* Python	282	0.01	0.28	0.00
* Ruby	250	0.01	0.11	0.00
* Fortran	8	0.00	0.01	0.00
* Visual Basic, VBA.NET	407	0.02	0.52	0.00
* Java	974	0.05	0.94	0.00
* PhP	5747	0.29	0.69	0.09
* C+/C++ program	23411	1.18	20.86	0.01
* Perl	289	0.01	0.31	0.00
* JavaScript	370	0.02	0.26	0.00
Digital media & web design	**7293**	**0.37**	**1.91**	**0.02**
* Digital media/design	506	0.03	0.12	0.00
* Web/web page design, web development	1827	0.09	1.01	0.01
* Illustrator	569	0.03	0.13	0.00
* InDesign	553	0.03	0.23	0.00
* Photoshop	1219	0.06	0.40	0.00

* CSS	3642	0.18	0.93	0.01
Desktop publishing	**2188**	**0.11**	**1.13**	**0.00**
* Desktop publishing	1678	0.08	0.91	0.00
* MS Publish	482	0.02	0.25	0.00
* Visual Studio	61	0.00	0.10	0.00
CMS	**11574**	**0.58**	**4.64**	**0.01**
* Content/client/customer/ contact management system	11354	0.57	4.64	0.01
* Drupal	133	0.01	0.07	0.00
* Joomla	141	0.01	0.05	0.00
* Plone	8	0.00	0.00	0.00
Social media & blogging	**53569**	**2.69**	**6.71**	**0.41**
* Social media, social network	13439	0.68	3.64	0.07
* Facebook	27021	1.36	3.54	0.23
* LinkedIn	21045	1.06	3.69	0.17
* Twitter	20769	1.04	2.39	0.21
* Blog	5716	0.29	3.06	0.01
* WordPress	468	0.02	0.23	0.00
SEO	**429**	**0.02**	**0.20**	**0.00**
* SEO, search engine optimisation	406	0.02	0.20	0.00
* Google Analytics	39	0.00	0.03	0.00

We then investigate for which occupations advanced digital skills are most highly demanded; see below, Table 10. Many of the occupations here are typical medium- to high-skilled white-collar office jobs. Four occupations appear more than once: HR specialist (4 times), secretary (3 times), office clerk (2 times) and bookkeeping, accounting, auditing clerks (2 times). One important result is that the general concepts typically receive many more counts than the individual programs listed.

Table 10. The occupations with the highest demand for different advanced digital skills (numbers in brackets refer to share of vacancies that comprise the keyword in the column header. Only skills that appear in at least 1% of total vacancies are listed)

	Databases & data management	Data analysis & statistics	Programming & programming languages	Social media & blogging
1	Secretary (39%)	Secretary (9%)	Security Guard (21%)	HR Specialist (7%)
2	Meeting, Convention, Event Planner (37%)	Office Clerk (7%)	Computer Support Specialist (3%)	Sales Representative Wholesale (5%)
3	Office Clerk (36%)	Bookkeeping, Accounting, Auditing Clerk (6%)	HR Specialist (3%)	Nursing Assistant (5%)
4	HR Specialist (33%)	HR Specialist (6%)	Secretary (2%)	Personal Care Aide (4%)
5	Bookkeeping, Accounting, Auditing Clerk (31%)	First-Line Office Supervisor (5%)	Maintenance Worker (2%)	Sales Agent, Financial Services (4%)

Note: The result for security guard should be interpreted with caution, as in this case the algorithm captured the use of programs rather than programming or programming languages.

Demand for advanced digital skills: results for low-, medium- and high-skilled occupations

In Table 11, we compare the percentages of job advertisements across low-, medium- and high-skilled occupations that refer to each of the broad categories of advanced digital skills. While a similar pattern emerges to that for the other digital skills, the differences across the three skill groups are limited. We therefore do not devote much more attention to this table but instead focus on a set of occupations that are particularly interesting in the next sections.

Table 11. Demand for advanced digital skills for three groups of occupations

	Low-skilled occupations (ISCO 9) (%)	Medium-skilled occupations (ISCO 4-8) (%)	High-skilled occupations (ISCO 1-3) (%)
CRM	0.09	0.82	1.41
Databases & data management	5.18	10.86	17.13
Data analysis & statistics	0.49	1.91	2.80
Programming & programming languages	0.42	1.70	1.31
Digital media & web design	0.12	0.35	0.53
Desktop publishing	0.00	0.12	0.09
CMS	0.11	0.36	1.68
Social media & blogging	2.25	2.51	3.62
SEO	0.01	0.02	0.02

As a next step, we zoom in on four occupations that have shown relatively high demands for the advanced digital skills: secretaries, HR specialists, computer support specialists and office clerks. Figure 7 presents a brief overview of which advanced digital skills matter most. Counts for specific programs used for complex tasks, like SQL, SAS, Matlab, typically appear in the vacancies for computer support specialists and are less present in job advertisements for other occupations.

Figure 7. Focus on the advanced digital skills demanded in four occupations
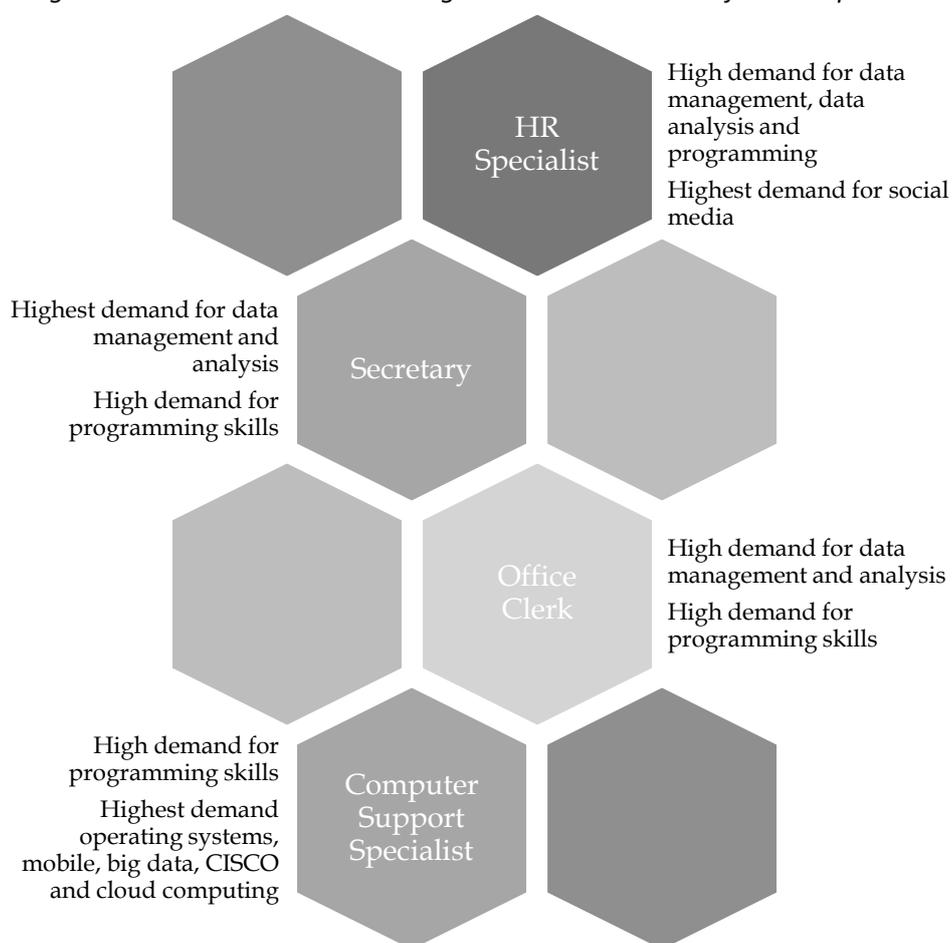
Besides the large number of keywords and combinations of keywords that we listed so far, our analysis contained a series of other keywords such as big data, cloud computing, CISCO, Oracle and scripting. These keywords were found in less than 1% of the vacancies studied (with shares ranging from 0% to about 4% across occupations). We therefore do not explore these concepts any further, a second reason being that it was rather difficult to classify them under any of the other categories. Across the 30 occupations, the highest shares are recorded for the computer support specialists when it comes to big data (0.22% of vacancies), CISCO (3.22%) and cloud computing (1.36%). The highest percentages for Oracle are found among the bookkeeping, accounting and auditing clerks (3.19%).

Another concept we investigate is mobile. This is captured by keywords such as mobile, iPhone and Android. About 8.29% of all advertisements contain at least one of these keywords. Some 8.23% of the vacancies lists mobile, while hardly any vacancies refer to iPhone or Android.

Finally, we also investigated how many job advertisements mention operating systems, Microsoft Windows, Apple, Mac, Linux, or Unix. 0.78 of the vacancies refer to operating systems. About 5.8% mentions Microsoft Windows. Less than 1% refers to Apple or Mac, Linux and Unix.

Skill mismatches

Using the previously described coding of tasks associated with individual occupations, we went one step further and coded the tasks, which possibly or certainly require IT skills to determine which precise IT skills are implied by the tasks. We then contrasted the task list with the share of advertisements requiring IT skills to identify potential mismatches. We defined a mismatch as a situation in which either a high percentage of vacancies for an occupation calls for a specific IT skills but this is not reflected in the list of tasks associated with it, or vice versa. We identified 16 occupations with a mismatch. In ten cases, the mismatch was of the latter category, for example the bank tellers' tasks involve considerable work with various databases, but there seems to be little explicit demand for the data skills in advertisements. The security guard occupation is the only one that contains both types of mismatch. Finally, five occupations had a relatively high requirement of an IT skill, which does not seem related to any of the tasks for that occupation (Table 12 and Table 13).

Interestingly, the mismatch where the skill was required according to the task but not present in advertisements is connected to basic IT skills, such as email, in particular. This suggests that those skills are sometimes assumed implicitly. The opposite situation relates to high-level IT skills, such as computer programming, which might suggest technologically driven up-skilling.

Table 12. Comparison of density of IT skills requirement in vacancies and implicit IT skill requirement associated with tasks relevant for specific occupations. Detected mismatches are in bold frames

Occupation	Internet		Social media & blogging		E-mail		Software	
Bookkeeping, Accounting, Auditing Clerks	1	17.34	0	2.42	1	31.43	1	24.21
Cashiers	1	12.67	0	0.41	**1**	**7.07**	1	2.46
Combined Food Prep Workers	0	6.02	0	1.07	**1**	**11.52**	1	1.95
Computer Support Specialists	1	43.98	0	2.89	1	27.16	1	37.46
Cooks, Restaurant	0	8.32	0	1.48	1	16.77	0	1.81
CS Representatives	1	19.2	0	2.24	1	26.11	1	12.13
First-Line Office Supervisors	1	17.11	1	3.34	1	26.26	1	13.74
General and Operations Managers	1	14.3	1	3.14	1	24.14	1	11.64
Heavy Truck And Tractor Drivers	1	10.2	0	1.5	1	15.23	1	2.06
HR Specialists	1	23.75	1	6.71	1	28.47	1	17.04
Janitors and Cleaners	0	12.12	0	3.67	1	16.71	0	1.99
Labourers	0	8.81	0	1.58	0	17.19	0	4.48
Light Truck, Delivery Service Drivers	0	9.49	0	1.84	1	13.58	1	2.76
Maintenance Worker	1	13.89	0	2.1	1	20.24	1	9.36
Medical Assistants	0	14.76	0	2.57	1	15.17	1	9.34

Medical Secretaries	1	10.08	0	2.9	1	20.61	1	15.71
Meeting, Convention, Event Planners	1	45.41	1	0.88	1	93.05	0	1.51
Merch Displayers	0	59.55	0	1.11	0	27.65	1	12.33
Nursing Assistant	0	8.49	0	4.89	1	12.28	1	3.28
Office Clerks	1	21.56	0	2.97	1	33.05	1	21.2
Personal Care Aides	0	11.27	0	4.11	1	15.12	1	3.59
Retail Salesperson	1	27.99	0	2.81	1	14.19	1	3.37
Sale Worker Supervisors	1	10.81	0	2.06	1	16.8	1	4.03
Sales Agents, Financial Services	1	12.3	0	3.91	1	13.49	1	12.21
Sales Repr Wholesale	1	23.98	0	5	1	27.91	1	9.08
Secretaries	1	22.89	1	3.42	1	41.41	1	29.59
Security Guards	0	29.47	0	0.98	1	11.32	0	2.59
Supervisors Of Food Prep, Serving Workers	1	8.66	0	2.63	0	15.2	1	5.62
Tellers	1	9.81	0	1.73	1	20.96	1	5.54

Table 13. Comparison of density of IT skills requirement in vacancies and implicit IT skill requirement associated with tasks relevant for specific occupations. Detected mismatches are in bold frames

Occupation	Word processing		Spread-sheets		Databases & data management		Programming & program. languages	
Bookkeeping, Accounting, Auditing Clerks	1	32.75	1	47.23	1	31.45	0	1.01
Cashiers	1	3.11	1	2.69	1	2.49	0	0.34
Combined Food Prep Workers	1	2.63	1	2.41	0	2.21	0	0.6
Computer Support Specialists	1	13.72	1	13.5	1	19.47	1	3.11
Cooks, Restaurant	1	2.94	1	3.4	1	2.17	0	0.6
CS Representatives	1	15.01	1	15.59	1	17.31	0	0.68
First-Line Office Supervisors	1	21.97	1	24.47	1	14.3	0	1.4
General and Operations Managers	1	18.03	1	19.76	1	6.05	0	0.9
Heavy Truck And Tractor Drivers	0	2.35	0	1.13	0	1.73	0	0.54
HR Specialists	1	26.35	1	27.97	1	33.46	0	2.93
Janitors and Cleaners	0	4.07	0	1.79	0	1.25	0	0.6
Labourers	0	4.78	0	5.28	0	7.04	0	0.33

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Light Truck, Delivery Service Drivers	1	2.87	1	1.63	0	3.13	0	0.37
Maintenance Worker	1	10.42	1	9.46	1	5.37	0	2.1
Medical Assistants	1	7.33	1	5.11	1	11.79	0	1.18
Medical Secretaries	1	19.79	1	15.04	1	22.5	0	1.3
Meeting, Convention, Event Planners	1	54.3	1	54.53	0	37.47	0	0.22
Merch Displayers	1	8.34	1	20.9	1	15.23	0	0.17
Nursing Assistant	1	2.96	1	1.08	1	3.69	0	0.64
Office Clerks	1	36.8	1	33.83	1	35.51	0	1.54
Personal Care Aides	1	1.02	1	0.47	1	6.14	0	1.26
Retail Salesperson	1	5.19	1	14.51	1	3.73	0	0.51
Sale Worker Supervisors	1	7.12	1	6.75	1	4.29	0	0.52
Sales Agents, Financial Services	1	7.67	1	8.68	1	6.85	0	0.56
Sales Repr Wholesale	1	13.68	1	16.47	1	13.66	0	0.47
Secretaries	1	50.51	1	50.77	1	38.63	0	2.13
Security Guards	1	3.85	0	2.65	0	7.81	0	21.19
Supervisors Of Food Prep, Serving Workers	1	9.3	1	5.95	1	3.14	0	0.4
Tellers	1	3.65	1	3.62	1	1.42	0	0.44

The O*NET classification also contains estimates of the importance and intensity of 35 skills[10] which we correlated with the demand for individual IT skills in job vacancies (Table 14 and Table 15). We find that STEM skills are crucial for the development of digital literacy, but competencies such as critical thinking and active learning also matter (which are also associated with social science and humanities studies).

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[10] As coded by O*NET, median of values assigned by 8 experts.

Table 14. Correlation coefficients between the importance of certain skills and the percentage of vacancies that call for basic digital skills in the specified area. Coefficients with value higher than 0.4 are highlighted in light grey

Occupation	Internet	Social media & blogging	E-mail	Software	Word processing	Spread-sheets	Databases & data management	Programming & program. languages
Reading Comprehension	0.45	0.40	0.37	0.28	0.31	0.36	0.35	0.28
Active Listening	0.43	0.28	0.28	0.25	0.26	0.30	0.29	0.16
Writing	0.49	0.15	0.31	0.25	0.24	0.30	0.29	0.46
Speaking	0.54	0.27	0.37	0.31	0.34	0.40	0.37	0.18
Mathematics	0.00	-0.04	0.12	0.06	0.10	0.18	0.06	-0.09
Science	0.46	0.11	0.69	0.21	0.49	0.41	0.52	-0.03
Critical Thinking	0.24	0.54	0.39	0.37	0.41	0.39	0.41	-0.01
Active Learning	0.06	0.44	0.38	0.34	0.46	0.40	0.42	0.09
Learning Strategies	0.04	0.28	0.31	0.08	0.27	0.25	0.14	-0.04
Monitoring	0.12	0.36	0.37	0.09	0.30	0.31	0.26	-0.03
Social Perceptiveness	0.18	0.48	0.38	0.10	0.37	0.39	0.31	-0.09
Coordination	0.10	0.39	0.23	0.05	0.22	0.21	0.18	0.10
Persuasion	0.06	0.53	0.24	0.29	0.38	0.38	0.31	-0.10
Negotiation	0.06	0.52	0.20	0.27	0.32	0.32	0.26	0.00
Instructing	0.11	0.23	0.22	0.14	0.17	0.19	0.04	-0.08
Service Orientation	0.20	0.15	0.05	-0.09	-0.04	0.00	-0.06	0.09
Complex Problem Solving	0.31	0.58	0.20	0.48	0.24	0.25	0.34	0.04
Operations Analysis	0.14	0.60	0.14	0.42	0.27	0.19	0.34	0.09
Technology Design	0.00	0.61	0.11	0.47	0.29	0.20	0.42	0.07
Equipment Selection	-0.10	0.02	-0.05	0.15	-0.04	-0.13	0.03	-0.07
Installation	0.02	0.08	-0.02	0.34	0.05	-0.04	0.14	0.01
Programming	0.38	0.10	0.28	0.44	0.32	0.33	0.33	0.16
Operation Monitoring	-0.07	0.17	0.08	-0.09	-0.05	-0.14	-0.08	-0.23
Operation and Control	-0.24	0.06	-0.11	0.00	-0.09	-0.24	-0.11	-0.08
Equipment Maintenance	-0.08	0.05	-0.08	0.18	-0.05	-0.15	0.01	-0.04
Troubleshooting	-0.13	0.19	-0.02	0.14	-0.02	-0.15	0.00	-0.08
Repairing	-0.09	0.07	-0.11	0.18	-0.08	-0.18	0.00	-0.03
Quality Control Analysis	-0.13	0.04	0.06	-0.01	0.02	-0.12	-0.03	0.17
Judgment and Decision Making	0.09	0.45	0.23	0.24	0.28	0.23	0.27	0.06
Systems Analysis	0.22	0.38	0.28	0.31	0.29	0.28	0.33	0.09
Systems Evaluation	0.11	0.46	0.24	0.21	0.25	0.23	0.23	-0.02
Time Management	0.32	0.37	0.12	0.14	0.13	0.17	0.20	0.43
Management of Financial Resources	0.01	0.51	0.07	0.12	0.17	0.19	0.19	0.17
Management of Material Resources	-0.04	0.45	0.07	0.03	0.15	0.13	0.15	0.14
Management of Personnel Resources	0.14	0.24	0.08	0.06	0.08	0.12	0.04	0.10

Table 15. Correlation coefficients between the preferred levels of certain skills and the percentage of vacancies that call for basic digital skills in the according area. Coefficients with value higher than 0.4 are highlighted in light grey

Occupation	Internet	Social media & blogging	E-mail	Software	Word processing	Spread-sheets	Databases & data management	Programming & program. languages
Reading Comprehension	0.37	0.38	0.34	0.33	0.36	0.40	0.40	0.26
Active Listening	0.48	0.31	0.37	0.33	0.36	0.45	0.42	0.23
Writing	0.34	0.32	0.24	0.25	0.25	0.30	0.31	0.31
Speaking	0.42	0.36	0.43	0.32	0.43	0.47	0.45	0.18
Mathematics	0.10	0.18	0.23	0.15	0.20	0.28	0.19	-0.15
Science	0.46	0.16	0.55	0.34	0.37	0.30	0.45	0.00
Critical Thinking	0.28	0.38	0.38	0.39	0.46	0.45	0.46	0.21
Active Learning	0.21	0.37	0.41	0.33	0.45	0.43	0.45	0.15
Learning Strategies	0.09	0.23	0.28	0.16	0.22	0.23	0.17	0.00
Monitoring	0.09	0.36	0.30	0.17	0.30	0.28	0.27	0.06
Social Perceptiveness	0.24	0.36	0.35	0.17	0.35	0.36	0.34	0.07
Coordination	0.09	0.30	0.24	0.15	0.26	0.24	0.22	0.00
Persuasion	0.09	0.49	0.26	0.29	0.37	0.35	0.32	-0.08
Negotiation	0.07	0.49	0.17	0.32	0.30	0.31	0.27	-0.02
Instructing	0.16	0.27	0.25	0.26	0.21	0.20	0.17	0.01
Service Orientation	0.16	0.20	0.13	0.06	0.08	0.10	0.05	0.11
Complex Problem Solving	0.19	0.48	0.34	0.36	0.38	0.36	0.44	0.07
Operations Analysis	0.08	0.67	0.11	0.47	0.29	0.22	0.36	0.02
Technology Design	-0.06	0.58	0.02	0.41	0.20	0.11	0.32	0.01
Equipment Selection	-0.10	0.03	-0.06	0.19	-0.04	-0.13	0.02	-0.06
Installation	0.04	0.07	-0.01	0.36	0.05	-0.03	0.15	0.01
Programming	0.36	0.10	0.19	0.47	0.20	0.22	0.24	0.16
Operation Monitoring	-0.11	0.15	0.09	0.00	-0.01	-0.10	-0.07	-0.29
Operation and Control	-0.27	0.06	-0.14	0.01	-0.12	-0.27	-0.14	-0.10
Equipment Maintenance	-0.06	0.04	-0.09	0.19	-0.08	-0.17	-0.01	-0.03
Troubleshooting	-0.08	0.12	0.04	0.15	0.00	-0.13	0.00	-0.09
Repairing	-0.06	0.07	-0.11	0.20	-0.08	-0.18	-0.01	-0.03
Quality Control Analysis	-0.12	0.08	0.07	0.06	0.02	-0.12	-0.03	0.06
Judgment and Decision Making	0.08	0.57	0.27	0.37	0.37	0.32	0.43	0.10
Systems Analysis	0.31	0.31	0.33	0.34	0.34	0.36	0.38	0.03
Systems Evaluation	0.16	0.42	0.31	0.28	0.34	0.30	0.33	-0.05
Time Management	0.17	0.40	0.10	0.19	0.16	0.19	0.20	0.23
Management of Financial Resources	0.00	0.46	0.04	0.08	0.12	0.14	0.13	0.21
Management of Material Resources	-0.05	0.46	-0.04	0.00	0.03	0.03	0.05	0.21
Management of Personnel Resources	0.05	0.36	0.08	0.15	0.14	0.16	0.15	0.15

Conclusions

This paper explored the size and structure of demand for IT skills in 30 most frequently advertised occupations in the US labour market, providing a cross-section of the mainstream labour market demand for such skills across a wide variety of jobs. The study concerns itself with a granular analysis that provides both a detailed structure of IT skills demand for a given occupation and a comparison of the demand for the same skills across different occupations.

On average, 35% of vacancies request one or more IT skills. There are still occupations where IT literacy is not a frequent condition of recruitment. This is because there is a huge variation between different kinds of jobs. For example, less than 5% of vacancies for personal care aides contained any IT skills, while more than 92% of advertisements for meeting and convention planners did. In other words, demand for IT skills ranges from rare to universal, depending on the occupation. As the example shows, high demand for IT skills is not limited to 'IT professions'. In our sample, occupations with the highest share of different types of IT skills demanded are, in addition to the already mentioned meeting and convention planners, also secretaries and customer service representatives.

We furthermore found a strong level of consistency between IT intensity as measured by demand for IT skills in job advertisements and based on tasks associated with individual occupations by labour market experts. Where there was a difference between two measures, it largely appears to be caused by vacancies not mentioning basic IT skills (possibly implicitly expecting candidates to possess them) or by demanding specific IT skills not foreseen by the experts (suggesting potential technological up-skilling of occupations).

Given the vast number and differentiation of various IT skills, the paper also provides a conceptualisation for classification into basic, intermediate and advanced skills. For basic and intermediate skills, it also constructs an IT skills pyramid dependent on the frequency with which the specific skills is requested. The paper finds that the absolute frequency of how much a specific skills is demanded does differ across low-, medium- and high-skilled occupations, with individual IT skills usually being more demanded for overall more skill-intensive occupations (as measured by ISCO classification). On the other hand, their relative ranking in the pyramid generally does not.

Demand for basic IT skills – such as email, internet browsing or generic 'computer' skills - is highly diffused across the economy, even among low-skilled jobs. The paper finds very strong demand for basic IT skills, such as knowledge of working with a computer. Interestingly, such demand is commonly explicitly mentioned, even in the case of medium to high skill occupations. Furthermore, the structure of demand is quite similar across the occupation complexity structure, suggesting that indeed basic IT literacy is a valid selection criterion for high skilled workers, just as much as for the low skilled workers.

With respect to intermediate IT skills, the paper finds that these skills – ranging from spreadsheets and word processing to other similar packages - are present for medium to high skill occupations. This suggests that skills such as handling various MS Office software – by far the most commonly demanded skill - is an 'entry ticket' to mid- and high-level jobs. This might be relevant from the policy perspective, with respect to the employment of 50+ skilled workers, whose lack of digital skills might be a barrier to them accessing work on their skill level.

Finally, advanced IT skills, such as computer programming, but also social media management or data managements, are not present across the whole set of occupations, but limited only to a small

number of jobs. Unlike the basic and intermediate skills, the skills requested and their frequency differ significantly across different types of occupations, precluding generalisation. It is, however, worth noting that even for these specialised skills, approximately every 10th vacancy for low-skilled jobs still contained at least one of these, making them an important marker of future skills demand, even for the lower end of the labour market.

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Appendix

Table 16. The 30 most frequently advertised occupations in the US, their ISCO code and the percentage of vacancies calling for basic digital skills or general concepts. Occupations with the highest shares are indicated in light grey cells, occupations with the lowest shares in dark grey cells

ISCO	Occupation	Computer	Software	Hardware	Internet	E-mail
3	Bookkeeping, Accounting, Auditing Clerk	43.92	24.21	0.91	17.34	31.43
4	Cashier	10.82	2.46	0.80	12.67	7.07
5	Combined Food Preparation Worker	13.18	1.95	0.13	6.02	11.52
2	Computer Support Specialist	65.02	37.46	23.35	43.98	27.16
5	Cooks, Restaurant	8.29	1.81	0.22	8.32	16.77
4	Customer Service Representative	48.94	12.13	1.77	19.20	26.11
3	First-Line Office Supervisor	34.63	13.74	1.56	17.11	26.26
1	General and Operations Manager	41.02	11.64	1.71	14.30	24.14
8	Heavy Truck and Tractor Driver	13.63	2.06	0.53	10.20	15.23
2	HR Specialist	40.07	17.04	1.43	23.75	28.47
7	Installation, Maintenance, Repair Worker	31.35	14.01	6.77	13.53	17.89
9	Janitor and Cleaner	12.07	1.99	6.15	12.12	16.71
9	Labourer	27.05	4.48	0.80	8.81	17.19
8	Light Truck, Delivery Service Driver	16.60	2.76	0.73	9.49	13.58
7	Maintenance Worker	31.06	9.36	3.65	13.89	20.24
3	Medical Assistant	42.44	9.34	0.40	14.76	15.17
4	Medical Secretary	58.29	15.71	0.83	10.08	20.61
3	Meeting, Convention, Event Planner	92.34	1.51	36.72	45.41	93.05
5	Merchandise Displayer	53.56	12.33	8.35	59.55	27.65
3	Nursing Assistant	24.54	3.28	0.08	8.49	12.28
4	Office Clerk	53.99	21.20	1.75	21.56	33.05
5	Personal Care Aid	4.99	3.59	0.09	11.27	15.12
5	Retail Salesperson	23.71	3.37	2.46	27.99	14.19
5	Sales Agent, Financial Services	24.94	12.21	0.93	12.30	13.49
5	Sales Representative, Wholesale	37.68	9.08	2.49	23.98	27.91
5	Sales Worker Supervisor	34.56	4.03	0.67	10.81	16.80
4	Secretary	48.14	29.59	1.71	22.89	41.41
5	Security Guard	27.70	2.59	0.36	29.47	11.32
5	Supervisor of Food Preparation, Serving Workers	23.43	5.62	0.29	8.66	15.20
4	Teller	38.56	5.54	0.04	9.81	20.96

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Table 17. The 30 most frequently advertised occupations in the US, their ISCO code and the percentage of vacancies calling for intermediate digital skills. Occupations with the highest shares are indicated in light grey cells, occupations with the lowest shares in dark grey cells

ISCO	Occupation	Word processing	Spread-sheets	Power-Point	Office	SAP
3	Bookkeeping, Accounting, Auditing Clerk	32.75	47.23	3.03	20.52	5.39
4	Cashier	3.11	2.69	0.20	2.62	0.10
5	Combined Food Preparation Worker	2.63	2.41	0.33	1.63	0.29
2	Computer Support Specialist	13.72	13.50	3.02	17.13	1.32
5	Cooks, Restaurant	2.94	3.40	0.11	0.90	0.02
4	Customer Service Representative	15.01	15.59	2.00	12.69	1.38
3	First-Line Office Supervisor	21.97	24.47	5.36	16.08	1.45
1	General and Operations Manager	18.03	19.76	4.25	18.97	1.07
8	Heavy Truck and Tractor Driver	2.35	1.13	0.08	1.03	0.37
2	HR Specialist	26.35	27.97	8.07	20.66	2.19
7	Installation, Maintenance, Repair Worker	8.19	9.90	0.78	7.44	0.81
9	Janitor and Cleaner	4.07	1.79	0.27	1.52	0.05
9	Labourer	4.78	5.28	0.46	4.10	3.03
8	Light Truck, Delivery Service Driver	2.87	1.63	0.17	1.57	0.15
7	Maintenance Worker	10.42	9.46	1.12	7.98	2.06
3	Medical Assistant	7.33	5.11	0.80	4.02	0.11
4	Medical Secretary	19.79	15.04	1.85	9.60	0.15
3	Meeting, Convention, Event Planner	54.30	54.53	0.73	1.73	0.37
5	Merchandise Displayer	8.34	20.90	0.66	1.68	0.06
3	Nursing Assistant	2.96	1.08	0.16	0.93	0.04
4	Office Clerk	36.80	33.83	7.16	21.78	1.11
5	Personal Care Aid	1.02	0.47	0.03	0.38	0.02
5	Retail Salesperson	5.19	14.51	0.76	5.13	1.25
5	Sales Agent, Financial Services	7.67	8.68	1.90	6.34	0.21
5	Sales Representative, Wholesale	13.68	16.47	4.89	12.43	0.60
5	Sales Worker Supervisor	7.12	6.75	1.59	3.99	0.40
4	Secretary	50.51	50.77	19.88	31.39	2.44
5	Security Guard	3.85	2.65	0.45	3.70	0.11
5	Supervisor of Food Preparation, Serving Workers	9.30	5.95	0.72	4.87	0.34
4	Teller	3.65	3.62	0.04	2.87	0.01

Table 18. The 30 most frequently advertised occupation in the US, their ISCO code and the percentage of vacancies that call for advanced digital skills (on condition that they appear in at least 1% of the total number of job advertisements). The occupations with the highest shares are indicated in light grey cells, the occupations with the lowest shares in dark grey cells

ISCO	Occupation	Databases & data management	Data analysis & statistics	Programming & program. languages	Social media & blogging
3	Bookkeeping, Accounting, Auditing Clerk	31.45	6.11	1.01	2.42
4	Cashier	2.49	0.63	0.34	0.41
5	Combined Food Preparation Worker	2.21	0.70	0.60	1.07
2	Computer Support Specialist	19.47	3.40	3.11	2.89
5	Cooks, Restaurant	2.17	0.27	0.60	1.48
4	Customer Service Representative	17.31	1.82	0.68	2.24
3	First-Line Office Supervisor	14.30	4.79	1.40	3.34
1	General and Operations Manager	6.05	2.37	0.90	3.14
8	Heavy Truck and Tractor Driver	1.73	0.35	0.54	1.50
2	HR Specialist	33.46	5.67	2.93	6.71
7	Installation, Maintenance, Repair Worker	6.22	0.90	1.00	3.05
9	Janitor and Cleaner	1.25	0.42	0.60	3.67
9	Labourer	7.04	0.52	0.33	1.58
8	Light Truck, Delivery Service Driver	3.13	0.30	0.37	1.84
7	Maintenance Worker	5.37	1.08	2.10	2.10
3	Medical Assistant	11.79	2.63	1.18	2.57
4	Medical Secretary	22.50	3.35	1.30	2.90
3	Meeting, Convention, Event Planner	37.47	0.29	0.22	0.88
5	Merchandise Displayer	15.23	0.21	0.17	1.11
3	Nursing Assistant	3.69	0.31	0.64	4.89
4	Office Clerk	35.51	7.49	1.54	2.97
5	Personal Care Aid	6.14	0.15	1.26	4.11
5	Retail Salesperson	3.73	0.46	0.51	2.81
5	Sales Agent, Financial Services	6.85	0.48	0.56	3.91

5	Sales Representative, Wholesale	13.66	0.72	0.47	5.00
5	Sales Worker Supervisor	4.29	3.44	0.52	2.06
4	Secretary	38.63	8.94	2.13	3.42
5	Security Guard	7.81	0.32	21.19	0.98
5	Supervisor of Food Preparation, Serving Workers	3.14	1.03	0.40	2.63
4	Teller	1.42	0.28	0.44	1.73

Table 19. The 29 most frequently advertised occupations in the US, their O*NETSOC code and the importance of certain skills as assigned by experts

O*NETSOC code	Occupation	Reading Comprehension	Active Listening	Writing	Speaking	Mathematics	Science	Critical Thinking	Active Learning	Learning Strategies	Monitoring	Social Perceptiveness	Coordination	Persuasion	Negotiation	Instructing	Service Orientation	Complex Problem Solving	Operations Analysis
43303100	Bookkeeping, Accounting, and Auditing Clerks	3.38	3.38	3.25	3.38	3.25	1.12	3.25	2.88	2.38	3.25	3.12	2.88	2.62	2.5	2.38	2.75	2.75	1.5
41201100	Cashiers	2.62	3.38	2.38	3.25	3.12	1	2.88	2.38	2.12	2.75	3	2.62	2.5	2.5	2.5	3.25	2.12	1
35302100	Combined Food Preparation and Serving Workers, Including Fast Food	2.62	3.38	2.12	3.25	2.75	1	2.75	2.62	2.75	3.12	3.12	3.12	2.5	2.25	3	3.25	2.38	1.12
15115100	Computer User Support Specialists	3.88	4	3.62	4	2.38	2.12	3.75	3.25	2.75	3.25	3.12	3.12	2.62	2.75	3.25	3.12	3.5	2.62
35201400	Cooks, Restaurant	2.62	3	2.38	2.88	2.5	1.25	2.88	2.62	2.25	3.12	2.75	3.12	2.12	2.25	2.25	2.38	2.38	1.5
43405100	Customer Service Representatives	3.38	3.88	2.75	3.88	2	1	3.12	3	2.62	3	3	2.88	3.12	2.88	2.5	3.75	2.88	1.62
35101200	First-Line Supervisors of Food Preparation and Serving Workers	3.38	3.75	2.88	3.88	3	1.12	3.38	2.88	3.12	3.62	3.5	3.75	3.25	3.12	3.5	3.75	3.12	2
43101100	First-Line Supervisors of Office and Administrative Support Workers	4	4	3.75	4	2.75	1	3.88	3.75	3.62	4	4	4	3.62	3.62	3.75	3.62	3.38	2.38
41101100	First-Line Supervisors of Retail Sales Workers	3	3.62	3	3.5	3	1.12	3.5	2.88	2.88	3.5	3.38	3.5	3.12	3.12	3.12	3.5	3.12	2.5
11102100	General and Operations Managers	3.88	4	3.25	4	2.38	1.88	3.88	3.5	3	4	4	4	3.38	3.62	3.12	3.25	3.5	2.75
53303200	Heavy and Tractor-Trailer Truck Drivers	3	2.88	2.75	3	2	1	3	2.75	2.5	3	2.75	2.88	2.12	2.25	2.5	2.75	2.88	1.88
13107100	Human Resources Specialists	3.88	4	3.5	4	2.25	1.25	3.62	3.12	2.75	3.12	3.25	3.38	2.88	2.88	2.75	3	3	1.38
37201100	Janitors and Cleaners, Except Maids and	2.38	3	2	2.62	1	1	2.75	2.5	1.88	2.5	2.75	2.75	2	1.88	2	2.5	2.12	1.38

	Housekeeping Cleaners																		
53706200	Laborers and Freight, Stock, and Material Movers, Hand	2.75	2.75	2.38	2.75	2	1	2.88	2.12	2	2.62	2.38	2.88	2	2	2.12	2.25	2.38	1.38
53303300	Light Truck or Delivery Services Drivers	3	3.12	2.88	3.12	2.5	1.12	2.88	2.12	1.88	3	2.88	2.5	2.12	1.88	1.88	2.88	2.62	1.75
49907100	Maintenance and Repair Workers, General	3	2.88	2.75	3	2.12	1.75	3.12	3	2.25	3.12	2.75	3	2	1.88	2	2.25	3	2
31909200	Medical Assistants	3.88	3.88	3.5	4	2.62	2.75	3.62	3.25	3	3.75	3.88	3.5	2.88	2.75	3	3.38	2.75	1.62
43601300	Medical Secretaries	3.25	3.88	3.12	4	2	1.25	3	2.12	2	3	3.12	3.12	2.25	2.12	2.25	3.62	3	1.5
13112100	Meeting, Convention, and Event Planners	3.88	4.12	3.25	4	2.25	1.25	3.88	3.12	2.38	3.5	3.75	3.75	3.38	3.38	2.5	3.75	3.25	3.12
27102600	Merchandise Displayers and Window Trimmers	3	3.5	2.88	3.25	2	1.25	3.25	2.88	2.38	2.75	3	3	2.88	2.38	2.25	2.88	2.88	2.38
31101400	Nursing Assistants	3.12	3.62	2.88	3.25	2.12	1.62	3.12	2.5	2.5	3.25	3.62	3.25	2.38	2.38	2.62	4	2.75	1.12
43906100	Office Clerks, General	3.62	3.62	3.25	3.62	2.38	1	3	2.5	2.38	2.88	3.25	2.88	2.62	2.62	2.75	3.12	2.62	1.12
39902100	Personal Care Aides	2.88	3.5	2.88	3.25	1.88	1.75	3	2.75	2.75	3.12	3.62	3	2.25	2	3	3.88	2.75	1
41203100	Retail Salespersons	3.38	3.75	2.88	3.75	2.5	1.12	3.12	2.88	2.5	3	3.5	3.25	3.75	3.5	2.75	3.62	2.88	1.62
41303102	Sales Agents, Financial Services	3.88	4	3	4	3	1.25	4	3.12	2.88	3	3.75	2.88	4.12	3.12	3	3.25	3.12	2.25
41401200	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	3.38	4	2.88	4	2.12	1.25	3.62	3.12	2.38	3	3.75	3.12	3.88	3.62	2.75	3.25	2.88	2
43601400	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	3.88	3.88	4	3.88	2.12	1.12	3.12	2.88	2.38	3	3	3.25	2.38	2.5	2.38	3.5	2.75	1.75
33903200	Security Guards	2.88	3.5	2.62	3.12	1.25	1.25	3	2.62	2.38	2.88	2.88	2.88	2.75	2.5	2.38	2.88	2.5	1.75
43307100	Tellers	3.25	3.5	3	3.38	3.25	1.12	3.25	2.62	2.38	3.12	3.12	2.75	2.5	2.38	2.75	3.25	2.88	1.25

*Table 20. The 29 most frequently advertised occupations in the US, their O*NETSOC code and the importance of certain skills as assigned by experts*

O*NETSOC code	Occupation	Technology Design	Equipment Selection	Installation	Programming	Operation Monitoring	Operation and Control	Equipment Maintenance	Troubleshooting	Repairing	Quality Control Analysis	Judgment and Decision Making	Systems Analysis	Systems Evaluation	Time Management	Management of Financial Resources	Management of Material Resources	Management of Personnel Resources
43303100	Bookkeeping, Accounting, and Auditing Clerks	1.38	1.12	1	1.38	1.75	1	1	1	1	1.12	2.75	2.38	2.12	3.25	2.12	1.75	2.5
41201100	Cashiers	1	1	1	1.38	1.88	1.88	1	1	1	1	2.75	2.12	2.25	2.75	1.12	1.12	2.38
35302100	Combined Food Preparation and Serving Workers, Including Fast Food	1.38	1	1	1.38	2.12	2	1	1.62	1	2.25	2.88	1.75	2	2.5	1.75	2	2.5
15115100	Computer User Support Specialists	1.88	2	2	2	2.75	2.62	2.38	2.75	2.38	2.62	3.25	3	2.62	3.38	1.75	1.75	2.75
35201400	Cooks, Restaurant	1.38	1.75	1	1	2.75	2.38	1.12	1.62	1	2.88	2.88	2.12	2	2.62	2.12	2.38	2.62
43405100	Customer Service Representatives	1.5	1	1	1.5	1.88	1	1	1	1	1.38	2.88	2.25	2.12	3	1.12	1.12	2.12
35101200	First-Line Supervisors of Food Preparation and Serving Workers	1.38	1.25	1	1.38	2.25	2.12	1.38	1.75	1	2.88	3.25	3	3	3.38	2.75	2.75	3.62
43101100	First-Line Supervisors of Office and Administrative Support Workers	1.5	1	1	1.88	2.25	1.12	1	2	1	2.88	3.75	3	3.12	3.75	2.5	2.75	3.75
41101100	First-Line Supervisors of Retail Sales Workers	1.5	1	1	1.62	2.25	2	1	1.75	1	2.5	3.12	3	2.75	3.25	2.75	2.75	3.38
11102100	General and Operations Managers	1.88	1	1	1.5	2.75	2	1	2	1	2.38	3.5	3	3	3.75	3.12	3.25	3.5
53303200	Heavy and Tractor-Trailer Truck Drivers	1.62	2.25	1.62	1.12	3.75	3.88	2.88	3	2.88	2.62	2.88	2	2.12	3.12	2	2	2.12

Code	Occupation																
13107100	Human Resources Specialists	1.5	1.12	1	1.62	1.62	1.25	1	1	1	1.5	3.25	2.5	2.38	3.12	1.5	1.75	3
37201100	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	1	1.88	1	1	2.12	2	2	2	2	2	2.25	1.75	1.5	2.62	1	1.25	2
53706200	Laborers and Freight, Stock, and Material Movers, Hand	1.25	2	1.38	1	2.75	2.88	2.25	2.25	2.12	2	2.5	1.88	1.88	2.5	1.38	1.88	2
53303300	Light Truck or Delivery Services Drivers	1.38	1.75	1	1	2.88	3.25	2.38	2.25	2.25	2.38	2.88	2	2	3	1.75	1.88	1.88
49907100	Maintenance and Repair Workers, General	2	3.12	3	1.12	3.12	3.12	4	3.62	4	3	3	2.38	2.25	3	1.88	2	2
31909200	Medical Assistants	1.38	1.25	1	1.5	2.75	1.88	1.12	1.75	1	2.38	3.12	2.62	2.5	3.25	1.75	2	2.62
43601300	Medical Secretaries	1	1	1	1.25	1.88	1	1	1	1	1.12	2.75	2	2	3.12	1.38	1.38	2.75
13112100	Meeting, Convention, and Event Planners	1.75	1	1	1.38	2.12	1.88	1	1.12	1.12	1.12	3.5	3.12	2.88	3.88	2.62	2.62	3.25
27102600	Merchandise Displayers and Window Trimmers	1.75	1.38	1.12	1.5	1.75	1.75	1	1.62	1	2.12	3.12	2.38	2.25	3	1.62	2	2.25
31101400	Nursing Assistants	1.5	1.38	1	1	2.25	1.38	1	1.88	1	2.12	2.88	1.88	2	2.88	1.38	1.75	2.12
43906100	Office Clerks, General	1.38	1.12	1	1.38	2.25	1.38	1	1.12	1	1.25	2.75	2	1.88	3.25	1.88	2.12	2.38
39902100	Personal Care Aides	1.38	1	1	1	2.25	1.75	1	1.75	1	2	3	2	2	3	1.38	1.62	1.88
41203100	Retail Salespersons	1.75	1.12	1	1.25	1.75	1.75	1	1.62	1	1.75	2.75	2	2	3	1.88	1.75	2.5
41303102	Sales Agents, Financial Services	1.5	1	1	1.62	1.75	1	1	1	1	1.38	3.25	3	2.88	3	2.12	1.75	2.5
41401200	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	1.62	1	1	1.5	1.62	1.88	1	1	1	1.25	3.12	2.25	2.12	2.75	1.75	1.75	2.25
43601400	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	1.38	1	1	1.5	1.5	1.38	1	1.12	1	2.38	3	2.38	2.12	3.88	2.12	2.12	2.75
33903200	Security Guards	1	1	1	1.12	2.5	2.12	1	1.88	1.12	2.25	2.75	1.25	2	2.62	1	1	2.25
43307100	Tellers	1	1	1	1.25	2	1.75	1	1	1	1.5	3	2.12	2.12	2.75	1.12	1.12	2.25

*Table 21. The 29 most frequently advertised occupation in the US, their O*NETSOC code and preferred level of certain skills proficiency as assigned by experts*

O*NETSOC code	Occupation	Reading Comprehension	Active Listening	Writing	Speaking	Mathematics	Science	Critical Thinking	Active Learning	Learning Strategies	Monitoring	Social Perceptiveness	Coordination	Persuasion	Negotiation	Instructing	Service Orientation	Complex Problem Solving	Operations Analysis
43303100	Bookkeeping, Accounting, and Auditing Clerks	3.75	3.88	3.25	3.38	3.25	0.12	3.5	3	2.5	3.12	2.88	2.62	2.5	2.5	2.38	2.62	2.88	0.88
41201100	Cashiers	2.75	2.88	2.5	2.62	2.38	0	2.88	2.12	1.88	2.5	2.62	2.62	2.12	2	2.25	2.75	2	0
35302100	Combined Food Preparation and Serving Workers, Including Fast Food	2.25	2.25	2	2.5	1.88	0	2.25	2.12	2.5	2.12	2.38	3	2.25	1.62	2.38	2.75	2.12	0.12
15115100	Computer User Support Specialists	4	3.75	3.38	3.75	2.12	2.12	3.75	3.25	3	3.38	3.12	3.25	2.75	2.75	3.62	3.25	3.12	2.62
35201400	Cooks, Restaurant	2.38	2.62	2.5	2.62	2.12	0.25	2.88	2.75	2.38	3.25	2.5	3.25	1.88	2.12	2.62	2.25	2.38	0.62
43405100	Customer Service Representatives	3.38	3.75	3	3.75	2.12	0	3.25	2.88	2.88	3	3	3	3	2.88	2.75	3.5	3	0.75
35101200	First-Line Supervisors of Food Preparation and Serving Workers	3.75	3.38	3.12	3.88	2.75	0.12	4	3.25	3.12	3.75	3.62	4	3	3.12	3.12	3.5	3	1.62
43101100	First-Line Supervisors of Office and Administrative Support Workers	3.75	3.88	3.75	4	2.75	0	3.88	3.75	3.75	4	3.88	3.75	3.5	3.62	3.62	3.5	3.25	2.5
41101100	First-Line Supervisors of Retail Sales Workers	3.75	3.38	3.5	3.75	3.12	0.25	3.75	3.5	3.5	4	3.75	3.5	3.75	3.62	3.62	3.5	3.5	2.25
11102100	General and Operations Managers	4	4	3.88	4	2.5	1.12	4	3.62	3.25	4	4	3.88	3.5	3.62	3.25	3.12	3.75	3.12
53303200	Heavy and Tractor-Trailer Truck Drivers	3	3	2.5	3	2.12	0	3	2.25	2.12	3	2.38	2.25	2	2	2.12	2.12	2.88	1.12
13107100	Human Resources Specialists	4.12	4.12	3.88	4	2.25	0.25	4	3.25	3.12	3.75	3.88	3.62	3.12	3.12	3.12	3.38	3.12	0.62
37201100	Janitors and Cleaners,	2	2.25	1.5	2.12	0	0	2.12	2	0.88	1.88	2.12	2.12	1.88	1.5	1.12	2.38	2	0.38

Code	Occupation																	
	Except Maids and Housekeeping Cleaners																	
53706200	Laborers and Freight, Stock, and Material Movers, Hand	2.38	2.38	2	2.12	1.88	0	2.38	2	1.75	2.25	2.12	2.88	1.75	1.62	1.88	2	2.25	0.38
53303300	Light Truck or Delivery Services Drivers	2.75	2.88	2.5	2.75	2.12	0.12	2.88	2.12	1.75	2.5	2.25	1.88	1.88	1.62	1.62	2.38	2	0.75
49907100	Maintenance and Repair Workers, General	3.12	2.88	2.88	2.88	2.38	0.88	3.12	3.12	2.25	3	2.62	3	1.62	1.62	2.25	2.12	3	2
31909200	Medical Assistants	3.88	3.88	3.25	4	2.5	1.88	3.75	3.38	3	3.62	3.62	3.38	2.88	2.38	3	3.25	3	0.62
43601300	Medical Secretaries	3.12	3.75	3.12	3.38	2	0.25	3	2.38	2	2.62	3	2.88	2.12	2.12	2.12	3	2.62	0.5
13112100	Meeting, Convention, and Event Planners	4.12	3.88	3.38	3.75	2.5	0.38	3.62	3.12	2.62	3.5	3.5	3.75	3.38	3.62	2.88	3.62	3.38	3.5
27102600	Merchandise Displayers and Window Trimmers	3.12	3.12	2.88	3.25	1.38	0.25	3.38	3	2	2.88	2.88	3.12	3	2.25	2.38	2.88	2.88	2
31101400	Nursing Assistants	3.12	3	2.75	3.25	1.75	1	3	2.5	2.25	3	3.12	2.88	2.12	2	2.5	3.5	2.38	0.12
43906100	Office Clerks, General	3.62	3.62	3.12	3.38	2.25	0	3	2.5	2.12	2.62	2.75	2.75	2.25	2.25	2.5	3	2.12	0.12
39902100	Personal Care Aides	2.75	2.88	2.75	2.88	1.62	0.75	3	2.75	2.62	3.12	3.12	2.88	2.38	2	2.38	3.75	2.38	0
41203100	Retail Salespersons	3.25	3.62	3	3.25	1.88	0.12	3.38	2.62	2.38	3.12	3	3	3.75	3.5	2.88	3.75	2.62	1.12
41303102	Sales Agents, Financial Services	4	4	3.75	4	3.25	0.25	4	3.62	2.88	3.12	3.5	3	4.25	3	3	3.38	3.12	2.25
41401200	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	3.75	3.88	3.12	4	2.12	0.25	4	3.12	2.38	3.12	3.38	3	3.88	3.88	2.75	3.38	3	1.88
43601400	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	4	4	3.88	3.75	1.5	0.12	3.75	3.12	2.38	3.12	3.12	2.88	2.25	2.25	2.5	3.38	2.75	0.75
33903200	Security Guards	2.88	3	2.62	2.62	0.38	0.38	2.75	2.25	2.12	2.88	2.5	2.75	2.5	2.12	2.25	2.62	2.12	1
43307100	Tellers	3.25	3.5	3.12	3.12	2.88	0.12	3.38	2.75	2.5	2.75	2.62	2.5	2	2.12	2.88	3.38	2.75	0.25

Table 22. The 29 most frequently advertised occupations in the US, their O*NETSOC code and preferred level of skills proficiency as assigned by experts

O*NETSOC code	Occupation	Technology Design	Equipment Selection	Installation	Programming	Operation Monitoring	Operation and Control	Equipment Maintenance	Troubleshooting	Repairing	Quality Control Analysis	Judgment and Decision Making	Systems Analysis	Systems Evaluation	Time Management	Management of Financial Resources	Management of Material Resources	Management of Personnel Resources
43303100	Bookkeeping, Accounting, and Auditing Clerks	0.38	0.25	0	0.5	1.25	0	0	0	0	0.25	2.88	2.25	1.75	3.12	2.12	1.12	2.5
41201100	Cashiers	0	0	0	0.38	1.5	1.5	0	0	0	0	2.38	2	1.88	2.5	0.25	0.25	2
35302100	Combined Food Preparation and Serving Workers, Including Fast Food	0.38	0	0	0.38	1.62	1.88	0	1.12	0	1.5	2.25	1.5	1.5	2.25	1	1.25	2.25
15115100	Computer User Support Specialists	1.12	1.62	1.62	1.62	2.75	2.62	2.38	3	2.25	3	3.12	3	2.88	3.12	1.25	1.25	2.75
35201400	Cooks, Restaurant	0.38	1.25	0	0	2.38	2.12	0.25	1.12	0	2.62	2.5	1.88	1.75	2.75	1.88	2.12	2.38
43405100	Customer Service Representatives	0.5	0	0	0.62	1.25	0	0	0	0	0.5	2.88	2.12	2	2.75	0.12	0.12	2
35101200	First-Line Supervisors of Food Preparation and Serving Workers	0.62	0.62	0	0.5	2.25	2	0.5	1.38	0	2.62	3	3	3.5	3.62	2.62	2.62	3.5
43101100	First-Line Supervisors of Office and Administrative Support Workers	0.62	0	0	1	2	0.25	0	1.38	0	2.75	3.12	3	3	3.75	2.62	2.62	3.75
41101100	First-Line Supervisors of Retail Sales Workers	0.88	0	0	0.88	2	1.62	0	1.25	0	2.62	3.12	3	3.25	3.62	3.25	2.62	3.62
11102100	General and Operations Managers	1.12	0	0	0.62	2.62	1.75	0	1.38	0	2.12	3.75	3	3.12	3.75	3.38	3.25	3.88
53303200	Heavy and Tractor-Trailer Truck Drivers	0.62	1.88	0.75	0.12	3.12	3.5	2.75	2.75	2.75	2.75	2.75	2	2	3	1.62	2	2.12

Code	Occupation																	
13107100	Human Resources Specialists	0.62	0.12	0	0.88	0.75	0.38	0	0	0	1.12	3.25	2.75	2.88	3	0.75	1.25	3
37201100	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	0	1	0	0	2	1.38	1.88	1.62	1.12	1.25	2.12	0.75	0.5	2.12	0	0.25	1.38
53706200	Laborers and Freight, Stock, and Material Movers, Hand	0.25	1.62	0.5	0	2.62	2.75	2.12	2.25	1.88	2.12	2.12	1.75	1.5	2.12	0.38	1	1.75
53303300	Light Truck or Delivery Services Drivers	0.38	1.38	0	0	2.5	3	2	1.88	2	2.25	2.12	1.38	1.25	2.88	1.12	1.12	1.62
49907100	Maintenance and Repair Workers, General	1.62	3.12	3.12	0.12	3.12	3.12	4	3.5	4	3.12	3	2.25	2.38	2.88	1.25	1.25	2.25
31909200	Medical Assistants	0.38	0.25	0	0.5	2.5	1.25	0.12	1.5	0	2.12	2.88	2.62	2.75	2.88	1.12	1	2.38
43601300	Medical Secretaries	0	0	0	0.25	1.12	0	0	0	0	0.25	2.38	2.12	1.88	2.88	0.38	0.62	2.12
13112100	Meeting, Convention, and Event Planners	1	0	0	0.5	1.75	1.5	0	0.12	0.12	0.25	3.38	3	3.5	3.75	2.75	2.75	3.12
27102600	Merchandise Displayers and Window Trimmers	0.75	0.5	0.12	0.5	1	1	0	0.75	0	1.75	3	2.38	2.38	2.88	0.75	1.5	2.38
31101400	Nursing Assistants	0.75	0.38	0	0	1.62	0.38	0	1.25	0	1.75	2.5	1.5	1.5	2.25	0.5	1.12	2
43906100	Office Clerks, General	0.5	0.12	0	0.5	1.88	0.62	0	0.12	0	0.5	2.12	1.88	1.38	2.75	1.38	1.62	2.25
39902100	Personal Care Aides	0.38	0	0	0	1.62	1.38	0	0.88	0	1.75	2.5	1.38	1.5	2.62	0.38	0.62	1.75
41203100	Retail Salespersons	1.25	0.25	0	0.25	1.38	1.38	0	0.75	0	1.25	2.88	1.5	2	2.88	1.12	1	2.38
41303102	Sales Agents, Financial Services	0.5	0	0	0.75	0.75	0	0	0	0	0.5	3.5	3	3.12	3	2.12	1.12	2.38
41401200	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	0.75	0	0	0.5	1	1.12	0	0	0	0.38	3.12	2.25	2.5	2.62	1	0.88	2.12
43601400	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	0.38	0	0	0.62	0.5	0.5	0	0.12	0	1.5	2.88	2	1.75	3.38	2.12	2	2.75
33903200	Security Guards	0	0	0	0.12	2.25	2	0	1.38	0.25	2	2.5	0.5	1.5	2.38	0	0	2.12
43307100	Tellers	0	0	0	0.38	1.88	1.25	0	0	0	0.75	2.88	1.88	1.75	2.5	0.25	0.25	2

Table 23. Correlations between skills inferred from tasks from both and only O*NET datasets

Occupation	Tasks possibly requiring IT skills (both datasets)	Tasks certainly requiring IT skills (both datasets)	Tasks possibly requiring IT skills (O*NET)	Tasks certainly requiring IT skills (O*NET)	Tasks certainly or possibly requiring IT skills (both datasets)	Tasks certainly or possibly requiring IT skills (O*NET)
Bookkeeping, Accounting, Auditing Clerks	63%	31%	63%	30%	94%	93%
Cashiers	40%	3%	30%	0%	43%	30%
Combined Food Prep Workers	11%	0%	14%	0%	11%	14%
Computer Support Specialists	25%	75%	25%	75%	100%	100%
Cooks, Restaurant	15%	0%	20%	0%	15%	20%
CS Representatives	55%	5%	40%	7%	60%	47%
First-Line Office Supervisors	51%	3%	52%	0%	54%	52%
General and Operations Managers	59%	0%	59%	0%	59%	59%
Heavy Truck And Tractor Drivers	3%	5%	3%	6%	8%	10%
HR Specialists	63%	17%	56%	20%	80%	76%
Janitors And Cleaners	7%	0%	9%	0%	7%	9%
Labourers	0%	0%	0%	0%	0%	0%
Light Truck, Delivery Service Drivers	14%	0%	17%	0%	14%	17%
Maintenance Worker	16%	0%	13%	0%	16%	13%
Medical Assistants	21%	25%	30%	15%	46%	45%
Medical Secretaries	63%	17%	50%	25%	79%	75%
Meeting, Convention, Event Planners	82%	0%	76%	0%	82%	76%
Merch Displayers	10%	3%	8%	4%	13%	12%
Nursing Assistant	8%	0%	9%	0%	8%	9%
Office Clerks	52%	32%	43%	38%	84%	81%
Personal Care Aides	30%	0%	36%	0%	30%	36%
Retail Salesperson	48%	0%	46%	0%	48%	46%
Sale Worker Supervisors	54%	0%	52%	0%	54%	52%
Sales Agents, Financial Services	79%	0%	88%	0%	79%	88%
Sales Repr Wholesale	63%	0%	65%	0%	63%	65%
Secretaries	53%	30%	44%	38%	83%	81%
Security Guards	11%	0%	17%	0%	11%	17%
Supervisors Of Food Prep, Serving Workers	22%	0%	27%	0%	22%	27%
Tellers	62%	21%	61%	21%	82%	82%
Correlation with skill req.	**0.59**	**0.66**	**0.52**	**0.69**	**0.82**	**0.79**