frontier economics

DEMAND FOR GEOSPATIAL SKILLS

Report for the Geospatial Commission

October 2020

Geospatial Commission

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EXECUTIVE SUMMARY

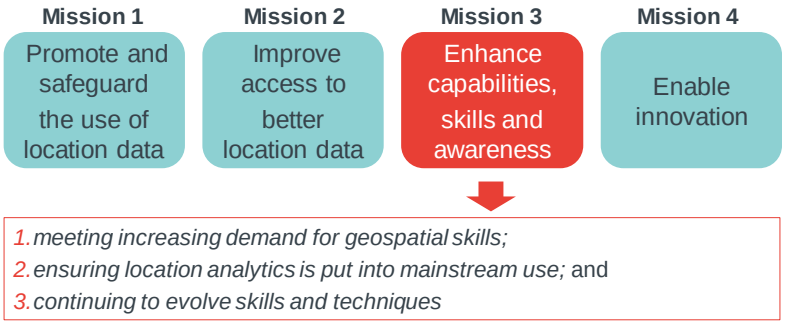
Background & Context

There is a growing interest from government and industry in how the UK can realise the full potential offered by the growth of data skills and capabilities.[1] Previous studies have identified the benefits of embedding data skills into all sectors of the economy, but there are associated challenges with this including: a perceived skills gap, the need for greater availability of foundational training in data skills, and building a coordinated approach to data skills across all relevant parts of government. Geospatial data skills are an important subset of data skills, but to date, the demand for geospatial data skills in the UK has never been examined in-depth.

To help fill this gap, Frontier Economics was asked by the Geospatial Commission to analyse current demand for geospatial skills. We used job vacancy data collected by Burning Glass Technologies to examine the demand for geospatial data skills across all sectors and regions of the UK economy between 2014-2019.[2]

The Geospatial Commission was established in 2018 within the Cabinet Office, to promote best use of geospatial data. Their recent UK Geospatial Strategy (2020) included four missions (Figure 1). As the digital and data revolution transforms the economy and society, data skills are in increasingly high demand. Developing these skills is a cross-cutting policy issue, articulated in the People pillar of the Government's Industrial Strategy (2017).[3] Mission 3 of the UK Geospatial Strategy states that the UK must develop more people with the right skills and tools to work with location data to meet future needs.

Figure 1 Geospatial Commission Missions



Source: UK's Geospatial Strategy, 2020 to 2025 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/894755/Geospatial_Strategy.pdf

To achieve this vision, the Geospatial Commission requires an understanding of the dynamics of a fast-changing labour market and the interactions between geospatial skills and other science, technology, engineering and maths (STEM)

[1] See for example https://www.burning-glass.com/wp-content/uploads/no_longer_optional_report.pdf and https://royalsociety.org/topics-policy/projects/dynamics-of-data-science/

[2] Burning Glass Technologies are an analytics software company who provide real-time data on job growth, skills in demand, and labour market trends. https://www.burning-glass.com/uk/

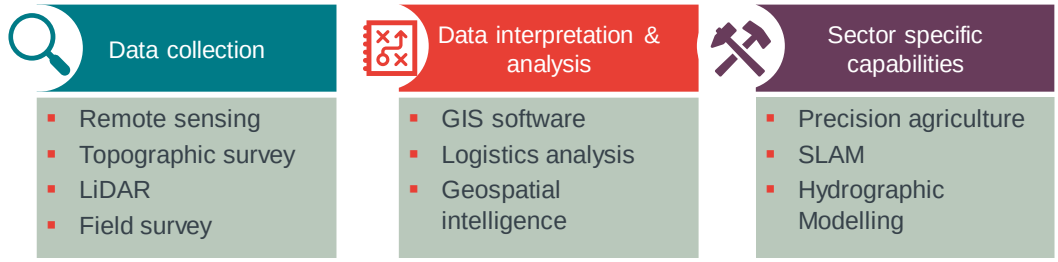
[3] https://www.gov.uk/government/topical-events/the-uks-industrial-strategy

capabilities, data and digital skills. The importance of geospatial skills is expected to increase over time, as more geospatial data is collected and shown to be useful, and where open source geospatial software packages make analysis of that data more accessible. This timely assessment of patterns and trends in demand for geospatial skills across the UK will be used by the Geospatial Commission to develop long term economy-wide initiatives and meet the UK's future geospatial skills requirements.

Geospatial skills

We identified a diverse list of geospatial skills that are called for by employers within job postings. This reflects the broad range of activity across the UK economy that can be considered geospatial. Required skills include the capability to work with specific software and scripting packages as well as those that correspond to earlier stages of the geospatial value chain such as collection and manipulation of data.

Figure 2 Examples of geospatial skills identified



The most commonly occurring geospatial skills include familiarity with GIS software packages. Open source GIS software packages like QGIS are rapidly rising in prevalence. Surveying skills and remote sensing also feature prominently. Geospatial skills need to be combined with complimentary skills such as communication and project management. Specialised skills that are common amongst the broader data skills cohort also appear frequently on geospatial vacancies. These include Python which is a programming language and AutoCAD which is a computer aided design software package.

Spread of geospatial jobs across the economy

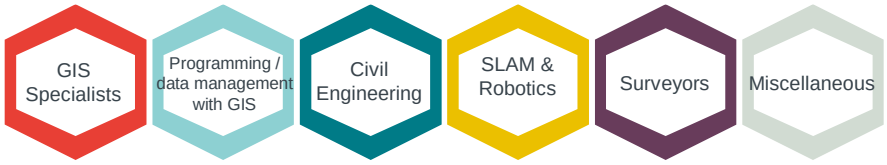
Geospatial jobs are not confined to one particular industry. Our data analysis identified a wide spread of sectors across the economy that require geospatial skills, for example retail (employers such as Asda), banking (employers such as JP Morgan Chase) and pharmaceuticals (employers such as Bayer AG). This pattern is in line with trends seen in the wider data science skills ecosystem and emphasises the importance of a targeted approach to expand the benefits resulting from the increasing uptake of geospatial skills across the UK.

Geospatial subgroups

We grouped similar geospatial postings together based on their skill mix, to highlight more granular subsets of geospatial activity. In addition, to distinct skill requirements subsequent analysis revealed that demand for these subgroups has

evolved at different rates and the groups also differed in terms of their geographic concentration and educational requirements. We have illustrated the resulting six subgroups in Figure 3 below. For each subgroup we have noted the geospatial skill that appears most frequently as part of included postings. We have also included the most prevalent co-occurring skill and the number of postings within each group.

Figure 3 Illustration of geospatial occupation subgroups



Most common geospatial skill	GIS software	GIS software	Building information modelling	SLAM	Land Surveys	Mapping
Most common co-occurring skill	Communication skills	SQL	AutoCAD	C++	Communication skills	Project Planning
Number of postings	18,672	8,529	7,625	4,845	16,551	15,783

Source: Frontier based on analysis of Burning Glass data

Note: For each subgroup we have noted: the most commonly occurring geospatial skill (e.g. the geospatial skill which appeared in the highest proportion of postings in that group) and the most commonly occurring non-geospatial skill. We have also sized according to the number of postings that are included in each subgroup. We found that over the period 2014-19 71,300 postings called for a geospatial skill. In addition, a further 700 had a clearly geospatial job title and role, but no geospatial skills specified

- We have called our first group ***GIS specialists***. Job postings that fall into this category almost always specify a GIS capability including ArcGIS or QGIS. The most commonly occurring non-geospatial skill is communication.
- Our second group is titled ***programming and data management with GIS***. Job postings in this subgroup tend to require GIS skills but also specify database administration skills such as SQL, and/or data programming skills such as Python or Java
- ***Civil Engineering and design software*** capability is concentrated in our third group. Nearly 80% of these job postings require building information modelling (BIM) capabilities. This software is used to create digital representations of physical features. Typically, postings in this group also call for engineering and drafting software packages such as AutoCAD and Revit which allow users to design a building in 3D.
- Our fourth group is defined primarily by **simultaneous localisation and mapping** (SLAM) capability. SLAM technology involves the use of cameras and/or sensors to capture 3D measurements and generate a map. Some autonomous vehicles systems use SLAM to navigate through an unknown environment. This group features a high prevalence of coding capability such as C++, machine learning and python skills.
- The vast majority of ***surveyors and related professionals*** are included within the fifth group. 97% of postings in this group specify a skill from the 'surveying' skills cluster, which includes field surveys, topographic surveys and LiDAR.
- Our final ***miscellaneous*** category includes a variety of smaller subgroups. Some postings in this group call for the application of geospatial skills in contexts such as meteorology or urban planning. This shows how pervasive geospatial skills are across the economy and emphasises the wide-uptake of geospatial insights. There is also a subset of roles within this group that call for remote sensing skills such Earth Observation. Another cluster of postings

within this group specify generic 'mapping' capability, but do not tend to mention GIS skills.

In Figure 4 below we have collected detailed examples of roles that fall into each of our subgroups. These pen portraits help to illustrate the type of vacancy that tends to be classified into each cluster and allows us to see how geospatial skills are used in conjunction with a wide variety of supporting capabilities across multiple sectors of the economy.

Figure 4 Examples of roles that fall into each subgroup

Subgroup	Role & Sector	Description of vacancy	Skills and qualifications
GIS Specialists	Data Scientist – public sector	Lead on data standardisation and development of a spatial framework and data observatory.	Analysis of planning and data; data management; GIS spatial mapping tools; Strategic planning or place-making expertise; digital innovation.
Programming and data management with GIS	Senior Data Journalist - broadcasting	Working to bring together journalists, designers, developers and editors to provide compelling visual coverage of news stories.	Explore and summarise data for data-driven stories using GIS, SQL, Python and R; html and scripting for data visualisation or analysis; knowledge of QGIS and/or Tableau. Ability to visualise spatial patterns
Civil Engineering and design software	Senior Hydraulic Modeller - management consultant	Lead on the delivery of hydraulic modelling for a broad range of clients on flood risk, and integrating AI and statistical processes.	Requires MEng (Hons) Civil Engineering. Highly proficient in the use of modelling and GIS software. Experience with other software (e.g. InfoWorks) is desirable
SLAM and robotics	Artificial Intelligence Architect - PropTec	Establish data science function. Solution design, architecture, model performance, model currency and ultimate delivery	Understanding of Machine Learning and AI techniques, strong technical architecture, design, deployment and knowledge of AI platforms, and protocols
Surveyors and related expertise	Hydrographic Surveyor - renewable energy	Use of marine geospatial techniques and tools in offshore and marine environments.	Knowledge of geodesy, GIS, software, awareness of navigation on water. Experience of sensor technologies.
Miscellaneous	Consultant, Poverty and Equity– financial sector	Analytical and operational consultant aiming to end extreme poverty and boost shared prosperity	Knowledge of STATA, R, Python and ArcGIS; applied macroeconomics; quantitative skills.

Source: *Burning Glass data*

Note: *Included posts are illustrative examples and not necessarily fully representative of wider group in each case.*

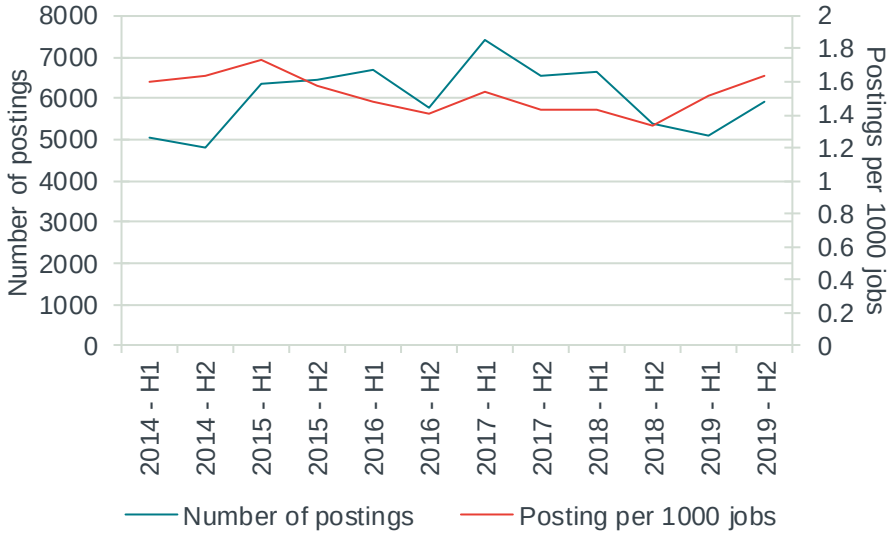
Changes in demand over time

We found that over the period 2014-19 71,300 postings called for a geospatial skill.[4] This corresponds to 1.6 geospatial postings per thousand job adverts. There

[4] In addition, a further 700 had a clearly geospatial job title and role, but no geospatial skills specified.

is no consistent trend in the number of geospatial postings over the entire period although there may be early evidence of a rise in the rate of geospatial postings from the first half of 2018 to the end of 2019. However, demand for different subgroups of postings has evolved differently. For example, both the surveying and related expertise subgroup and the civil engineering and design software group experienced material increases in the number of postings between 2014-19.

Figure 5 Monthly rate and number of Burning Glass postings that call for any geospatial skill (2014-19)



Source: Frontier analysis of Burning Glass data

Specific geospatial skills and co-occurring skills which appear on geospatial postings are in higher demand now relative to 2014. For example, specific GIS software packages are now more commonly required. The rapid rise in popularity of QGIS in particular suggests that open source geospatial software is becoming more prevalent. In addition, expertise relating to sensor technologies has also become more prevalent. In terms of co-occurring skills Python has seen the largest proportional increase and is now frequently called for in conjunction with geospatial skills. Python has been highlighted previously as an increasingly important component of data science roles.[5] Other more generic data skills such as Big Data and Data Analysis also appear slightly more frequently on geospatial postings relative to 2014. Notably several variants of SQL now appear less frequently.

Regional patterns of demand

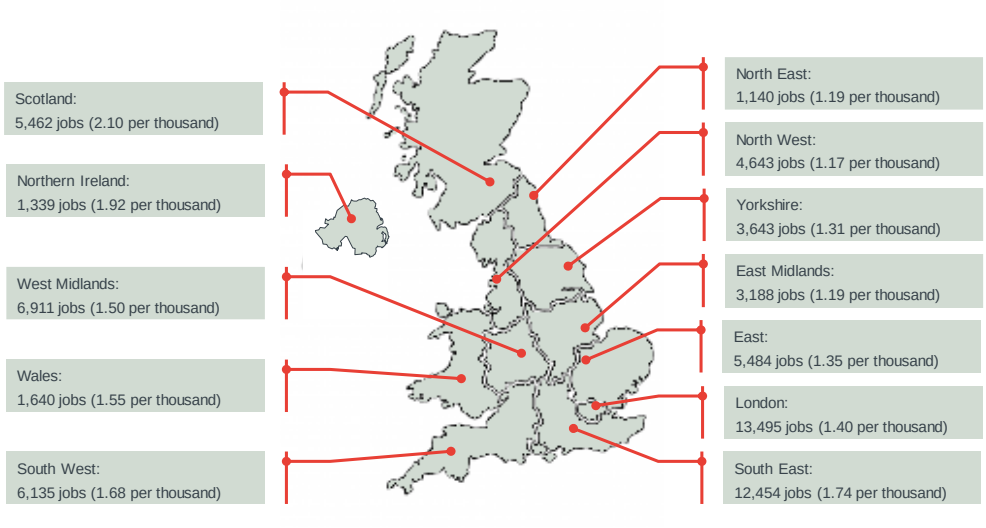
London[6] contains the highest number of geospatial postings. However, a distinctly different pattern emerges if we examine the proportion of all postings within a region that call for a geospatial skill. Scotland and Northern Ireland have the highest rates of geospatial intensity. GIS skills are demanded at above average rates in Scotland and Northern Ireland with cities such as Edinburgh, Glasgow and

[5] https://royalsociety.org/-/media/policy/projects/dynamics-of-data-science/dynamics-of-data-science-skills-report.pdf

[6] As defined by the high-level region which corresponds to the former Government Office Region geography.

Belfast driving this pattern. The lowest rates of geospatial intensity are observed in the North West and North East.

Figure 6 Location of Burning Glass postings that call for any geospatial skill and geospatial intensity of each region (2014-19)



Source: Frontier

1 BACKGROUND

This Section sets out the context for our study, our objectives and the approach we have undertaken.

1.1 Context for the study

1.1.1 Geospatial Commission

In 2018 the Government expressed an ambition to take advantage of the UK's existing world-class capability in geospatial data and acknowledged that previous attempts to coordinate geospatial data policy have struggled (Cabinet Office, 2018). [7]

The Geospatial Commission was established in April 2018 within the Cabinet Office, as an independent, expert committee in the centre of Government.[8] The Geospatial Commission is responsible for setting the UK's geospatial strategy and coordinating public sector geospatial activity. The aim of the Geospatial Commission is to unlock the significant economic, social and environmental opportunities offered by location data and boost the UK's global geospatial expertise.[9]

In particular the Geospatial Commission will:

- provide strategic oversight of the geospatial ecosystem in the UK;
- hold the budget for the public sector's largest investment in geospatial data; and
- make targeted investments in data projects that will accelerate innovation and adoption of geospatial data applications. [10]

1.1.2 Geospatial Skills

Improving the skills base of the UK is an on-going government priority. For example, the Government's Industrial Strategy (2017) identified ***People*** as one of the five foundations of productivity.

The Geospatial Commission's[11] recent UK Geospatial Strategy, 2020 to 2025 (2020) sets out how the UK can unlock the power of location. One of four missions in the strategy was to enhance capabilities, skills and awareness. Specifically, the Geospatial Commission set out an objective to develop more people with the right

[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/733864/Initial_Analysis_of_the_Potential_Geospatial_Economic_Opportunity.pdf

[8] https://www.gov.uk/government/organisations/geospatial-commission

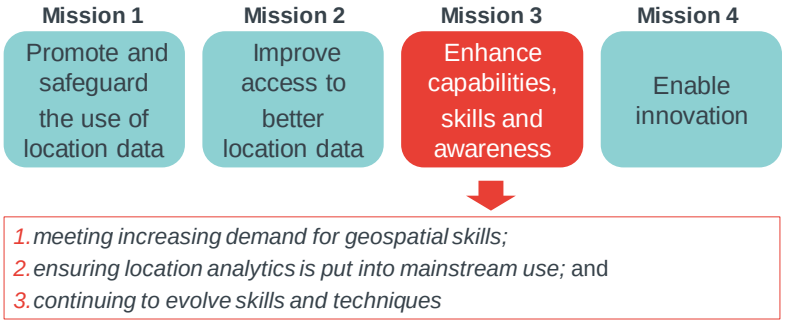
[9] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/894755/Geospatial_Strategy.pdf

[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/894755/Geospatial_Strategy.pdf

[11] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/894755/Geospatial_Strategy.pdf

skills and tools to use location data, across organisations and sectors to meet the UK's needs (Figure 7).

Figure 7 Geospatial Commission Missions



Source: *UK Geospatial Strategy* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/894755/Geospatial_Strategy.pdf

Mission 3 acknowledges that the UK must develop more people with the right skills and tools to work with location data. Currently there is no universally agreed definition for a geospatial skill or an established list of geospatial roles. As we describe below this novel piece of work will inform the Geospatial Commission's future activity by helping to address that gap.

1.2 Terms of reference

The objective of our work is to analyse the demand for geospatial skills in the UK. This contributes to a wider evidence base which will inform the Geospatial Commission's approach, develop understanding of the geospatial skills market, and anticipate the likely future evolution of the skills requirement. We have examined which jobs can be defined as geospatial, the present level of demand for geospatial roles and associated levels of remuneration.

In addition, we have examined:

- the areas in the UK where demand is particularly high or low;
- the distinct subgroups of geospatial roles that exist;
- the industries that demand geospatial skills and how is that demand distributed geographically and temporally; and
- which comparator occupations can be used to benchmark the evolving demand for geospatial skills and roles.

Our results can be used by the Geospatial Commission to consider future interventions. These interventions will help ensure that the UK public and private sectors have access to a diverse range of geospatial skilled individuals, which in turn will drive the innovative use of geospatial data. The analysis we have undertaken will help the Geospatial Commission to target and better align the content of skills development in the areas most likely to deliver benefit. Our results also provide a benchmark for current demand of geospatial skills. This analysis can be repeated in the future in order to identify changes in the market and measure the future impact of initiatives.

This study will feed into a wider programme of work that the Geospatial Commission is undertaking to evidence possible skill gaps. Our analysis does not explore the supply of individuals with geospatial skills which could be an important focus for future work. During each stage of our analysis we worked closely with the Geospatial Commission's skills, policy and analysis teams to ensure their expertise guided our work. We also presented interim findings to a wider group of stakeholders from across the sector. The feedback we received is reflected in our final approach.

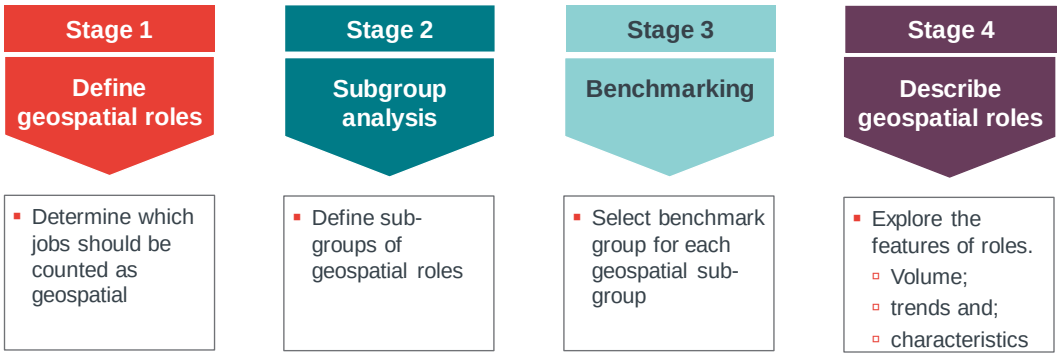
1.3 Our approach

1.3.1 Overarching methodology

Our work has been divided into four stages, which we have illustrated below in Figure 8.

- During Stage 1 we identified which jobs should be defined as geospatial. Whether or not a job is considered geospatial is determined by the skill mix required for that role by employers. The jobs we identified in this stage formed the basis for the remainder of our analysis.
- Geospatial skills will be deployed in a range of different settings and contexts. In Stage 2 we divided the wider groups of geospatial roles into a number of subgroups. We derived the subgroups using a combination of data driven techniques (based on occupational skills mix) and existing knowledge of the sector from within the Geospatial Commission. Our identification of these subgroups allowed us to explore more granular trends in demand for specific groups of jobs and skills.

Figure 8 Methodology



Source: Frontier

- The third stage of our work focused on identifying groups of comparator roles (on the basis of their occupation codes) that do not require geospatial skills but are similar in terms of other characteristics.
- Finally, we carried out a descriptive analysis of geospatial roles covering trends in the total number of jobs as well as key characteristics such as location and salary. In some cases, the comparator roles were used as a benchmark for key descriptive findings from Stage 3.

1.3.2 Data used

Burning Glass Technologies

We used data provided by the analytics software company Burning Glass Technologies[12] to analyse the demand for geospatial skills across the UK. We used data which covered 2014-2019 inclusive. Burning Glass uses a novel big-data approach to assess the job market. The dataset they provided to us consists of millions of online job vacancy postings. It contains a rich source of information on what employers are looking for in terms of the skills, qualifications and experience to fill their advertised posts, as well as the salary and contracted hours that they have on offer. The information is aggregated from more than 7,500 UK online job sites in near real-time. Job postings are de-duplicated by Burning Glass to remove repeated observations.

Burning Glass use natural language algorithms to scan the content of each posting for information. Burning Glass parses, extracts and codes dozens of data elements including what employers are looking for in terms of skills, qualifications and experience to fill their advertised posts. Burning Glass codes occupations and skills using a combination of machine learning techniques and expert-generated rules to appropriately assign a job posting to an occupation and tag the specific skills employers require.

Related work

DCMS used Burning Glass data (2019)[13] to provide specific and nuanced evidence about which digital skills are in demand by employers. The authors defined seven clusters of digital skills:

- Software and programming;
- Systems;
- Data analysis;
- Digital marketing;
- Digital design;
- Relationship management; and
- Manufacturing technology.

Of direct relevance for our work, the authors highlighted how job seekers need a complete package of skills for success in the economy, both digital and non-digital. This will apply to geospatial roles as well. Interestingly DCMS also concluded that digital skill requirements vary substantially from region to region. We have examined the extent to which this holds true for geospatial roles.

The Royal Society examined the demand for data science roles using Burning Glass.[14] The number of data science and analytics job postings rose by 35% between 2013-18. Interestingly this increase in postings was across all sectors. We also explored whether geospatial skills are similarly broadly distributed

[12] burning-glass.com

[13] https://www.burning-glass.com/wp-content/uploads/no_longer_optional_report.pdf

[14] https://royalsociety.org/topics-policy/projects/dynamics-of-data-science/

Limitations of the data

The Burning Glass data provide one indication of what is happening in the labour market as the advertisement of a vacancy signals that an employer in intending to recruit. However, not all vacant job positions will be advertised online.[15] This implies that across the entire dataset certain types of posting that are only advertised informally or within an organisation will be underrepresented. In general, we would not expect this to be a material issue for geospatial roles. Employers or employments agencies may also occasionally post adverts that do not necessarily correspond to actual current demand. For example, they may be looking to build a pipeline of potential future recruits.[16]

In addition, increases in geospatial postings do not always mean that there has been an increase in the number of geospatial jobs across the economy. For example, if job turnover increases, more vacancies will be advertised even if there has been no change in the number of people working in geospatial roles (Royal Society, 2019).

Burning Glass have been as comprehensive as possible in gathering all available information relating to each vacancy. However, due to the format of certain postings not every data field (such as location, employer name) is filled in for every vacancy. The skill requirements for each posting are based on the actual wording that the employers have used in each vacancy. Burning Glass converts the underlying text into a large number of standardised skills and skill groups which we describe further in the next section. The skills groups are defined by Burning Glass across all jobs and as a result may not match perfectly to the profile of skills used within geospatial roles in particular. The method we have used to define geospatial roles takes this into account.

Despite these limitations the Burning Glass data constitutes a unique and valuable source of information. As we describe above this dataset has been used in other related studies and is the most suitable data source for this piece of research.

The Burning Glass data also does not contain any information on the supply of individuals with geospatial skills. This is outside the scope of this piece of work but may be an important area to explore as part of future work. The pipeline of individuals who will fill these roles in the future is of crucial importance. The Geospatial Commission's UK Geospatial Strategy (2020) sets out a vision to develop more people with the right skills to work with location data across organisations and sectors.

1.4 Structure of the report

We have structured the remainder of our report as follows:

- In Section 2 we describe the process we have used to identify geospatial jobs.
- In Section 3 we describe how we carried out the subgroup analysis and present the results of this clustering.

[15] The 2016 Employer Perspectives Survey indicated that 28% of employers exclusively used such internal resources including word of mouth to recruit staff.

[16] https://data.london.gov.uk/job-postings/

- In Section 4 we present descriptive analysis for each geospatial subgroup and include results from the comparator analysis.
- Section 5 concludes the report.

2 DEFINING GEOSPATIAL ROLES

The first stage of our analysis involved identifying which postings within the Burning Glass data were for geospatial roles. In this Section we describe the process that we used for this identification and the results of implementing that process. Using this approach, over the years 2014-2019 inclusive, we identified 71,300 job postings calling for geospatial skills out of a total of 49 million vacancy postings within the Burning Glass data.

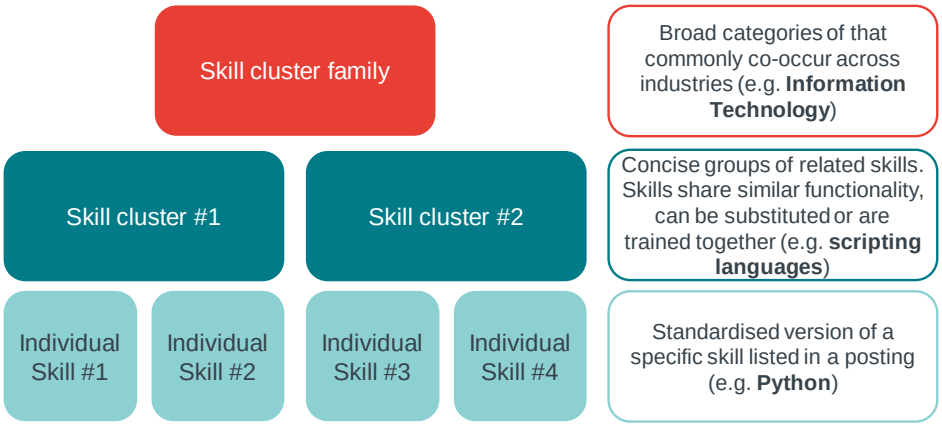
2.1 Using skill requirements to identify geospatial jobs

We define geospatial roles according to the skills required to carry out the job. Each posting that is recorded by Burning Glass contains a list of skills which the posting organisation (an employer or recruitment agency) require any applicant to have. Our first step was to devise a list of skills that can be considered to be geospatial in nature. We could then highlight postings that call for any of these skills as being geospatial jobs.

2.1.1 Structure of Burning Glass data

Burning Glass assigns each skill that appears in a job posting into a large number of standardised categories. These skills are arranged into a hierarchy by Burning Glass (see Figure 9). Individual skills (such as proficiency with the software package Python for example) are grouped firstly into clusters which are narrowly defined groups of skills (such as scripting languages). Secondly these clusters are grouped into broader skill cluster families which are wider groupings of skills (such as all IT skills). This hierarchy has been created by Burning Glass using a combination of clustering algorithms and manual assessment of skill similarity.

Figure 9 Burning Glass skills hierarchy



Source: Burning Glass

Within our data extract[17] there are approximately 30 Skill cluster families, 600 skill clusters and 9,000 individual standardised skills.[18] To ensure our definition of geospatial roles is as granular and comprehensive as possible we have carried out

[17] Which consisted of all UK based job adverts over the period 2014-19 inclusive.

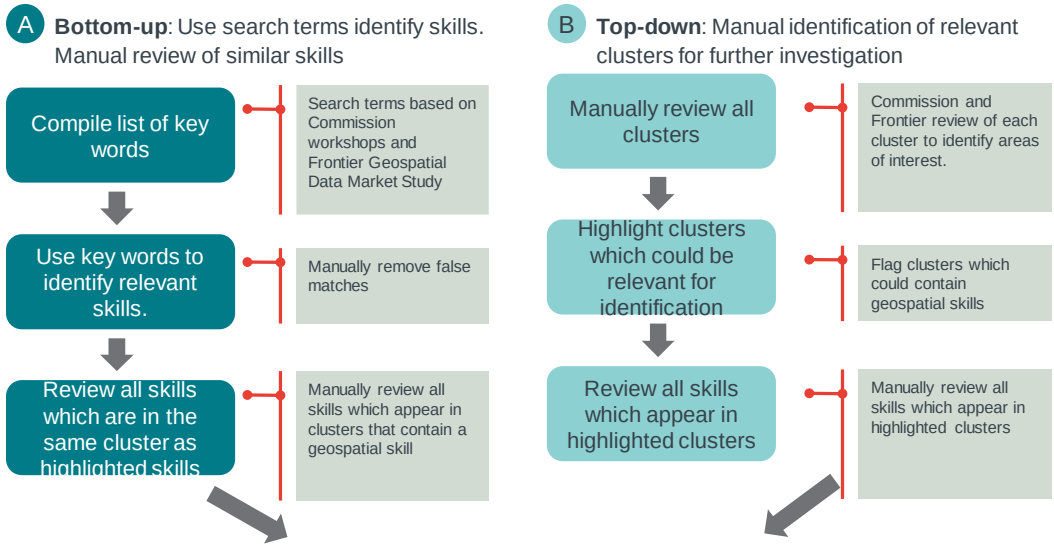
[18] We refer to these granular skills as *individual skills* throughout the report.

our identification of roles at the individual skill level, rather than relying solely on skills clusters or skill families. However, as we describe below, we have used Burning Glass' skills hierarchy to aid in that process.[19]

2.2 Procedure to identify relevant individual skills

We devised a replicable and transparent method of highlighting relevant geospatial skills. The overall process involved two complementary approaches (A: Bottom-up, B: Top Down) which we have summarised in Figure 10 below. We have also provided additional detail on each in the following two subsections of this chapter.

Figure 10 Geospatial skill identification



Source: Frontier

2.2.1 Bottom-up

During the bottom up identification process, we defined a list of key words which were known to correspond to geospatial activities (e.g. GIS, spatial, survey, radar, map). We used this list of key words to search through every individual skill listed in the Burning Glass dataset (of which there are over 9,000). Individual skills which contained any of the key words were highlighted as potential geospatial skills. We compiled the list of search terms from two primary sources:

- Previous analysis carried out by Frontier to identify organisations who carry out geospatial activity. This built on initial work carried out by the Geospatial Commission on the same topic which was informed by a series of workshops on geospatial firms and their activities.
- Dedicated geospatial skill workshops held by the Geospatial Commission to draw together a list of geospatial skills and software packages.

[19] There are also certain skills in the Burning Glass database which are not categorised into any skill cluster. This may be because they are very generic or emergent, so they do not have an established position in the classification system.

Several of the search terms identified through this process were quite generic (e.g. geo) which meant that individual key words matched against multiple individual skills in the Burning Glass database. Following an initial application of the search terms to the full individual skill list we manually reviewed each match and removed any false positives. This included cases where a search term picked up individual skills that were not geospatial in nature but did contain a geospatial word or phrase (e.g. curriculum **map**ping).

As a further robustness check we then manually reviewed every individual skill which appeared in Burning Glass skill clusters, that had been flagged as containing at least one match against our search terms. This ensured that for example we did not miss out on any surveying skill variant even if our search terms did not directly identify them initially.

To illustrate, the search term “geo” identified some skills in the environmental geology” skills cluster. The skills of GeoJSON and geologic data interpretation were deemed to be geospatial, while environmental hydrogeology was not. The whole skills cluster was then explored, and hydrologic modelling was identified as relevant, while many other skills such as soil collection were not.

2.2.2 Top-down

During the top-down skills identification process Frontier and the Geospatial Commission reviewed the entire list of skill clusters produced by Burning Glass and highlighted clusters of interest for further investigation (see **Figure 45** in the Annex section). We then manually reviewed every individual skill which appeared in each of the highlighted clusters and added any relevant individual skills which we had not picked up via the bottom-up analysis to our final list.

During this process we selected only those individual skills which would be helpful in pinpointing geospatial roles rather than attempting to include all possible individual skills that could feature in any geospatial role. For example, we included GIS as an individual geospatial skill because any role that calls for GIS usage will have a geospatial component. However, we did not include more generic individual skills at this stage such as data science for example. While data science skills will feature in a subset of geospatial roles these skills are also required in a range of roles that include no explicit geospatial component. Therefore, it would not be helpful to identify roles using these broader skills.

In later stages of the analysis where we have divided geospatial roles into a number of different subgroups, we have used co-occurring individual skills to help make the distinction between groups.

2.3 Individual skills identified

The final list of individual skills that were identified via the process described above is captured in Figure 11 below.

The list is diverse, reflecting the broad range of activity and expertise that can be considered geospatial. Specifically, it includes software packages like Esri or QGIS. In addition, there are multiple individual skills that correspond to activities at different stages of the geospatial value chain such as collection and manipulation

of data., There are also sector specific individual skills which relate to agriculture, meteorology and geology for example.

This broad range of individual skills further emphasises the importance of our subgroup analysis (Section 3) which has defined coherent groups of postings that call for specific combinations of the skills we have identified.

Figure 11 List of individual skills used to identify geospatial roles

Burning Glass individual skill		
ArcGIS	Geopak	Object Tracking
Arcview	Geospatial Information Systems	OTM Mapping
Building Information Modelling	Geospatial Intelligence	Pipeline Survey
Construction Map Making	Google Maps API	Precision Agriculture
Digital Mapping	GPS Data	QGIS
e-Science	GRASS GIS	Record Survey Measurements
Esri Software	Hydrologic Modelling	Remote Sensing
Field Surveys	Land Survey	Routing Optimisation
Fixed Asset Tracking Systems	Lidar	Simultaneous Localisation and Mapping (SLAM)
Geographic Information System (GIS)	Locating Underground Utilities	Soil Testing
Geographic Information System (GIS) Data	Logistics Analysis	Survey Analysis
GeoJSON	Mapping	Survey Instruments
Geologic Data Interpretation	Mapping Software	Topographic Surveys
Geological Data Collection	MapQuest	Topographical Maps
Geological Maps	Navigation Equipment	Urban Planning
Geological Surveys	Object Recognition	Vehicle Tracking Systems
Geophysical Surveys	Physical Map	

Source: Frontier

2.3.1 Validation

We carried out a validation procedure to ensure that:

- all roles which we flagged as geospatial were truly geospatial; and
- we were as comprehensive as possible in identifying jobs which involved geospatial activity.

Firstly, we created a list of specific employers who were posting a significant number of vacancies which calls for geospatial skills. We then examined the postings linked to organisations who we would not expect to be calling for geospatial capabilities to confirm that all postings were genuine geospatial jobs.

This led to the exclusion of a small number of postings where skills were incorrectly categorised in the underlying data.[20]

Secondly, the list of search terms we used, and individual skills identified was shared with a wide group of industry stakeholders for feedback. We received a number of suggestions, which led to us identifying a small number of additional skills.

Finally, we drew up a list of occupations where we would expect high levels of geospatial activity.[21] We then examined a sample of postings falling under each of these occupations to verify that no additional relevant skills featured, and we were picking up a high proportion of all postings. This revealed that a small number of postings for geospatial roles contained very few or no individual skills due to the format of the posting or the data collection method. To add these postings to our group of geospatial jobs we applied a narrower key word search across all job titles rather than skills.[22]

[20] In particular certain acronyms such as SLAM and GIS appeared in job postings but did not refer to the relevant geospatial skill.

[21] We focused here on “Geographer / GIS Specialist” and “Land Surveyor”.

[22] We include the following job titles: Geographic Data Scientist, Geographic Information Analyst, Geographic Information Systems Analyst, GIS Analyst / Consultant / Specialist, Spatial Data Analyst Scientist, Location Intelligence Analyst. In addition, we include job titles containing the following text: “Geospatial”, “Geomatic”, “Geodatic”, “Geographic Information”, “Land Survey”, “Field Survey”, “Topographic”

3 CREATING SUB-GROUPS OF GEOSPATIAL ROLES

In this section we describe the approach we have undertaken for our subgroup analysis and the groups we identified when implementing this method. This analysis involved dividing all geospatial roles into 6 clusters based on their skill mix.

3.1 Rationale for sub-group analysis

We have identified around **71,300** geospatial jobs postings in total. Grouping similar postings together based on the type of skills they require offers a number of advantages:

- Geospatial skills will be deployed in a range of very different settings and contexts. Defining sub-groups allows us to explore more **granular trends in demand** for specific groups of postings to reach more nuanced conclusions. This in turn means that the Geospatial Commission can assess which groups of geospatial roles will be most impacted by future interventions and can tailor policies to increase effectiveness.
- The results of the subgroup analysis will allow us to accurately identify **comparable occupations** (which do not call for geospatial skills) for each subgroup rather than using generic comparator groups.

3.2 Approach to sub-group analysis

We have adopted a mixed methods approach to inform the composition of the sub-groups. This involved an upfront data driven categorisation based on patterns of similar skills. However, we also incorporated experience and insight from the Geospatial Commission and wider sector stakeholders following initial iterations of the results. This ensured that the final groupings represented the underlying data and were also reflective of practical real-world groupings of geospatial occupations.

We used a single job posting as the unit of our data driven subgroup analysis. The clustering algorithm we adopted, grouped together similar job postings. We used a posting's skill requirements to define similarity in this context. Creating the subgroups on the basis of skill requirements is conceptually justified as other factors (e.g. location or salary) represent a fundamentally different set of characteristics. We have still examined how these vary by subgroup.

As we describe above the Burning Glass dataset groups individual skills into clusters and cluster families. We used skills clusters as the basis of our subgroup analysis. This has a number of advantages. Firstly, it allowed us to create continuous measures of skill intensity by counting the number of skills within a specific cluster that every posting calls for. Also, it made our analysis more tractable and eliminates the possibility that very similar skills (e.g. two GIS software packages) are treated as entirely different by the algorithm.

Specifically, we focused on the specialised skill clusters which appeared in at least 5% of geospatial job postings. This led to 28 skill clusters being used (see full list in **Figure 48** in the Annex section).[23] Further detail on the approach we used for the subgroup analysis including selection of the optimal number of subgroups is also available in the Annex section.

3.3 Results of the sub-group analysis

3.3.1 Overview of subgroups' skill prevalence

We identified a large number of geospatial vacancies with varied skillsets. Grouping similar geospatial postings together allowed us to explore more granular trends in demand for specific groups of postings. We have illustrated the resulting six subgroups in Figure 12 below. For each subgroup we have noted the individual geospatial skills that appear most frequently as part of included postings. We have also included the most prevalent individual co-occurring skill and the number of postings within each group.

- We have called our first group ***GIS specialists***. Job postings that fall into this category almost always specify a GIS capability including ArcGIS or QGIS. The most commonly occurring non-geospatial skills for this group include generic capability such as communication skills or the use of common software packages such as Microsoft Excel. In terms of number of postings this is the largest group.
- Our second group is titled ***data management and software development with GIS specialists***. This group also is similar to the first group in that GIS skills are important. However, job postings in this subgroup also require database administration skills such as SQL, and/or data programming skills such as Python or Java.

Figure 12 Illustration of geospatial occupation subgroups

	GIS Specialists	Programming / data management with GIS	Civil Engineering	SLAM & Robotics	Surveyors	Miscellaneous
Most common geospatial skill	GIS software	GIS software	Building information modelling	SLAM	Land Surveys	Mapping
Most common co-occurring skill	Communication skills	SQL	AutoCAD	C++	Communication skills	Project Planning
Number of postings	18,672	8,529	7,625	4,845	16,551	15,783

Source: *Frontier based on analysis of Burning Glass data*

Note: *For each subgroup we have noted: the most commonly occurring geospatial skill (e.g. the geospatial skill which appeared in the highest proportion of postings in that group) and the most commonly occurring non-geospatial skill. We have also listed the number of postings that are included in each subgroup.*

- ***Civil engineering and design software*** capability is concentrated in our third group. Nearly 80% of these job postings require applicants to have Building

[23] Following initial iterations of the subgroup analysis we decided to remove six of these clusters which covered more generic skills (like Project Management) from the categorisation algorithm. We did this to avoid the possibility that the algorithm would place too much weight on these more peripheral attributes.

Information Modelling (BIM) capabilities. This is used by architects, engineers and construction professionals to create digital representations of physical features. Typically, postings in this group also call for engineering and drafting software packages such as autoCAD and Revit which allow users to design a building and structure and its components in 3D.

- Our fourth group is defined primarily by **Simultaneous Localisation and Mapping** (SLAM) capability. SLAM technology involves the use of cameras and/or sensors that capture 3D measurements and stitch the resulting data together to generate a map. Some autonomous vehicles systems use SLAM to concurrently map and navigate through an unknown environment. In terms of non-geospatial skills this group features a high prevalence of coding capability such as C++, machine learning and python skills.
- The vast majority of ***surveyors and occupations with related expertise*** are included within the fifth group. 97% of postings in this group specify at least one skill from the 'surveying' skills cluster, which includes field surveys, and topographic surveys.[24]
- Our final ***miscellaneous*** category Group F contains a wide variety of skill requirements and there is far less commonalities between the included postings in this group compared to all other groups. It should be noted that when selecting the appropriate number of sub-groups to create, we are trading off the number of sub-groups with the added explanatory power. If a potential group of postings is not sufficiently different to other groups, a separate group for it will not be created by the algorithm. Group F brings together several of these less distinct sub-groupings within it.
    - The most prevalent cluster of postings within Group F specify generic 'mapping' capability, which covers 19% of group F postings. There may be some similarity to GIS, but the skill profile is not sufficiently similar for them to be placed in Group A, and it is rare to see "GIS" in the job title. 15% of Group F postings are for logistics analysis. These are typically posted by large companies in retail, transport and manufacturing sectors.
    - Urban planning appears in another 15% of Group F postings. Employers include local councils, academic institutions and planning advisory firms.
    - Another significant grouping within F covers earth observation skills such as imaging and remote sensing. These are highly specialised skills not observed much in the other groups. Over half of postings specifying these skills are in academic institutions.

The varied and diverse set of subgroups we have identified highlights the variety of geospatial skillsets that exist across a range of roles. Despite this variation we can also see links between certain subgroups. For example, **Group A** and **Group B** are both heavily reliant on GIS capability whereas **Group B** and **Group D** feature a range of advanced data processing and programming capabilities. Finally, **Groups C** and **E** share some common features such as the use of design software and some surveying capabilities.

We can also see clear evidence of the importance of combining geospatial skills with complimentary skills which is in keeping with previous research on digital and data skills more generally.

[24] The Burning Glass skill cluster does not include marine or hydrographic surveying skills within this cluster.

In Figure 13 below we have collected detailed examples of roles that fall into each of our subgroups. These pen portraits help to illustrate the type of vacancy that tends to be classified into each cluster and allows us to see how geospatial skills are used in conjunction with a wide variety of supporting capabilities across multiple sectors of the economy.

Figure 13 Examples of roles that fall into each subgroup

Subgroup	Role & Sector	Description of vacancy	Skills and qualifications
GIS Specialists	Data Scientist – public sector	Lead on data standardisation and development of a spatial framework and data observatory.	Analysis of planning and data; data management; GIS spatial mapping tools; Strategic planning or place-making expertise; digital innovation.
Programming and data management with GIS	Senior Data Journalist - broadcasting	Working to bring together journalists, designers, developers and editors to provide compelling visual coverage of news stories.	Explore and summarise data for data-driven stories using GIS, SQL, Python and R; html and scripting for data visualisation or analysis; knowledge of QGIS and/or Tableau. Ability to visualise spatial patterns
Civil Engineering and design software	Senior Hydraulic Modeller - management consultant	Lead on the delivery of hydraulic modelling for a broad range of clients on flood risk, and integrating AI and statistical processes.	Requires MEng (Hons) Civil Engineering. Highly proficient in the use of modelling and GIS software. Experience with other software (e.g. InfoWorks) is desirable
SLAM and robotics	Artificial Intelligence Architect - PropTec	Establish data science function. Solution design, architecture, model performance, model currency and ultimate delivery	Understanding of Machine Learning and AI techniques, strong technical architecture, design, deployment and knowledge of AI platforms, and protocols
Surveyors and related expertise	Hydrographic Surveyor - renewable energy	Use of marine geospatial techniques and tools in offshore and marine environments.	Knowledge of geodesy, GIS, software, awareness of navigation on water. Experience of sensor technologies.
Miscellaneous	Consultant, Poverty and Equity– financial sector	Analytical and operational consultant aiming to end extreme poverty and boost shared prosperity	Knowledge of STATA, R, Python and ArcGIS; applied macroeconomics; quantitative skills.

Source: *Burning Glass data*

Note: *Included posts are illustrative examples and not necessarily fully representative of wider group in each case.*

In Figure 14 below we have illustrated a detailed breakdown of each subgroup (columns labelled A-F) in terms of the proportion of postings in each subgroup that calls for at least one skill from a range of relevant skill clusters as defined in the Burning Glass dataset (see rows 1-17). These skill clusters contain both individual geospatial skills and cooccurring skills. To illustrate, 97.4% of the postings in Group

A call for a skill in the GIS Software cluster.[25] We have only included certain clusters of particular interest in Figure 14. Each group will call for a wider skill mix, which we have illustrated for each subgroup in turn in the Annex section.

This confirms that Group A is focused primarily on GIS capability whereas Group B uses GIS in conjunction with SQL, as well as broader data analysis and data management capabilities. As expected, postings in Group C call for skills within the civil engineering, drafting, and visual design clusters. Group D combines SQL capability with skills in the robotics cluster (SLAM). Finally, Group F includes postings that call for a range of skills such as earth science, environmental work and imaging but no single cluster stands out.

Figure 14 Proportion of job postings in each sub-group calling for a skill in relevant skill clusters, covering both co-occurring and geospatial skills

	A	B	C	D	E	F
GIS software	97.4%	69.2%	8.9%	6.7%	3.7%	0.3%
SQL Databases and Programming	2.6%	68.9%	0.7%	19.9%	0.5%	0.8%
Data Science	1.3%	6.8%	0.6%	5.2%	0.6%	1.3%
Earth and Space Science	8.1%	1.3%	1.1%	3.4%	1.5%	14.3%
Environmental Work	12.3%	2.9%	4.5%	0.7%	8.0%	12.1%
Civil and Architectural Engineering	9.9%	1.0%	24.8%	0.7%	11.9%	6.6%
Environmental Geology	4.1%	2.2%	2.4%	0.8%	1.5%	9.7%
Geotechnical Engineering	3.1%	0.1%	1.2%	0.2%	1.3%	2.6%
Drafting and Engineering Design	11.7%	3.6%	63.9%	1.5%	22.7%	3.6%
Data Analysis	10.9%	19.5%	1.3%	6.3%	5.2%	5.0%
Surveying	1.4%	3.3%	5.1%	5.8%	96.6%	0.3%
Electrical and Computer Engineering	0.9%	0.6%	2.2%	3.0%	0.8%	1.0%
Imaging	4.9%	4.8%	1.4%	10.2%	2.7%	14.8%
Engineering Software	0.1%	1.5%	83.9%	0.6%	0.1%	0.0%
Graphic and Visual Design Software	4.0%	3.5%	24.9%	0.4%	2.2%	2.7%
Data Management	9.6%	27.0%	3.6%	3.3%	2.7%	3.3%
Database Administration	2.4%	38.0%	1.2%	2.2%	0.7%	1.6%
Robotics	0.1%	2.7%	0.7%	73.0%	3.7%	0.0%
Number of postings	**18,672**	**8,529**	**7,625**	**4,845**	**16,551**	**15,783**

Source: *Frontier*

Note: ***Group A****: GIS specialists.* ***Group B****: Data management and software development with GIS,* ***Group C****: Engineering and design software,* ***Group D****: Robotics and SLAM,* ***Group E****: Surveyors,* ***Group F****: Miscellaneous. Proportions > 15% are highlighted. Included skill clusters cover both geospatial and co-occurring skills.*

In Figure 15 below we have further broken down each subgroup's skill requirements by listing the specific skills (rather than skill clusters) that appear most frequently. This includes geospatial as well as other co-occurring skills. We can immediately see the importance of cross-cutting co-occurring skills like communication. We can see that GIS packages are used most frequently by Groups A and B. Whereas specific programming and software development tools are used by both Groups B and D (such as Python and Java). BIM and AutoCAD

[25] Some emerging GIS software packages are not yet included in the *GIS Software* skill cluster by Burning Glass. Instead they are uncategorised. If these skills (such as QGIS) were included in the *GIS Software* skills cluster the relevant prevalence figure in Figure 21 would rise from 97.4% to 100%.

stand out most prominently for Group C along with project management. Land surveys and generic surveying appear frequently in Group E posts as well as field surveys. As above Group F's skill requirements are diverse.

Figure 15 Proportion of job postings in each sub-group calling for an individual skill

	A	B	C	D	E	F
AutoCAD	8%	2%	41%	0%	19%	2%
Budgeting	9%	7%	13%	3%	13%	7%
Building Information Modelling	0%	1%	78%	0%	0%	0%
Civil Engineering	9%	1%	19%	0%	11%	5%
Communication Skills	26%	30%	33%	20%	27%	26%
Creativity	4%	9%	11%	5%	4%	5%
Customer Service	7%	7%	8%	4%	6%	7%
Data Analysis	8%	16%	1%	5%	4%	4%
Detail-Orientated	9%	11%	6%	4%	8%	6%
English	6%	5%	7%	5%	5%	6%
Field Surveys	1%	0%	1%	0%	28%	0%
Geographic Information System (GIS)*	97%	72%	10%	9%	4%	3%
Information Systems	23%	11%	2%	1%	1%	0%
Land Survey	0%	0%	2%	0%	42%	0%
Mapping	4%	8%	0%	2%	1%	19%
Microsoft Excel	15%	16%	9%	13%	10%	11%
Microsoft Office	10%	6%	12%	1%	8%	7%
Organisational Skills	8%	7%	11%	3%	10%	8%
Project Planning**	25%	13%	23%	12%	22%	33%
Problem Solving	9%	19%	9%	9%	8%	9%
Project Management	14%	12%	21%	5%	16%	12%
Python	5%	35%	1%	28%	1%	1%
Research	13%	11%	10%	26%	13%	21%
Software Development	3%	27%	2%	20%	0%	1%
SQL	2%	58%	0%	19%	0%	1%
Surveys	3%	3%	3%	0%	24%	0%
Teamwork / Collaboration	11%	15%	18%	15%	10%	12%
Writing	10%	12%	9%	8%	12%	9%

Source: *Frontier*

Note: *Group A: GIS specialists. Group B: Data management and software development with GIS, Group C: Engineering and design software, Group D: Robotics and SLAM, Group E: Surveyors, Group F: Miscellaneous. Proportions > 15% are highlighted. Included individual skills cover both geospatial and co-occurring capabilities. * For simplicity GIS includes all skills in the GIS cluster, as well as QGIS. ** Project Planning is captured in the Burning Glass data as "planning". However, to avoid confusion we have termed it project planning as it refers to generic planning of work tasks / projects rather than planning in the context of property.*

We have defined the subgroups on the basis of their skill requirements. Therefore, the groupings reflect jobs with similar associated activities rather than jobs in specific segments of the economy. Some of the subgroups may contain postings for jobs distributed across a range of different sectors. In other cases, a subgroup's postings may be concentrated in a small number of sectors.

3.3.2 Summary of subgroup occupations

We have also examined the most prevalent occupations for postings within each group. We have used two occupation classification systems for this:

- the **Standard Occupational Classification**[26] (SOC) codes which are a coding system used to classify occupations across government and feature in national statistics. Each job is given a specific occupation code depending on its "skill level" and "skill specialisation". Each of these codes fits into a wider hierarchy. Specifically, the SOC system features nine major groups (e.g. managers, directors and senior officials), 25 sub-major groups (e.g. corporate managers and directors), 90 minor groups (e.g. chief executives and senior officials) and 369 unit groups or jobs (e.g. elected officers and representatives). We have examined each postings' unit group classification.
- **Burning Glass**' own occupation coding system which was specifically developed to incorporate emerging roles which are not well captured in established systems such as the SOC. Burning Glass use a blend of human generated rules and machine learning systems to ensure that each job is coded into the correct occupational category. The system includes 25 career areas (e.g. finance), 159 occupation groups (e.g. accounting professionals) and 751 occupations (e.g. tax manager). We have examined each postings' occupation.

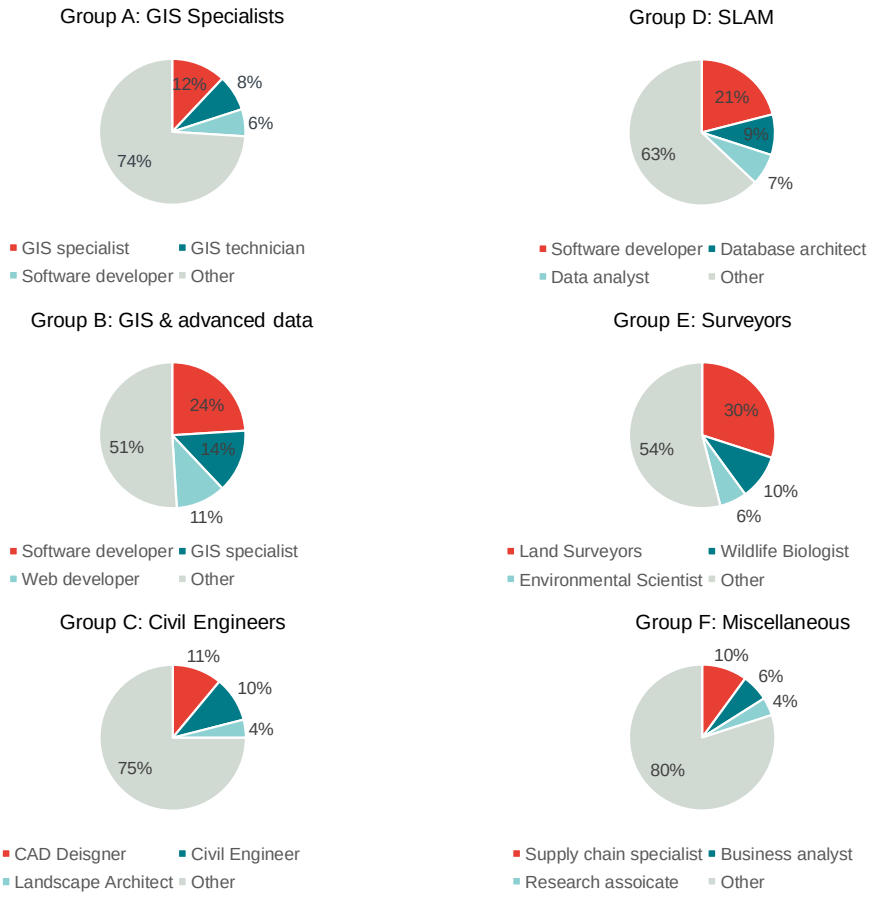
For both systems Burning Glass assign the appropriate occupation code primarily based on job title. However, they also use other data elements (including skill requirements) where the job title is ambiguous. In some cases, Burning Glass cannot retrieve enough information from a posting to classify it under a specific occupation code. Specifically, 2.5% of postings in our sample do not contain a SOC code and 9.4% do not contain a Burning Glass occupation code. For postings that do contain a SOC code but do not contain a Burning Glass code and there is an obvious link between the two systems we impute the appropriate Burning Glass code.[27] This reduces the proportion of observations missing a Burning Glass occupation code to 4.9%.

We have presented a visual summary of prevalent occupational codes within each subgroup according to Burning Glass' own hierarchy in Figure 16 below. Posts in the GIS Specialists group are most commonly found in GIS focused roles. Postings in Groups B and D are most commonly classified as software developers, data analysts and web developers. Architects and CAD professionals and civil engineers feature prominently in Group C, while surveyors dominate Group E. As expected, Group F is spread thinly across a wider number of occupations including logistics professionals.

[26] https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc

[27] The imputation methodology is as follows: where both SOC and Burning Glass occupation code are available, we calculate for each SOC code the percentage of job ads accounted for by each Burning Glass occupation code. If their share is in excess of 50%, we consider this to be a tight mapping and use the Burning Glass occupation code corresponding to the SOC code in cases where the Burning Glass occupation code is missing.

Figure 16 Occupational mix of each subgroup



Source: *Frontier analysis of Burning Glass data*

Note: *The chart shows the most common occupational classifications for each of our subgroups.*

3.4 Creation of comparator groups for each subgroup

Rationale

As we described in Section 1.2 we wanted to define a comparator group of postings for each of our geospatial subgroups. Each of these comparator groups contain postings which do not call for geospatial skills but are drawn from similar occupational groups. In some cases, these comparator postings will be seen as close substitutes for our geospatial postings by labour market participants. In other cases, the comparator postings will be composed of the non-geospatial variant of an occupation which may or may not require geospatial expertise such as a web developer. Examining the demand for these comparator groups relative to our geospatial occupations allows us to contextualise our findings in a more nuanced way.

Approach

As we have described above the postings falling into each subgroup are distributed across a number of occupational codes. For example, for Group B, the three most common occupational codes are Software Developer / Engineer, Geographer / GIS

Specialist, and Web Developer. The remainder of postings in that group are spread across a number of other occupational codes. Importantly, while each of these occupational codes will contain some geospatial roles the majority of Burning Glass postings categorised these categories will not contain an individual geospatial skill. For example, only 0.3% of postings for Software Developer / Engineer explicitly calls for one of our geospatial skills. As we have shown below even in occupational codes that are inherently related to geospatial activity (such as GIS Technician) there are postings that do not call for geospatial skills.

We have therefore created a comparator group for each of our geospatial subgroups which is composed of postings which do not call for geospatial skills but fall into the same occupational categories as geospatial postings. We have used the Burning Glass classification system for the creation of these comparator groups as it more precisely identifies relevant occupations. Figure 17 shows illustrative examples of job titles we uncovered during our analysis for geospatial and non-geospatial roles for the top occupations. The included examples do not necessarily represent the most common job titles for occupations in either group.

Figure 17 Illustrative geospatial and non-geospatial job titles in comparator occupations

Occupation	Example geospatial job title	Example non-geospatial job title
Land Surveyors	Land surveyor	Asbestos Surveyor
Software Developer / Engineer	GIS developer - ArcGIS	Java Developer
Civil Engineer	Geotechnical Engineer	Project Manager Structural Glazing
Surveying / Mapping / GIS Technician	GIS Technician	Assistant Building Surveyor
Data / Data Mining Analyst	Wind Analyst	Brand Commercial Analyst
Wildlife Biologist	Principal Ecologist	Ornithologist
Logistician / Supply Chain Specialist	Logistics Analyst	Spares & Logistics Coordinator
Business / Management Analyst	Business Analyst - Data, Mapping, Modelling Asset Management.	Business Analyst
Environmental Scientist / Specialist	Senior Ecologist	Environmental Consultant
Researcher / Research Associate	Field Scientist	Post-Doctoral Researcher Energy Transitions

Source: Frontier

The comparator results presented in Section 4 (unless otherwise stated) refer to a weighted index of these relevant occupational groups. The weights are based on the proportion of postings in each subgroup falling under each occupational group. Therefore, for Group B the comparator index will include a relatively large share of software developers and only very small shares for the occupations that are observed rarely for this group.[28]

[28] While there is a small risk of including fundamentally geospatial roles on the comparator group (if the geospatial skills are not explicitly specified on the posting), in general the effect of this should be de low, as this would only be a small number of cases. There are a handful of occupations that are more intensive in geospatial, with 2/3 of postings in the Geographer / GIS specialist calling for geospatial skills, 18% of Surveying / Mapping

Skill mix of the comparator groups

Below we compare the individual skills specified in geospatial and non-geospatial roles within the top occupations. For each occupation, we show the top three individual skills that are required more in geospatial roles than in non-geospatial, and vice versa.

The geospatial software developers (found in Groups A and D) are for more likely to call for C++ and Python (in conjunction with a geospatial skill) relative to non-geospatial software developers who more frequently call for other software development platforms such as .NET and ASP. This may suggest that geospatial software developers are more focused on software that allows for the manipulation of data whereas non-geospatial software professionals are move likely to be building web pages.

The postings that are classified as geographers or GIS Specialists by Burning Glass and include one of our individual geospatial skills are mostly included in our Group A and Group B. These geospatial postings are far more likely to call for data management and JavaScript capability than postings in the same occupational category which do not specify any individual geospatial skill. Postings in this comparator group of geographers are much more likely to explicitly call for research and teaching which suggests less of a technical focus.

In addition, civil engineering and surveyor posts that specify an individual geospatial skill (Group C and Group E) frequently also specify AutoCAD as a co-occurring skill. However, postings in the same occupational groups that do not call for an individual geospatial skill do not tend to call for AutoCAD capability. Civil engineering posts that do not specify any geospatial capability are more likely to call for project and contract management suggesting a focus on more administrative tasks. Postings classified as surveyors who do not call for any geospatial capacity are more likely to require property management and demolition expertise.

Figure 18 Comparator group occupation skill mix

Occupation	Required more in geospatial roles			Required more by non-geospatial roles	
	Prevalence in geospatial roles	*Prevalence in non-geospatial roles*		Prevalence among geospatial roles	Prevalence among non-geospatial roles
Land Surveyors	AutoCAD	33%	<5%	Demolition	<5%	12%
	Global Positioning System (GPS)	22%	<5%	Property Management	<5%	10%
	Surveys	19%	<5%	Budgeting	8%	11%
Software Developer / Engineer	C++	26%	12%	.NET	13%	23%
	Python	22%	10%	Active Server Pages (ASP)	6%	12%

/ GIS Technician, 13% of wildlife biologists, and 24% hydrologists. However, these occupations only make up a small proportion of the total share of jobs in a group, which will reduce the magnitude of any such effect.

Occupation	Required more in geospatial roles			Required more by non-geospatial roles		
	Systems Engineering	13%	<5%	ASP.NET	5%	12%
Geographer / GIS Specialist	Python	30%	<5%	IBM WEBSPHERE	<5%	12%
	Data Management	23%	<5%	Teaching	<5%	14%
	JavaScript	19%	<5%			
Civil Engineer	Civil Engineering	69%	42%	VMware	<5%	7%
	AutoCAD	37%	17%	Microsoft Active Directory	<5%	6%
	Planning*	32%	13%	Windows Server	<5%	5%
Surveying / Mapping / GIS Technician	Data Capture	16%	<5%	Contract Management	<5%	16%
	AutoCAD	16%	7%	Contract Administration	<5%	15%
	Data Management	11%	<5%	Project Management	6%	16%
Data / Data Mining Analyst	Data Analysis	39%	23%	Finance	<5%	9%
	Research	21%	10%	Accounting	<5%	8%
	Python	12%	<5%	Stakeholder Management	6%	10%
Wildlife Biologist	Organisational Skills	20%	6%	Environmental Consulting	9%	14%
	Budgeting	24%	10%	Staff Management	<5%	7%
	Planning*	37%	26%	Preparing Proposals	<5%	5%

Source: Frontier

*Note: * Project Planning is captured in the Burning Glass data as "planning". However, to avoid confusion we have termed it project planning as it refers to generic planning of work tasks / projects rather than planning in the context of property.*

4 DESCRIPTIVE ANALYSIS

In this section we present the results of our descriptive analysis. Our descriptive analysis sought to explore the subgroups of geospatial postings that we identified in the previous chapter. This analysis covered a number of domains including:

- change in number of postings over time;
- salaries offered by employers;
- geographic location of postings;
- employers' qualification requirements; and
- sectoral breakdown of geospatial postings.

4.1 Postings identified

The Burning Glass data does not record the level or proficiency required in relation to individual skill requirements. This is because the data is taken from online job vacancy postings which do not normally include this type of information. Therefore, we have used our skills list to identify any posting that calls for any individual geospatial skill. This means that some postings that we have included call for a single geospatial skill and the some of the roles being advertised might not always involve a high level of geospatial intensity or proficiency. As our methodology captured very specific geospatial skills, these roles with a narrow geospatial focus are still of interest.

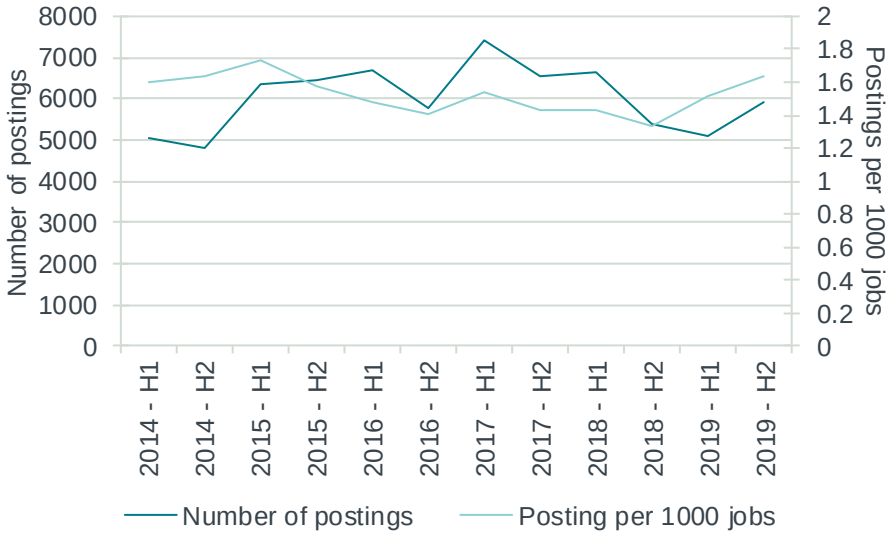
4.1.1 Number of postings

In total over the period 2014-19 inclusive 71,300 postings called for at least one individual geospatial skill, out of 49 million postings in total.[29] To examine trends over time we focused primarily on the proportion of postings containing a geospatial skill. Our sample of 71,300 postings corresponds to approximately 1.6 postings per thousand ads collected by Burning Glass over this period. The proportion accounts for the fact that Burning Glass identifies a higher number of all vacancies over time. For completeness we have also presented the absolute number of geospatial postings over time in Figure 19 below. Both series show similar patterns. As expected, the absolute number of postings exhibits a higher level of seasonal variation.

Overall, there is no consistent trend over the entire period (Figure 19). There is some evidence of a rise in the rate of geospatial postings from 1.3 postings per thousand in the first half of 2018 to 1.6 in the second half of 2019, but this is not conclusive. These results can serve as a baseline for the Geospatial Commission who could repeat this analysis in the future to determine if the recent trend has persisted. There may have been a significant expansion in geospatial postings prior to 2014. Additionally, as we will examine below there are specific groups of geospatial jobs that have seen an increase in demand over this period.

[29] In addition, a further 700 had a clearly geospatial job title and role, but no geospatial skills specified.

Figure 19 Monthly rate of Burning Glass postings that call for any individual geospatial skill (2014-19)

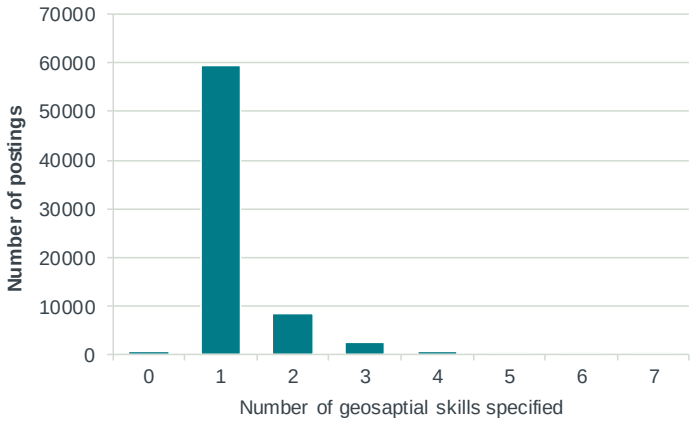


Source: Frontier

4.1.2 Number of individual geospatial skills per posting

The majority of geospatial jobs (80%) only call for one individual geospatial skill.

Figure 20 Distribution of geospatial skill requirements



Source: Frontier

This suggests that there are many distinct domains of geospatial capability which do not consistently overlap. A small proportion of postings (<1%) have an obviously geospatial job title, but no geospatial skills specified, which explains the small number of postings which have zero geospatial skills.

It is worth noting that postings which contain multiple geospatial skills generally feature multiple variants of GIS capability. This is shown in Figure 21 below. For example, in postings with only 1 geospatial skill, only 11% include GIS as an explicit requirement, compared with 79% if 3 or more are specified. By contrast,

other skills such as surveying, or BIM are observed less in postings with multiple geospatial skills.

Figure 21 Top 10 geospatial skills depending on the number of geospatial skills specified in the posting

Only 1 geospatial skill specified		2 geospatial skills specified		3+ geospatial skills specified	
Geographic Information System (GIS)	11%	Geographic Information System (GIS)	53%	Geographic Information System (GIS)	79%
Land Survey	11%	ArcGIS	46%	ArcGIS	77%
Building Information Modelling	10%	QGIS	15%	QGIS	29%
ArcGIS	8%	Land Survey	9%	Geographic Information System (GIS) Data	27%
Field Surveys	7%	Remote Sensing	9%	Esri Software	27%
Mapping	6%	Geographic Information System (GIS) Data	8%	Remote Sensing	15%
Simultaneous Localisation and Mapping (SLAM)	5%	Mapping	8%	Oracle Spatial	9%
Urban Planning	5%	Esri Software	7%	Field Surveys	7%
Logistics Analysis	4%	Field Surveys	5%	Lidar	7%
Remote Sensing	3%	Lidar	4%	Mapping	7%

Source: Frontier

4.2 Skill breakdown

4.2.1 Most prevalent individual skills

We have examined the most commonly occurring individual geospatial skills since 2014 (Figure 22). GIS capability is called for in 37% of postings. Surveying skills also feature prominently as well as remote sensing.

Figure 22 Most commonly appearing individual geospatial skills in geospatial postings

Individual Burning Glass skill	% of geospatial postings	Skill Cluster
Geographic Information System (GIS)*	37%	Geographic Information System (GIS) Software
Land Survey	10%	Surveying
Building Information Modelling	8%	Engineering Software
Field Surveys	7%	Surveying
Mapping	6%	-
Simultaneous Localisation and Mapping (SLAM)	5%	Robotics
Remote Sensing	5%	Imaging
Urban Planning	4%	Urban Planning
Logistics Analysis	4%	Logistics
Survey Instruments	3%	Surveying

Individual Burning Glass skill	% of geospatial postings	Skill Cluster
Meteorology	2%	Earth and Space Science
Hydrologic Modelling	2%	Environmental Geology
Lidar	2%	Surveying
Topographic Surveys	2%	Surveying
Vehicle Tracking Systems	1%	-

Source: Frontier

Note: To show the diversity of different skills, the various skills within the GIS skills cluster (including ArcGIS and ESRI) have been consolidated into one line for GIS, along with QGIS, which is not places in a skills cluster by Burning Glass

We have also examined commonly appearing non-geospatial individual skills within postings that call for at least one non-individual geospatial skill (Figure 23). This allows us to see the holistic package of capabilities required by employers who are filling geospatial roles. We have focused on cooccurring skills that are likely to be overrepresented in geospatial roles rather than presenting completely generic capabilities such as communication and teamwork that will be required in almost every job.

We can see that certain specialised skills appear such as AutoCAD which is a computer aided design and drafting software package that is heavily used by geospatial roles such as surveyors. Likewise, SQL and Python also appear in a significant portion of geospatial postings. Non-specific data skills such as data analysis and data management also appear.

Figure 23 Examples of commonly appearing co-occurring individual skills in geospatial postings

Burning Glass individual skill	% of geospatial postings
Microsoft Excel	12%
AutoCAD	12%
SQL	9%
Civil Engineering	8%
Python	8%
Information systems	8%
Data analysis	6%
Software development	6%
Data management	5%
JavaScript	5%

Source: Frontier

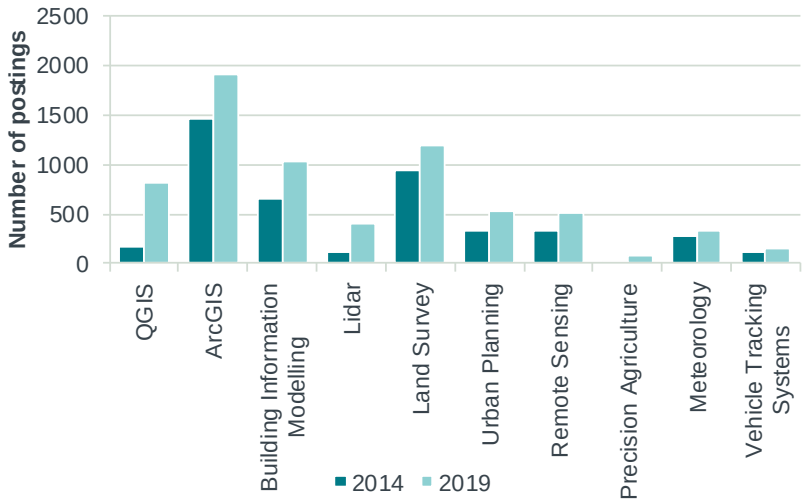
Notes: Generic co-occurring skills such as communication, project management, teamwork and writing have been excluded from this list despite featuring in a significant proportion of all postings. This is because we wanted to provide insights into the specific co-occurring skills that are more common in geospatial contexts.

4.2.2 Rising and falling skills

Over the period 2014-2019 individual geospatial skills have become far more common. In Figure 24 we have presented the top ten fastest growing individual geospatial skills. Specific GIS software packages are now more commonly required. The rapid rise in popularity of QGIS in particular suggests that open

source geospatial software is becoming more prevalent. In addition, expertise relating to sensor technologies (Lidar, remote sensing and vehicle tracking systems) have also become more common. In the case of Lidar skills specifically the rise in demand has coincided with a higher availability of data. For example, in 2015 the Environment Agency released free elevation data captured via Lidar and demand for Lidar skills started to rise significantly from 2016 onwards.[30] The increase in number of postings specifying Lidar skills might also be due to the growth in unmanned aerial vehicle (UAV) surveys which collect Lidar data and the increasing demand for immersive experiences; such as Virtual Reality and Augmented Reality. Building information modelling (BIM) is also now more frequently listed as a skill requirement which relates to the creation of digital representations of physical locations.

Figure 24 Fastest rising individual geospatial skills



Source: Frontier

Note: Generic co-occurring skills such as communication, project management, teamwork and writing have been excluded from this list despite featuring in a significant proportion of all postings. This is because we wanted to provide insights into the specific co-occurring skills that are more common in geospatial contexts.

Finally, sector specific skills like meteorology and precision agriculture have risen which may reflect advances in the adoption of geospatial data in certain sectors over the last five years. The Cabinet Office's (2018)[31] analysis of the potential economic opportunity highlighted the use of geospatial data to support farming as part of a key private sector use case.

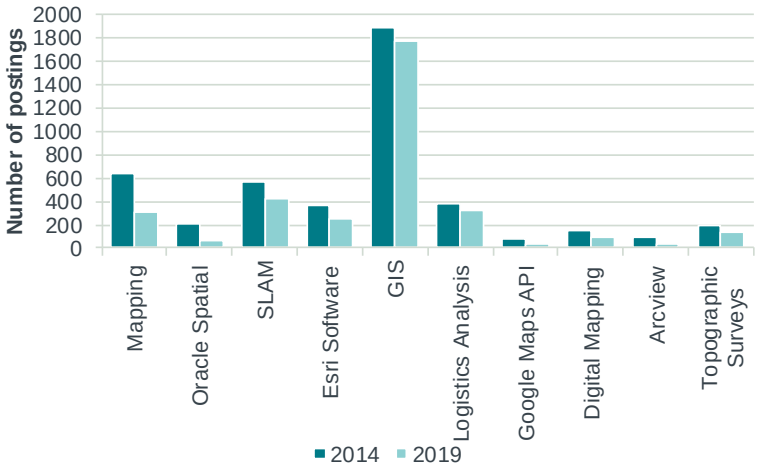
On the other hand, several individual geospatial skills have become less common (Figure 25). This is at least partially due to an evolution in the way in which certain skills are described. For example, employers may increasingly be referring to more specific geospatial requirements which explains why generic mapping and ESRI software all appear less frequently now. This could also be why generic GIS skills are being called for less frequently while demand for specific packages (such as

[30] https://environmentagency.blog.gov.uk/2015/06/16/free-mapping-data-will-elevate-flood-risk-knowledge/#:~:text=From%20September%202015%20all%20our,to%20access%20these%20through%20Datashare

[31] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/733864/Initial_Analysis_of_the_Potential_Geospatial_Economic_Opportunity.pdf

QGIS and ArcGIS) is rising. In addition, certain software packages like Arcview have been largely discontinued which explains the fall in number of postings. Oracle Spatial is also less common as is topographical surveying.

Figure 25 Fastest falling individual geospatial skills

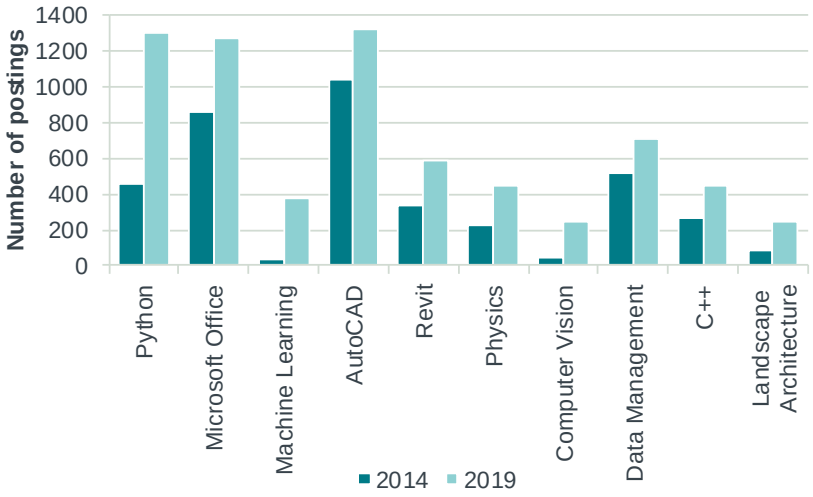


Source: Frontier

Our engagement with the Geospatial Commission Skills Team also suggested that the changing popularity of geospatial skills could also in part reflect an evolution of focus within the geospatial sector. Previously the focus was on data capture and this has now moved on to analysis and decision-making skills.

There have also been noteworthy trends in terms of co-occurring (non-geospatial) skills that are listed on geospatial postings over the same period. In Figure 26 we have examined some of the co-occurring skills which are growing in popularity in terms of appearing on geospatial postings.

Figure 26 Fastest rising individual co-occurring skills

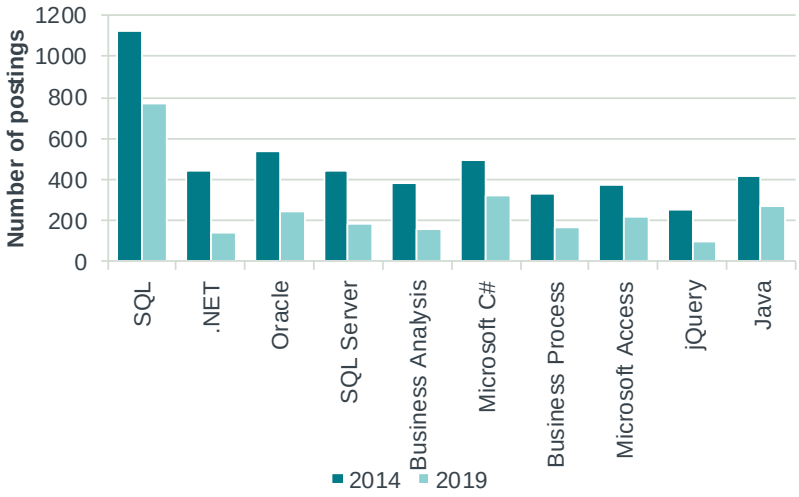


Source: Frontier

Python has seen the largest proportional increase and is now frequently called for in conjunction with geospatial skills. Machine learning and computer vision have seen rapid growth, appearing in hundreds of geospatial postings in 2019, compared with very few in 2014. AutoCAD and Revit design software packages are also becoming more prevalent. Outside of the top ten other more generic data skills such as Big Data and Data Analysis also now appear slightly more frequently on geospatial postings relative to 2014.

Figure 27 lists the co-occurring skills which are appearing in conjunction with geospatial skills less frequently. Notably several variants of SQL now appear less frequently. SQL is a language for communicating with relational database management systems. This trend could be because in geospatial contexts, data is increasingly stored in unstructured formats (like images or video feeds) which are unsuited to this type of data management. Alternatively, in some cases employers may be increasingly taking these skills for granted. Specific programming languages such as Java and Microsoft C# also have fallen in prevalence.

Figure 27 Fastest falling individual co-occurring skills



Source: Frontier

4.3 Trends in number of postings by subgroup

As we set out in Section 4.1.1 the number of postings containing a geospatial skill has remaining roughly constant over the study period (2014-2019). However, this overall trend masks underlying variation by subgroup. We have presented the number of postings in both 2014 and 2019 in Figure 28 below.

With the exception of Group B (Programming and Data Management with GIS) all subgroups experienced a rise in the number of associated postings. If both the GIS focused groups are examined together (Group A and B) the aggregate number of postings is approximately flat. The surveying and related expertise subgroup (Group E) experienced the largest rise in terms of number of postings (416 extra postings in 2019 relative to 2014). However, our civil engineering and design software group rose fastest as a proportion of postings in 2014 (an increase of 44%).

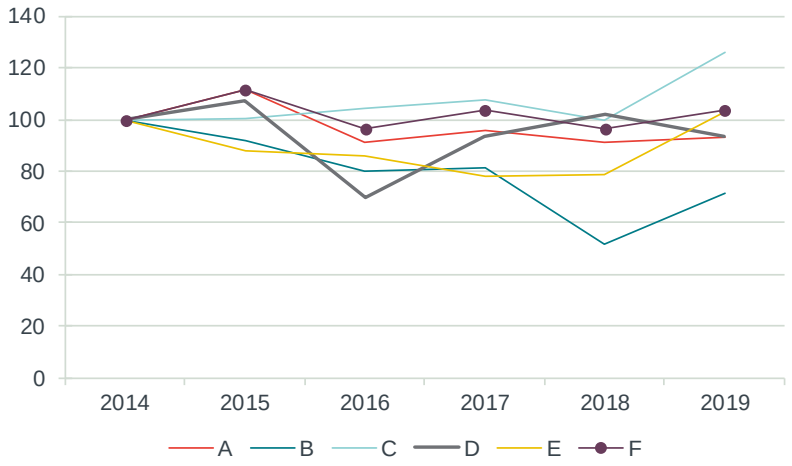
Figure 28 Number of postings per subgroup, 2014 & 2019

Subgroup	2014 postings	2019 postings	Change (2019-2014)
Group A: GIS specialists	2,473	2,631	158 (+6%)
Group B: Programming and Data Management with GIS	1,396	1,136	260 (-19%)
Group C: Engineering and design software	921	1,323	402 (+44%)
Group D: SLAM and robotics	662	705	43 (+6%)
Group E: Surveying	2,421	2,837	416 (+27%)
Group F: Miscellaneous	1,984	2,351	367 (+18%)

Source: Frontier

We have also illustrated these changes in Figure 29 which shows the annual rate of postings in each subgroup from 2014 onwards. The rate refers to the proportion of overall Burring Glass postings that each subgroup accounts for in each year.

Figure 29 Change in rate of postings per subgroup, (2014=100)



Source: Frontier

Note: The rate of postings per thousand Burning Glass adverts for each subgroup has been normalised to 100 in 2014 to facilitate comparison. If the rate of postings for a specific subgroup grew over time the value would be greater than 100 in 2019.

For ease of presentation we have normalised the rate of postings for each subgroup to 100 in 2014. For subgroups that have experienced growth relative to the overall number of postings since 2014, the value would be greater than 100 in 2019. The rate of Group C postings had risen relatively fast over time. While there is some annual variation the rate of posts in Groups D and E have also risen indicating positive demand for geospatial skills.

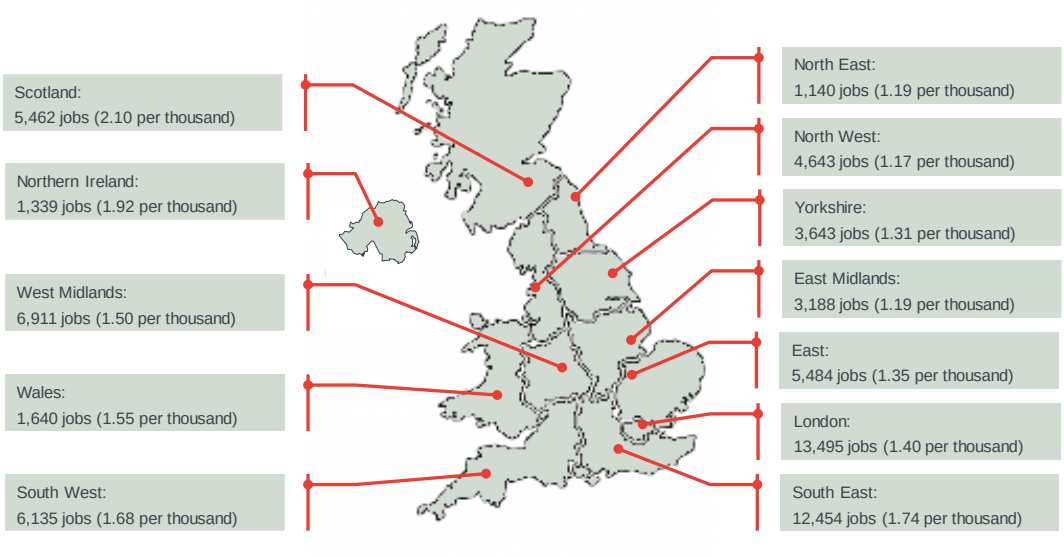
4.4 Geographic distribution of postings

4.4.1 Region

We have illustrated the high-level geographic location of all geospatial jobs in Figure 30 below. The relevant region was collected by Burning Glass in 91% of our sample of geospatial jobs.

For each region we have presented two statistics. Firstly, the number of geospatial postings over the entire period 2014-19 to get a sense of volume of activity and the rate of geospatial postings as a percentage of all postings to better understand the geospatial intensity of different labour markets.

Figure 30 Location of Burning Glass postings that call for any geospatial skill and geospatial intensity of each region (2014-19)



Source: Frontier based on Burning Glass data

As we would expect London contains the highest number of geospatial postings. Around 13,500 geospatial jobs specified a London location. This accounts for 21% of postings from our sample of geospatial jobs that specified a region. The South East contains the second largest volume of geospatial postings (~ 12,500 jobs). Other regions contain considerably fewer postings than this.

However, a distinctly different pattern emerges if we examine the proportion of all postings within a region that call for a geospatial skill. Using data collected by Burning Glass on the total number of postings within a region (both geospatial and non-geospatial), we can see that:

- Scotland (2.10 geospatial postings per thousand) and Northern Ireland (1.92 geospatial postings per thousand) have the highest rates of geospatial intensity across the UK.
- the lowest rates of geospatial intensity are observed in the North West (1.17 geospatial postings per thousand), North East (1.19 geospatial postings per thousand) and the East Midlands (1.19 geospatial postings per thousand).

- London has a rate of geospatial intensity which is roughly in line with the UK as a whole (1.4 geospatial postings per thousand).

In terms of the rate of postings per 1,000 vacancies the comparator group of occupations does not have this same geographic distribution. In particular comparator jobs are more skewed towards London, with a considerably lower rate of postings in Scotland, and Northern Ireland.[32]

Subgroup

We have also computed the regional prevalence of each geospatial subgroup. This is presented in Figure 31 below. Specifically, for each region we have presented the subgroup that is most likely to be found in that area relative to the national average and the subgroup which is the least common again relative to the national average. The figures represent the differential between the national rate of posts per thousand for that subgroup and the regional rate. For example, Scotland has 0.64 Group A postings per thousand, compared with a UK average of 0.39 per thousand. In some cases, there are no sub-groups which occur in a region more or less frequently than the national average.

Figure 31 Most and least commonly occurring subgroups by region relative to national average, 2014-2019

Region	Most prevalent subgroup relative to national average	Least prevalent subgroup relative to national average
East of England	(no subgroup appears more frequently than national average)	Group C: Engineering and design software (-0.03)
East Midlands	Group F: Surveyors (0.01)	Group A: GIS specialists (-0.13)
London	Group E: Robotics and SLAM (0.05)	Group A: GIS specialists (-0.09)
North East	Group C: Engineering and design software (0.03)	Group A: GIS specialists (-0.11)
Northern Ireland	Group A: GIS specialists (0.5)	Group F: Miscellaneous (-0.06)
North West	(no subgroup appears more frequently than national average)	Group B: Data management and software development with GIS (-0.09)
Scotland	Group A: GIS specialists (0.25)	Group C: Engineering and design software (-0.03)
South East	Group A: GIS specialists (0.09)	Group C: Engineering and design software -0.01)
South West	Group B: Data management and software development with GIS (0.06)	(no subgroup appears less frequently than national average)
Wales	Group A: GIS specialists (0.17)	Group E: Robotics and SLAM (-0.08)
West Midlands	Group F: Miscellaneous (0.07)	Group B: Data management and software development with GIS (-0.05)

[32] We explore geographic variation in geospatial intensity by comparing a region's share of jobs that are geospatial with the national average, taking the ratio of the two to give a location quotient. For Scotland, the geospatial job rate is 40% above the national average, and for London is 8% below. Meanwhile, for the comparator index, the job rate is 14% higher for London than the national average, and near average for Scotland. Comparing geospatial and comparator location quotients, we see that relative to the comparator, geospatial is more concentrated in Scotland, Northern Ireland and South East, and less concentrated in London, East Midlands and North West

Region	Most prevalent subgroup relative to national average	Least prevalent subgroup relative to national average
Yorkshire	Group F: Surveyors (0.02)	Group B: Data management and software development with GIS (-0.07)

Source: Frontier

Note: The figures in each cell represent the differential between the UK wide rate of postings per thousand for a particular subgroup and a specific region

Firstly, we can see in every region except the North West and East of England there is at least one subgroup which is more commonly found there than in the country as a whole. For example, we can see that GIS specialists (Group A) account for a significantly higher share of postings in Northern Ireland relative to the UK as a whole (the magnitude of this difference is equal to half an extra posting per thousand jobs). These patterns likely reflect differences in industry location patterns across the country.

4.4.2 Travel to Work Area

We have also explored the prevalence of geospatial postings within more granular geographies. The Burning Glass data captures the relevant Travel to Work Area for postings. Travel to Work Areas represent an attempt to divide the UK into separate labour markets. They have been created by ONS[33] following statistical analysis of commuting patterns such that relatively few commuters cross a TTWA boundary on their way to work.[34] Currently there are 228 TTWAs covering the entire UK.

In Figure 32 below we have ranked the most geospatially intensive TTWAs. For this ranking we have only considered TTWAs with at least 50,000 job postings over the entire period.

Figure 32 Table of Travel to Work Areas with the highest rate of geospatial postings (2014-19)

Travel to work area	Number of geospatial postings (2014-19)	Rate of geospatial jobs per 1,000	Total number of postings
Edinburgh	1,692	2.2	759,325
Reading	1,453	2.1	679,349
Oxford	1,134	2.0	580,096
Belfast	1,065	1.8	593,857
Cardiff	776	1.8	435,207
Exeter	516	1.8	289,601
Glasgow	1,434	1.8	815,423
Huntingdon	149	1.7	86,002
Bristol	1,895	1.7	1,098,173
Plymouth	273	1.7	161,413

[33] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/traveltoworkareaanalysisingreatbritain/2016#definition-of-2011-ttwas

[34] The current criteria for defining TTWAs are that at least 75% of the area's resident workforce work in the area and at least 75% of the people who work in the area also live in the area.

Source: Frontier

Note: TTWAs with fewer than 50,000 job postings over the entire period have been excluded

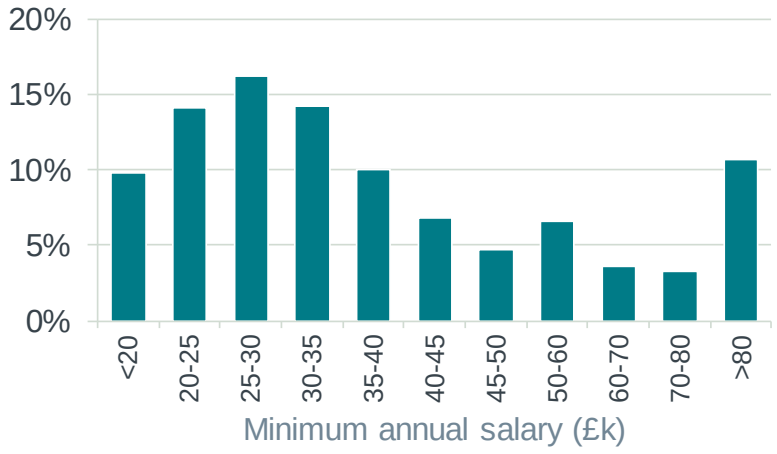
Edinburgh and Glasgow both feature in the top 10 which is not surprising given that Scotland was the region with the highest rate of geospatial jobs. English (Oxford), Welsh (Cardiff) and Northern Irish (Belfast) TTWAs are also represented. Suggesting a broad spread of demand for geospatial capability which is primarily concentrated in cities and major university locations.

4.5 Salaries offered for geospatial jobs

All geospatial postings

55% of the Burning Glass job postings which call for a geospatial skill contain minimum starting salary information. Using this subset of postings, we derived a salary distribution (Figure 33). This will not correspond to the salary earned by the successful candidate as minimum salaries will be adapted depending on the experience of the successful candidate. The figures we have presented below cannot be directly compared to other sources of earnings data such as the Annual Survey of Hours and Earnings (ASHE). This is because those surveys will include all workers rather than those who are about to start in a new post. Generally, we would expect a worker's salary to rise over time as they gain experience.

Figure 33 Reported minimum annual salary of Burning Glass postings that call for any individual geospatial skill (2014-19)



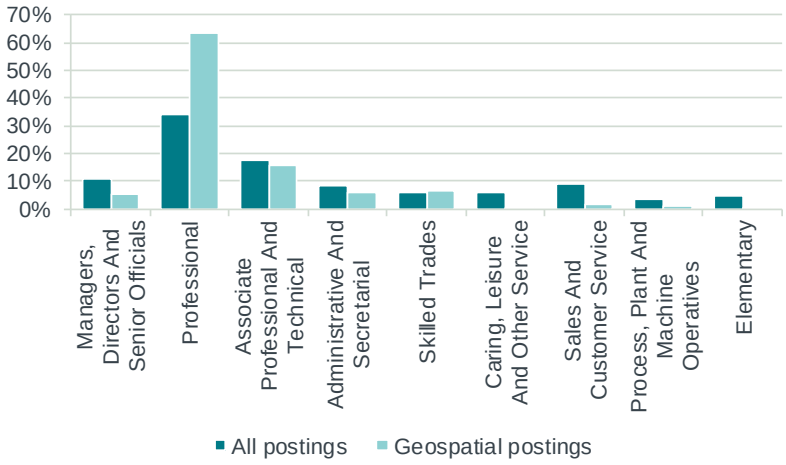
Source: Frontier

These geospatial postings have a median minimum salary of £31,000. As we describe above this cannot be directly compared to other sources of earnings. For the sake of illustration, recent ASHE data indicates that the median annual salary for full-time employees in the UK is £30,420.[35] We can see that the most common minimum starting salary band amongst geospatial postings is £25,000-30,000. However, almost 10% of geospatial postings that include salary information offer a minimum starting salary of less than £20,000 per year (some of these postings may be for part time roles) and over 10% offer a minimum starting salary in excess of

[35] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/annualsurveyofhoursandearnings/2019

£80,000. To help contextualise this salary breakdown we have shown the SOC breakdown of geospatial jobs in terms of seniority below (Figure 34).

Figure 34 Comparison of seniority of geospatial and all job postings using major SOC group



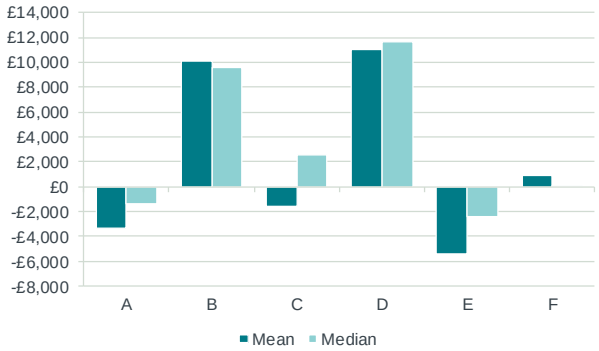
Source: Frontier based on Burning Glass data

Specifically, we have compared the geospatial job postings with all job postings in Burning Glass. Geospatial jobs are drawn heavily drawn from the professional occupations (over 60% of all geospatial postings are included under this category). On the other hand, relative to all Burning Glass postings a lower proportion of geospatial roles fall into the *Caring, Leisure & Other Service* category and the *Sales & Customer* service grouping. Geospatial roles are also less likely than average to be classified as *Elementary* occupations.

Variation in salary by subgroup

Some of the variation that we can see in the salary range presented above is accounted for by differences across our subgroups of geospatial jobs. In Figure 35 below we have presented the difference between the median minimum salary for each subgroup and the overall median for all geospatial postings. Therefore, subgroups which command higher than average starting salaries will have positive values and subgroups which contain less well-paid occupations on average will have negative values.

Figure 35 Pay levels relative to geospatial average



Source: *Frontier*

Note: ***Group A**: GIS specialists. **Group B**: Data management and software development with GIS, **Group C**: Engineering and design software, **Group D**: Robotics and SLAM, **Group E**: Surveyors, **Group F**: Miscellaneous*

We can see that Groups B and D (which require the most programming and advanced data capability) have significantly higher salaries than the geospatial average. Median salary for Group B is £40,000, and for Group D is £42,000. The other groups have salaries lower than the geospatial average.

We can also compare advertised geospatial salaries against advertised comparator group salaries (non-geospatial roles within the same occupation codes). We have presented the results of this analysis in Figure 36 below.

Figure 36 Pay levels relative to non-geospatial roles in equivalent occupations

Source: *Frontier analysis of Burning Glass data*

Note: ***Group A**: GIS specialists. **Group B**: Data management and software development with GIS, **Group C**: Engineering and design software, **Group D**: Robotics and SLAM, **Group E**: Surveyors, **Group F**: Miscellaneous*

Across all six subgroups, we see that median pay is lower for geospatial occupations than our comparator indices. However, if we look at the means rather than medians the differentials are much smaller, and the pattern is more mixed.

These differences could be because in some cases our comparator occupations are fundamentally different to our geospatial equivalents. For example, our surveying comparator group seems to include postings heavily concentrated in the construction sector. Whereas our geospatial surveying roles are spread across multiple areas. Likewise, non-geospatial software developers seem to have more

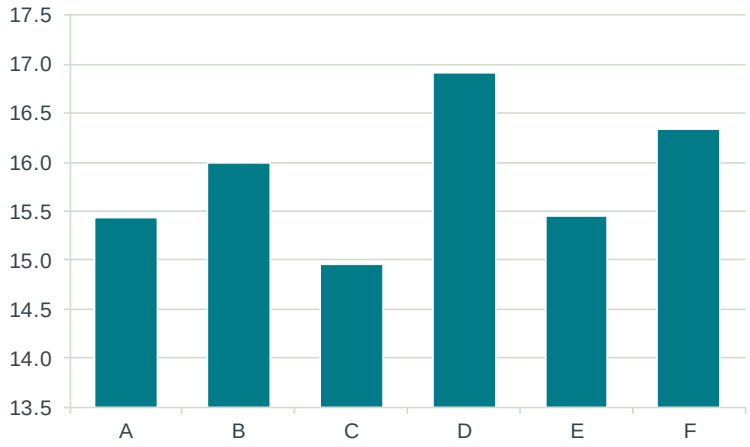
of a financial analysis focus and that sector may have higher rates of pay on average.

It is also important to note that pay comparisons of this type are not straightforward. There will be various other factors driving pay that are not captured here. In particular as we saw above geospatial roles have a distinct pattern of geographic coverage and are less well represented in London (which has above average rates of pay) relative to our comparator occupations.

4.6 Education and qualification requirements of geospatial postings

We have examined our subgroups in terms of educational requirements and professional certifications. The subgroups generally call for similar education requirements, ranging between 15 and 17 years. Years of education are measured from primary school. Therefore, 11 years' education corresponds to GCSE level, and 16 years to an undergraduate degree. Approximately two-thirds of geospatial jobs call for an undergraduate degree. Posts in Group D show the highest requirement at almost 17 years of education.

Figure 37 Average years of education required for postings in each subgroup

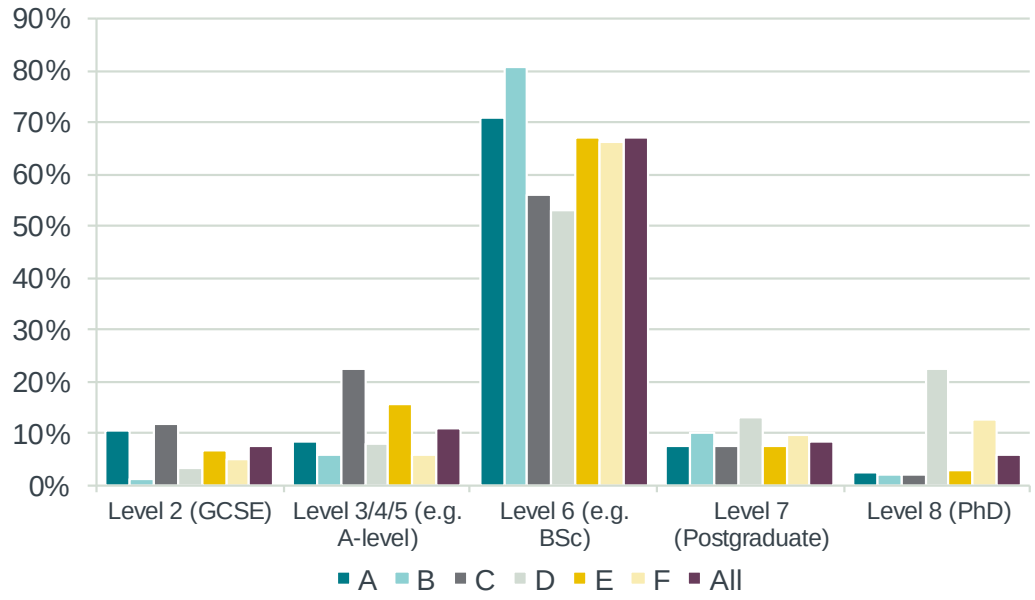


Source: *Frontier analysis of Burning Glass data*

Note: ***Group A****: GIS specialists.* ***Group B****: Data management and software development with GIS,* ***Group C****: Engineering and design software,* ***Group D****: Robotics and SLAM,* ***Group E****: Surveyors,* ***Group F****: Miscellaneous*

We have also explored in further detail the breakdown of educational requirement by sub-group (Figure 38). We see that for each sub-group, the majority of postings specify an undergraduate degree-level qualification. Group A, C and E have a greater proportion of postings only requiring A-level or GCSE. The proportion of postings requiring doctorate level is highest amongst groups D and F.

Figure 38 Distribution of education requirements by subgroup

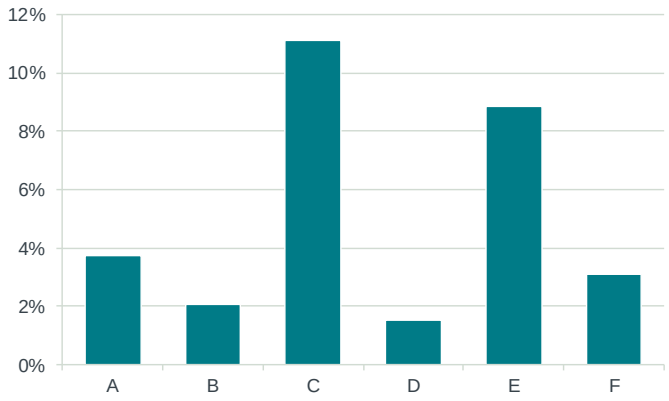


Source: *Frontier*

Note: ***Group A**: GIS specialists. **Group B**: Data management and software development with GIS, **Group C**: Engineering and design software, **Group D**: Robotics and SLAM, **Group E**: Surveyors, **Group F**: Miscellaneous*

We have also analysed the proportion of postings which call for a professional certification such as Chartered Survey Technician status or a Chartered Engineer, as well as the most commonly occurring specific certifications. We have illustrated the proportion of postings requiring a professional certification in Figure 39. In general, the requirement for certifications is low; only around 5% of geospatial postings specify a professional certification. It is highest in Groups C (Civil Engineering) and E (Surveying), which are both related to building and construction.

Figure 39 Proportion of postings within each subgroup calling for a professional certification

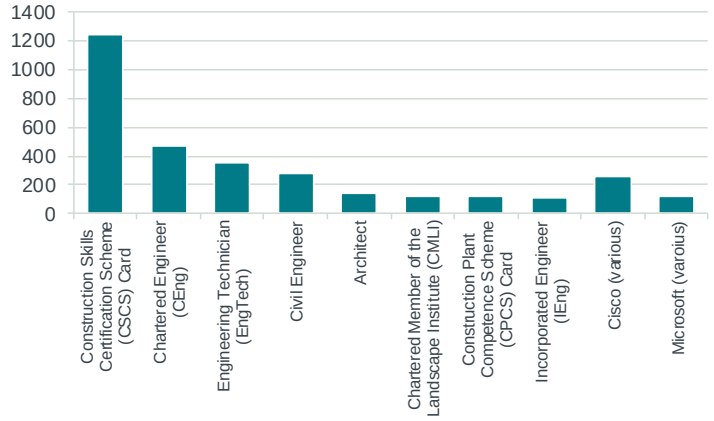


Source: *Frontier analysis of Burning Glass data*

Note: ***Group A**: GIS specialists. **Group B**: Data management and software development with GIS, **Group C**: Engineering and design software, **Group D**: Robotics and SLAM, **Group E**: Surveyors, **Group F**: Miscellaneous*

The most commonly occurring certifications are included in Figure 40. The majority of qualifications relate to engineering and construction. A small number of software certifications are specified (relating primarily to Microsoft and Cisco software).

Figure 40 Most commonly occurring professional certifications appearing in geospatial postings



Source: *Frontier analysis of Burning Glass data*

Note: ***Group A****: GIS specialists.* ***Group B****: Data management and software development with GIS,* ***Group C****: Engineering and design software,* ***Group D****: Robotics and SLAM,* ***Group E****: Surveyors,* ***Group F****: Miscellaneous*

4.7 Sectoral breakdown of geospatial postings

All geospatial postings

As we described above, we have defined the subgroups of geospatial jobs on the basis of the skills that employers require to fulfil a specific role. These skills may be spread across the economy or concentrated in certain sectors. To explore this further we have examined the employers who are posting geospatial vacancies as well as the sectors in which they are based.

Burning Glass is able to derive a Standard Industrial Classification (SIC) code for 41% of our geospatial postings. These codes refer to the employers' area of business or industry and is widely used across government.[36] As with the SOC system there is an established hierarchy. The SIC is divided into 21 sections (e.g. manufacturing) which are then further broken down into 88 divisions (manufacture of textiles), 272 groups (manufacture of other textiles) and 615 classes (manufacture of carpets and rugs).[37] In Figure 41 we have listed the detailed industry groups that called for over 400 geospatial postings between 2014 and 2019.

The list illustrates the diverse spread of geospatial roles across the entire economy. Higher education is the most prominent specific sector, this group of postings will include research-based roles in universities as well as partnerships between academia and industry. Therefore, this single SIC Code grouping will

[36] Further detail is available here: http://resources.companieshouse.gov.uk/sic/

[37] In some cases, classes are also broken down into subclasses.

feature multiple embedded commercial sectors which are not explicitly listed here. Architectural and engineering services also appear on the list below as well as a range of public sector activities covering administration and defence. There are also multiple commercial sectors including head office activities and different forms of consultancy and professional services, which will cover areas including environmental, management and IT work.

Figure 41 Most common SIC codes for geospatial postings, 2014-2019

Three digit SIC Code	Number of geospatial postings	% of geospatial postings	% of all postings
Higher education	3812	14.5%	3.0%
Architecture and engineering	3224	12.3%	0.7%
Local and national government	1752	6.7%	2.7%
Defence	1446	5.5%	0.6%
Computer programming and consultancy	912	3.5%	1.8%
Professional, scientific and technical services	720	2.7%	0.8%
Management consultancy	675	2.6%	1.3%
Business support service	583	2.2%	2.0%
Head offices	580	2.2%	1.3%
Construction	415	1.6%	0.7%

Source: Frontier

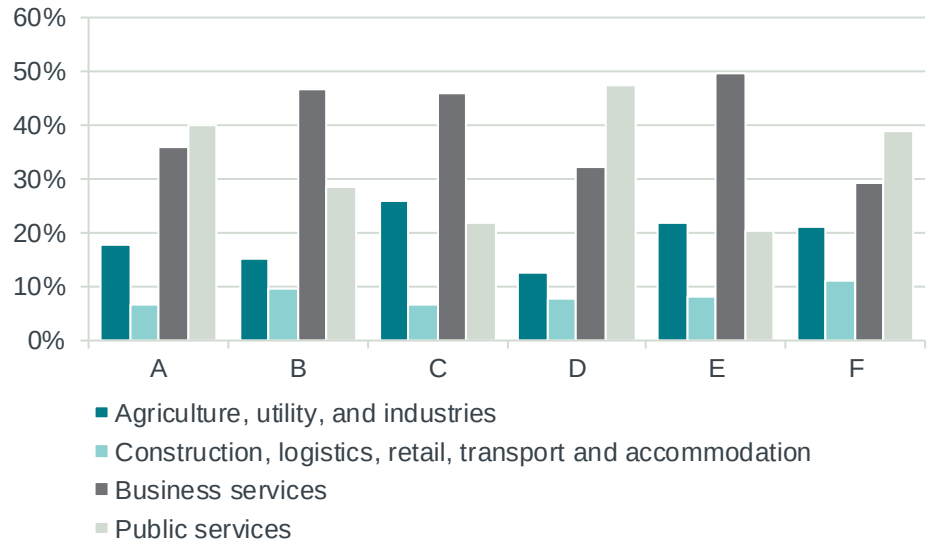
Subgroups of geospatial postings

We have looked at how different subgroups of geospatial jobs tend to be concentrated in different types of sector. To preserve sample size, we have carried out this analysis using the four high level SIC code groupings:

- Agriculture, industry, and utilities
- Construction, logistics, retail and transport
- Business services
- Public services

We have presented the results in Figure 42 below.

Figure 42 High level sectoral breakdown of each subgroup, 2014-2019



Source: *Frontier*

Note: ***Group A****: GIS specialists.* ***Group B****: Data management and software development with GIS,* ***Group C****: Engineering and design software,* ***Group D****: Robotics and SLAM,* ***Group E****: Surveyors,* ***Group F****: Miscellaneous*

We can see that **Groups B** (Data management and software development), **C** (Engineering and design software) and **E** (Surveyors) are mostly found in Business Services. **Groups A** (GIS specialists) and **D** (Robotics and SLAM) are mostly likely to be found in the public services category.

The wider adoption of geospatial skills across different sectors is further reinforced when we examine example employers who are posting geospatial job adverts (Figure 43). The firms below carry out activity across multiple segments of the economy such as insurance, property, retail, transport and manufacturing.

Figure 43 Illustrative employers and job titles

Employer	Sector	Job title	Included geospatial skill
Asda	Retail	Model Coordinator	Mapping Software
Bayer Ag	Pharmaceuticals	Agronomic Research Specialist	Object Tracking
Black Rock Programme Management Ltd.	Management consultancy	Land Surveyor	Survey Instruments
British Transport Police Authority	Public order and safety	Intelligence Analyst.	Mapping Software
Capgemini	Management consultancy	Management Consultant - Utilities Smart Energy	Simultaneous Localisation and Mapping (SLAM)
EasyJet	Passenger air transport	Operations Communications Officer	Routing Optimisation
Google	Computer consultancy	Deployment Engineer, Maps, Google For Work	Geospatial Information Systems

Employer	Sector	Job title	Included geospatial skill
High Speed 2	Real estate	Senior Property Acquisition Manager	Arcview
JPMorgan Chase & Co	Banks	Cib Office Of Legal Obligations Central Mapping & Remediation Vice President - , Or	ESRI
Lafarge Tarmac Limited	Mining and Quarrying	Assistant Geologist	Survey Instruments
Lloyd's Register Group Services Limited	Other business support service activities	Senior Geoscientist	Hydrologic Surveys
McKinsey & Company	Management consultancy	Geospatial Analyst - Agriculture Commodity Research Engine, Ventures	Esri Software
National Crime Agency	Justice and judicial activities	Senior Intelligence Analyst	Geographic Information System (GIS) Data
Sainsbury's	Retail	Competitor Insight Analyst	Esri Software
Tomtom Limited	Computer consultancy	Senior C++/Computer Graphic Software Engineer	Navigation Equipment

Source: *Frontier analysis of Burning Glass data*

Note: *Organisations listed above are examples and the list is not exhaustive*

5 CONCLUSION

Key findings

Data skills and digital capabilities are becoming an increasingly important aspect of jobs across the economy. Geospatial skills are an important aspect of this. The importance of data literacy in general and geospatial skills in particular will continue to increase in importance as more data is collected and made available and open source tools become more prevalent.

Our analysis has highlighted a diverse range of geospatial skills that are demanded by employers. This includes collection of geospatial data, processing and management of that data as well as data analysis, visualisation and the creation of geospatial insights.

Specific geospatial skill sets are called for by employers across large parts of the economy which reflects the wider adoption of geospatial data in recent years. In addition, the geospatial roles are geographically spread across the entire UK, with high representation particularly in Scotland and Northern Ireland.

Next steps

Our results illustrate current patterns of demand for geospatial skills in the UK. These insights will contribute to a wider evidence base that can be used by the Geospatial Commission to consider future interventions. These interventions will help ensure that the UK public and private sectors have access to a diverse range of geospatial skilled individuals, that meet their needs and drives the innovative use of geospatial detail. In particular, our findings will help the Geospatial Commission to target and better align the content of skills development.

Given that our analysis is novel and geospatial skills have not been examined in depth in the UK before, our results can also provide a benchmark for current demand of geospatial skills. This analysis can be repeated in the future in order to measure future impact of initiatives.

This study will feed into a wider programme of work that the Geospatial Commission is undertaking to evidence possible skill gaps. Our analysis does not explore the supply of individuals with geospatial skills which could be an important focus for future work. In keeping with this Geospatial Commission has already committed to:

- developing geospatial apprenticeships which will help to improve the supply of individuals into geospatial roles; and
- convening a skills forum which brings together relevant stakeholders including educational providers, public sector representatives.[38]

[38] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/894755/Geospatial_Strategy.pdf

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ANNEX A DETAILED RESULTS

A.1 Role identification

A.1.1 Full list of search terms used

Figure 44 Full list of search terms used

Search term	Search term	Search term
3D mapping	GLONASS	location-based technology
aerial photography	GNSS	map
aerial survey	gps data	maritime survey
aerial surveying	gps systems	mobile mapping
ArcGIS	gps technology	navigation devices
arcgis	gps tracking	navigation equipment
atmospheric research	gps tracking devices	OGC
building information management	gps-enabled	ogc services
building information modeling	hydrographic survey	photogrammetry
building information modelling	hydrographic surveying	precision agriculture
cadaster	indoor positioning	QGIS
cadastral surveying	interferometry	qgis
cadastre	journey planning	radar
cartograph	land survey	remote sensing
cartography	land surveying	remote sensing
coordinate systems	Landsat	routing optimisation
datums	Laser sacnning	simultaneous localisation and mapping
digital elevation models	lidar	soil testing
digital map	location data	spatial data analysis
digital mapping	location information	telemetry
DigitalGlobe	location intelligence	topography
earth observation	location tracking	tracking system
geo	location-based marketing	urban planning
GIS	location-based service	webmapping

Source: Frontier

A.1.2 Full list of skill clusters reviewed

Figure 45 Full list of Burning Glass clusters reviewed

Burning Glass skill cluster	Burning Glass skill cluster	Burning Glass skill cluster
Ad Hoc Analysis and Reporting	Data Storage	JavaScript and jQuery
Agricultural Research	Data Techniques	Logistics
Application Programming Interface (API)	Data Visualisation	Machine Learning
Artificial Intelligence	Data Warehousing	Market Analysis

Burning Glass skill cluster	Burning Glass skill cluster	Burning Glass skill cluster
Augumented Reality / Virtual Reality (AR / VR)	Earth and Space Science	Operations Analysis
Big Data	Environmental Geology	Oracle
Business Intelligence	Environmental Regulations	Other Programming Languages
Business Intelligence Software	Environmental Work	Scripting
C and C++	Extraction, Transformation, and Loading (ETL)	Scripting Languages
Cloud Computing	Financial Analysis	SQL Databases and Programming
Cloud Solutions	Forestry	Supply Chain Planning
Cloud Storage	Geographic Information System (GIS) Software	Surveillance
Data Analysis	Geotechnical Engineering	Surveying
Data Management	Imaging	Telecommunications
Data Mining	Intelligence Collection and Analysis	
Data Science	Java	

Source: Frontier

A.2 Subgroup analysis

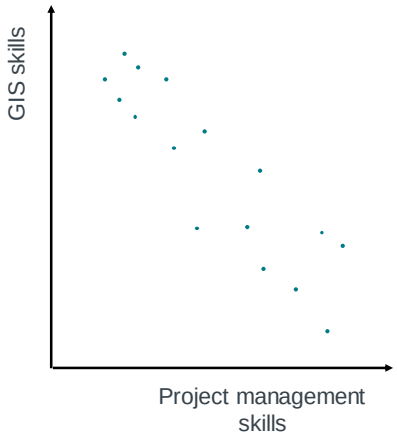
A.2.1 Approach

The specific method we have used is termed 'k-median clustering'. This approach divides all of the geospatial postings into a number of groups. Geospatial roles in the same group are more similar to each other than geospatial roles allocated to other groups.[39]

Firstly, can illustrate the principle of how this process works conceptually. If we assume for the sake of simplicity that all job postings have only two continuous characteristics. For example, these two characteristics could refer to the number of programming skills specified within a specific posting and the number of GIS skills specified by that same posting (Figure 46). In this hypothetical example each dot represents a job posting each of which will have different combination of project management and GIS requirements. This results in each posting having a different coordinate location. For example, postings in the top left corner of the distribution specific a large number of GIS skills but a relatively small number of project management skills.

[39] The number of groups that the method results in is denoted by k. For example, if the geospatial postings are divided into five subgroups k would equal 5.

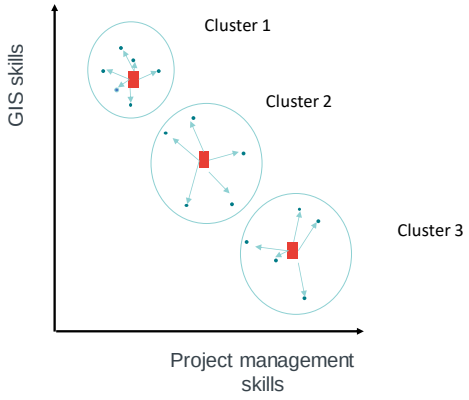
Figure 46 Illustrative skill distribution of postings



Source: Frontier

The clustering algorithm specifies 'centroids' in different parts of this space and calculates distance between the centroid and the potential members of its group. The clustering algorithm iterates through a large number of different centroids and finishes with the optimal positions which minimise the distances within each cluster (Figure 47).

Figure 47 Illustrative clustering of postings



Source: Frontier

In this hypothetical example we can see that the three clusters have been defined so that each posting is grouped with other postings that share similar GIS and project management skill requirements. This is the same process we used, albeit with a larger number of attributes.

We used skills clusters as the basis of our subgroup analysis. This has a number of advantages. Firstly, it allowed us to create continuous measures of skill intensity by counting the number of skills within a specific cluster that every posting calls for. Also, it made our analysis more tractable and eliminates the possibility that very similar skills (e.g. two GIS software packages) are treated as entirely different by the algorithm.

Specifically, we focused on the specialised skill clusters which appeared in at least 5% of geospatial job postings. This led to 28 skill clusters being used (see full list

in **Figure 48**). Following initial iterations of the subgroup analysis we decided to remove six of these clusters which covered more generic skills (like Project Management) from the categorisation algorithm. We did this to avoid the possibility that the algorithm would place too much weight on these more peripheral attributes.

Figure 48 Full list of Burning Glass skill clusters used in subgroup definition

Burning Glass Cluster	Prevalence amongst geospatial postings	Contains a geospatial skill?	Excluded from creation of subgroups
Geographic Information System (GIS) Software	34%	YES	NO
Surveying	23%	YES	NO
Project Management	18%	NO	YES
Drafting and Engineering Design	16%	NO	NO
Microsoft Office and Productivity Tools	15%	NO	YES
SQL Databases and Programming	10%	NO	NO
Software Development Principles	10%	NO	NO
Budget Management	9%	NO	YES
Civil and Architectural Engineering	9%	NO	NO
Basic Customer Service	9%	NO	YES
Engineering Software	9%	YES	NO
Business Process and Analysis	8%	NO	NO
Robotics	8%	YES	NO
Environmental Work	8%	NO	NO
Writing	8%	NO	YES
Scripting Languages	8%	NO	NO
Data Analysis	8%	NO	NO
System Design and Implementation	7%	NO	NO
Management Information System (MIS)	7%	NO	NO
Data Management	7%	NO	NO
Surveys	6%	NO	NO
Imaging	6%	YES	NO
Technical Support	6%	NO	YES
Earth and Space Science	6%	YES	NO
Database Administration	6%	NO	NO
Microsoft Development Tools	5%	NO	NO
JavaScript and jQuery	5%	NO	NO
Electrical and Computer Engineering	5%	YES	NO

Source: Frontier

We explicitly accounted for the patterns of correlations between the skill clusters by performing a factor analysis prior to the creation of the subgroups. Factor analysis is a form of data reduction which is used to turn a large number of

variables into a smaller number of factors. We used this step to identify skill clusters that tend to co-occur within a posting (for example SQL and scripting languages).

Specifically, we used a factor analysis to create 11 composite attributes (or factors) each of which reflected different loadings from our 22 skill clusters. We then used these 11 composite factors to define groups of similar postings for our subgroups. We have presented all of the factors and the top 10 skill cluster loadings for each in **Figure 49**. We found that carrying out this preliminary factor analysis produced more stable and robust subgroups than using each skill cluster as an individual attribute.

A.2.2 Composite factors used to define subgroups

Figure 49 Skill cluster loadings from the factor analysis

1	2	3	4	5	6	7	8	9	10	11
SQL Databases and Programming	Engineering Software	Geographic Information System (GIS) Software	Earth and Space Science	Surveying	Database Administration	System Design and Implementation	Scripting Languages	Business Process and Analysis	Imaging	Management Information System (MIS)
Microsoft Development Tools	Drafting and Engineering Design	Management Information System (MIS)	Environmental Work	Surveys	SQL Databases and Programming	Electrical and Computer Engineering	Software Development Principles	Data Analysis	Management Information System (MIS)	Robotics
JavaScript and jQuery	Civil and Architectural Engineering	Data Management	Civil and Architectural Engineering	Drafting and Engineering Design	Data Management	Software Development Principles	Robotics	Data Management	Data Analysis	Software Development Principles
Software Development Principles	Business Process and Analysis	Scripting Languages	Data Analysis	Civil and Architectural Engineering	Data Analysis	Imaging	Imaging	Management Information System (MIS)	Scripting Languages	Civil and Architectural Engineering
Scripting Languages	Surveys	Data Analysis	Business Process and Analysis	Environmental Work	Business Process and Analysis	Business Process and Analysis	Data Analysis	Environmental Work	System Design and Implementation	Business Process and Analysis
Database Administration	Electrical and Computer Engineering	JavaScript and jQuery	Management Information System (MIS)	Data Analysis	Management Information System (MIS)	Management Information System (MIS)	Data Management	Software Development Principles	Environmental Work	Database Administration
Geographic Information System (GIS) Software	Microsoft Development Tools	Database Administration	Drafting and Engineering Design	JavaScript and jQuery	Geographic Information System (GIS) Software	Database Administration	JavaScript and jQuery	Surveys	Software Development Principles	Environmental Work
System Design and Implementation	Environmental Work	SQL Databases and Programming	Geographic Information System (GIS) Software	Data Management	System Design and Implementation	JavaScript and jQuery	Geographic Information System (GIS) Software	Civil and Architectural Engineering	Engineering Software	Drafting and Engineering Design
Data Management	Database Administration	Environmental Work	#N/A	Database Administration	Scripting Languages	Data Analysis	Surveys	Electrical and Computer Engineering	JavaScript and jQuery	Imaging
Management Information System (MIS)	Data Management	Microsoft Development Tools	Scripting Languages	Microsoft Development Tools	Robotics	Environmental Work	System Design and Implementation	Microsoft Development Tools	Surveys	System Design and Implementation

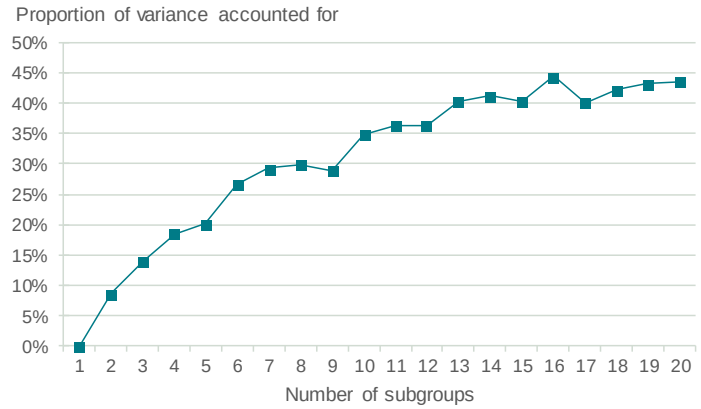
Source: Frontier

Note: The factor analysis led to the creation of 11 composite attributes each of which is listed above in its own column. The rows refer to the top 10 skill cluster loadings for each factor

A.2.3 Number of subgroups

We also needed to select the optimal number of subgroups of postings that we wanted the algorithm to identify. In keeping with best practice[40] we explored the cumulative proportion of variation in the data that is explained by different numbers of groupings (Figure 50). This allowed us to see the value of adding each additional cluster. Adding more clusters will always increase this proportion of variation but after a certain point, the gains in explanatory power will be small at which point we would stop to keep the results tractable and practically useful. Specifically, we wanted to identify the point at which the curve flattens. This tells us that additional clusters would bring diminishing returns.

Figure 50 Proportion of variation accounted for by data driven subgroups



Source: Frontier

We can see a sharp increase in the proportion of variation explained when the tenth subgroup is added. Until that point there is a relatively rapid rise in the value of adding additional categories. After 10, the further subgroups added contribute less explanatory power. On this basis we decided to explore the use of 10 subgroups. Figure 51 below shows the proportion of job postings in each sub-group calling for a skill in the relevant skill clusters. For example, the left-most cell on the first row shows that for group 1, 6.7% of postings specify at least one skill in the GIS skills cluster.

[40] The approach follows Makles, (2012) https://journals.sagepub.com/doi/pdf/10.1177/1536867X1201200213

Figure 51 Proportion of job postings in each sub-group calling for a skill in relevant skill clusters (full sub-groups)

Group number	1	2	3	4	5	6	7	8	9	10
Consolidated group	**D**	**B**	**E**	**Omitted**	**B**	**B**	**C**	**A**	**F**	**A**
Skills cluster:										
GIS software	6.7%	64.4%	3.7%	7.1%	73.2%	68.5%	8.9%	94.2%	0.3%	99.3%
SQL Databases and Programming	19.9%	78.8%	0.5%	1.4%	45.0%	78.4%	0.7%	2.6%	0.8%	2.6%
Data Science	5.2%	0.7%	0.6%	82.9%	5.3%	9.1%	0.6%	1.8%	1.3%	1.0%
Earth and Space Science	3.4%	0.7%	1.5%	97.1%	0.5%	1.8%	1.1%	1.7%	14.3%	11.9%
Environmental Work	0.7%	1.9%	8.0%	100.0%	2.8%	3.3%	4.5%	9.7%	12.1%	13.9%
Civil and Architectural Engineering	0.7%	0.7%	11.9%	98.6%	0.5%	1.4%	24.8%	5.9%	6.6%	12.3%
Geotechnical Engineering	0.2%	0.0%	1.3%	94.3%	0.2%	0.1%	1.2%	0.8%	2.6%	4.4%
Drafting and Engineering Design	1.5%	2.8%	22.7%	94.3%	2.3%	4.4%	63.9%	12.3%	3.6%	11.3%
Data Analysis	6.3%	2.7%	5.2%	95.7%	5.7%	30.5%	1.3%	18.6%	5.0%	6.4%
Surveying	5.8%	0.5%	96.6%	4.3%	2.8%	4.3%	5.1%	2.6%	0.3%	0.7%
Electrical and Computer Engineering	3.0%	1.7%	0.8%	91.4%	0.5%	0.3%	2.2%	1.3%	1.0%	0.7%
Imaging	10.2%	1.3%	2.7%	0.0%	9.2%	3.4%	1.4%	11.9%	14.8%	0.8%
Engineering Software	0.6%	2.5%	0.1%	1.4%	0.6%	1.7%	83.9%	0.3%	0.0%	0.0%
Graphic and Visual Design Software	0.4%	2.0%	2.2%	1.4%	5.8%	2.8%	24.9%	1.5%	2.7%	5.4%
Data Management	3.3%	6.0%	2.7%	10.0%	11.8%	39.7%	3.6%	17.9%	3.3%	4.8%
Database Administration	2.2%	20.0%	0.7%	7.1%	20.5%	51.1%	1.2%	4.1%	1.6%	1.4%
Robotics	73.0%	0.4%	3.7%	0.0%	1.2%	4.0%	0.7%	0.2%	0.0%	0.0%

Source: Frontier

As can be seen, some of these 10 subgroups are either very small in terms of number of postings or very similar to other subgroups in terms of their skill mix and occupational breakdown. We therefore decided in conjunction with the Geospatial Commission to manually combine several of these subgroups. As a result, we ended up with six subgroups which are described in further detail below.

A.3 Group-by-group skill summaries

In this section we present a more detailed portrait of each subgroup in terms of their skill requirements. We have calculated the mostly commonly occurring skill clusters, specific geospatial skills and specific co-occurring skills for each group.

Group A: GIS Specialists

Almost all postings in Group A call for a GIS skill. ArcGIS is the most prevalent specific GIS software that is called for, while QGIS is mentioned less frequently.[41]

The most common co-occurring skills for this group include generic capability like communication and planning as well as usage of management information systems and standard Microsoft Productivity Software.

Figure 52 Group A Skill Prevalence

Top skill / skills cluster	in % of postings
Skills clusters	
Geographic Information System (GIS) Software	97%
Management Information System (MIS)	23%
Microsoft Office and Productivity Tools	20%
Project Management	18%
Environmental Work	12%
Drafting and Engineering Design	12%
Data Analysis	11%
Basic Customer Service	10%
Civil and Architectural Engineering	10%
Data Management	10%
Writing	9%
Geospatial skills	
Geographic Information System (GIS)	54%
ArcGIS	39%
Mapping Software	10%
Geographic Information System (GIS) Data	7%
QGIS	6%
Esri Software	6%
Mapping	4%
Digital Mapping	3%
Remote Sensing	3%

[41] Just under 3% of postings in this group do *not* specify GIS, but are nevertheless placed in this group, as the wider pattern of co-occurring skills most closely matches this group.

Top skill / skills cluster	in % of postings
Arcview	2%
Co-occurring skills	
Communication Skills	26%
Planning	25%
Information Systems	23%
Microsoft Excel	15%
Project Management	14%
Research	13%
Teamwork / Collaboration	11%
Microsoft Office	10%
Writing	10%
Detail-Orientated	9%

Source: Frontier

Group B: GIS with data management and software development

Group B also calls for similar GIS skills to Group A as their primary geospatial capability. In contrast with Group A, postings in Group B call for other specialist technical skills in addition to GIS expertise. Specifically, most postings in Group B require SQL capability (which is used to manage information in relational databases) and a significant portion of the ads in this subgroup call for software skills such as Python, JavaScript or Microsoft C#. Other generic co-occurring skills are relatively less prevalent in this group.

Figure 53 Group B Skill Prevalence

Top skill / skills cluster	in % of postings
Skills clusters	
Geographic Information System (GIS) Software	69%
SQL Databases and Programming	69%
JavaScript and jQuery	42%
Software Development Principles	41%
Web Development	39%
Database Administration	38%
Scripting Languages	36%
Microsoft Development Tools	32%
Data Management	27%
Java	24%
Oracle	21%
Geospatial skills	
Geographic Information System (GIS)	41%
ArcGIS	39%
QGIS	13%
Esri Software	10%
Mapping	8%

Top skill / skills cluster	in % of postings
Oracle Spatial	7%
Geographic Information System (GIS) Data	6%
Google Maps API	5%
Mapping Software	3%
Simultaneous Localisation and Mapping (SLAM)	3%
Co-occurring skills	
SQL	58%
JavaScript	37%
Python	35%
Communication Skills	30%
Software Development	27%
SQL Server	24%
Microsoft C#	24%
Java	23%
Oracle	21%
Problem Solving	19%

Source: Frontier

Group C: Engineering and design software

Group C is signified by high use of engineering software, in particular Building Information Modelling (BIM). Other geospatial skills are far less prevalent. Alongside BIM, a number of related design software are commonly called for, such as AutoCAD, Revit, various graphic and visual design software, as well as civil engineering.

Figure 54 Group C Skill Prevalence

Top skill / skills cluster	in % of postings
Skills clusters	
Engineering Software	84%
Drafting and Engineering Design	64%
Architectural Design	35%
Project Management	27%
Graphic and Visual Design Software	25%
Civil and Architectural Engineering	25%
Microsoft Office and Productivity Tools	20%
Budget Management	14%
Business Process and Analysis	12%
Construction Management	11%
Basic Customer Service	10%
Geospatial skills	
Building Information Modelling	78%
ArcGIS	6%
Urban Planning	4%

Top skill / skills cluster	in % of postings
Land Survey	2%
Geopak	2%
Hydrologic Modelling	2%
Lidar	1%
Geographic Information System (GIS)	1%
QGIS	1%
Remote Sensing	1%
Co-occurring skills	
AutoCAD	41%
Revit	35%
Communication Skills	33%
Planning	23%
Project Management	21%
Civil Engineering	19%
Teamwork / Collaboration	18%
3D Modelling / Design	14%
Autodesk	14%
Budgeting	13%

Source: Frontier

Group D: SLAM and robotics

Group D is characterised by high prevalence of Simultaneous Localisation and Mapping (SLAM). Other geospatial skills include object tracking and recognition, remote sensing and lidar, but these are less prevalent. In terms of co-occurring skills, various software and data skills are specified, so this group bears some resemblance to Group B in terms of intensity in this area.

Figure 55 Group D Skill Prevalence

Top skill / skills cluster	in % of postings
Skills clusters	
Robotics	73%
Software Development Principles	33%
C and C++	30%
Scripting Languages	28%
Machine Learning	26%
SQL Databases and Programming	20%
Operating Systems	17%
Java	13%
Imaging	10%
Project Management	9%
Microsoft Development Tools	9%
Geospatial skills	
Simultaneous Localisation and Mapping (SLAM)	66%

Top skill / skills cluster	in % of postings
Remote Sensing	5%
Lidar	5%
Object Recognition	4%
Object Tracking	3%
Meteorology	3%
Mapping	2%
Geographic Information System (GIS)	2%
QGIS	2%
Navigation Equipment	2%
Co-occurring skills	
C++	30%
Python	28%
Research	26%
Software Engineering	20%
Software Development	20%
Communication Skills	20%
Computer Vision	19%
SQL	19%
Robotics	16%
Teamwork / Collaboration	15%

Source: Frontier

Group E: Surveyors and related expertise

Almost all postings in our sample that require surveying expertise are included in Group E. The most common specific skill is land surveying, but field surveys and topographic surveys are also included. Planning and communication skills are commonly found co-occurring skills.

Figure 56 Group E Skill Prevalence

Top skill / skills cluster	in % of postings
Skills clusters	
Surveying	97%
Surveys	24%
Drafting and Engineering Design	23%
Project Management	19%
Budget Management	13%
Microsoft Office and Productivity Tools	13%
Civil and Architectural Engineering	12%
Writing	10%
Basic Customer Service	8%
Environmental Work	8%
Quality Assurance and Control	6%
Geospatial skills	

Top skill / skills cluster	in % of postings
Land Survey	42%
Field Surveys	28%
Survey Instruments	13%
Lidar	7%
Topographic Surveys	6%
Survey Analysis	5%
Remote Sensing	2%
ArcGIS	2%
Geographic Information System (GIS)	1%
QGIS	1%
Co-occurring skills	
Communication Skills	27%
Surveys	24%
Planning	22%
AutoCAD	19%
Project Management	16%
Research	13%
Budgeting	13%
Writing	12%
Civil Engineering	11%
Global Positioning System (GPS)	11%

Source: Frontier

Group F: Miscellaneous

Group F contains a wide variety of skill requirements and there is far less commonalities between the included postings in this group compared to all other groups. It should be noted that when selecting the appropriate number of sub-groups to create, we are trading off the number of sub-groups with the added explanatory power. If a potential group of postings is not sufficiently different to other groups or sufficiently similar to the other members of it, a separate group for it will not be created by the algorithm. Group F appears to comprise several of these indistinct postings.

Nevertheless, further analysis suggests there may be some further sub-groups within it. For example, 'mapping' is presumably referring to GIS, but the skill profile is not sufficiently similar for them to be placed in Group A.[42]

A relatively distinct part of this group is logistics. Although relatively small in terms of job numbers, geospatial logistics roles are important in large sectors such as retail and transport.

[42] This could simply reflect some job postings having vaguer wording. We might see a posting that explicitly specifies GIS alongside programming languages, and this is placed in Group A or B. A similar role might only specify 'mapping' and no further skills and end up placed in Group F.

Other significant geospatial skills for this group include urban planning, hydrology and meteorology. These are highly specialised skills not observed much in the other groups.

Figure 57 Group F Skill Prevalence

Top skill / skills cluster	in % of postings
Skills clusters	
Project Management	17%
Logistics	17%
Urban Planning	15%
Imaging	15%
Earth and Space Science	14%
Business Process and Analysis	13%
Environmental Work	12%
Microsoft Office and Productivity Tools	12%
Environmental Geology	10%
Basic Customer Service	9%
Writing	7%
Geospatial skills	
Mapping	19%
Logistics Analysis	15%
Urban Planning	15%
Remote Sensing	12%
Meteorology	8%
Hydrologic Modelling	7%
Vehicle Tracking Systems	6%
Geospatial Intelligence	3%
QGIS	3%
Routing Optimisation	2%
Co-occurring skills	
Planning	33%
Communication Skills	26%
Research	21%
Logistics	16%
Teamwork / Collaboration	12%
Project Management	12%
Microsoft Excel	11%
Writing	9%
Problem Solving	9%
Organisational Skills	8%

Source: Frontier

A.4 Group by group occupational breakdown

This section provides a more detailed occupational breakdown by subgroup, using both Burning Glass and Standard Occupational Classification (SOC) systems.

Group A: GIS Specialists

Group A's occupation codes reflect the importance of GIS capability within this group. As expected, the more recently developed and more frequently updated Burning Glass occupation codes more closely match the specific activities undertaken than the SOC codes which are more generic. Common Burning Glass occupation codes for this group include Geographer / GIS Specialist and Surveying / Mapping / GIS Technician. On the other hand, the most commonly appearing SOC occupation is Information technology professionals who are not classified elsewhere in the taxonomy.

Specific job titles which occur in actual postings in this group include for example:

GIS Technician, GIS Analyst, GIS Consultant, Mapping and Planning Specialist; and GIS Developer.

Figure 58 Group A Occupational Breakdown

SOC Occupation Codes	% prevalence	Burning Glass Occupation Codes	% prevalence
Information technology and telecommunications professionals n.e.c.	13%	Geographer / GIS Specialist	12%
Other skilled trades n.e.c.	8%	Surveying / Mapping / GIS Technician	8%
Programmers and software development professionals	7%	Software Developer / Engineer	6%
IT business analysts, architects and systems designers	6%	na	6%
Management consultants and business analysts	5%	Data / Data Mining Analyst	4%
na	3%	Civil Engineer	3%
Business and financial project management professionals	3%	Computer Support Specialist	3%
Civil engineers	3%	Risk Manager / Analyst	3%
IT user support technicians	3%	Environmental Scientist / Specialist	2%
Physical scientists	3%	Project Manager	2%

Source: Frontier

Group B: GIS with data management and software development

Group B occupation codes include a heavy focus on software development and web design according to both classification systems. As with Group A the Burning Glass occupation system classifies a proportion of this group as GIS specialists.

Examples of job titles which appear in this group include: GIS Developer, GIS Consultant, GIS Analyst, Data Analyst, and Software Developer.

Figure 59 Group B Occupational Breakdown

SOC Occupation Codes	% prevalence	Burning Glass Occupation Codes	% prevalence
Programmers and software development professionals	26%	Software Developer / Engineer	24%
Information technology and telecommunications professionals n.e.c.	18%	Geographer / GIS Specialist	14%
IT business analysts, architects and systems designers	14%	Web Developer	11%
Web design and development professionals	11%	Data / Data Mining Analyst	7%
IT operations technicians	6%	Database Administrator	5%
Management consultants and business analysts	6%	Systems Analyst	3%
Other skilled trades n.e.c.	2%	Computer Systems Engineer / Architect	3%
IT user support technicians	2%	Business / Management Analyst	2%
na	1%	Database Architect	2%
Transport and distribution clerks and assistants	1%	Computer Programmer	2%

Source: Frontier

Group C: Engineering and design software

Group C occupations include CAD designer, civil engineer, other types of engineer, and architects. Typical job titles include: BIM Coordinator, CAD Technician, BIM Manager, BIM Technician, and Design Manager.

Figure 60 Group C Occupational Breakdown

SOC Occupation Codes	% prevalence	Burning Glass Occupation Codes	% prevalence
Draughtspersons	13%	CAD Designer / Draughtsperson/Draughtsman	11%
Civil engineers	10%	Civil Engineer	10%
Architects	7%	na	7%
Building and civil engineering technicians	3%	Landscape Architect	4%
Medical and dental technicians	3%	Chartered architectural technologists and town planning technicians	4%
Mechanical engineers	3%	Civil Engineering Technician	3%
Engineering professionals n.e.c.	3%	Architect	3%
Higher education teaching professionals	3%	Mechanical Engineer	3%

SOC Occupation Codes	% prevalence	Burning Glass Occupation Codes	% prevalence
Programmers and software development professionals	2%	Health Technician / Technologist (Other)	3%
Conference and exhibition managers and organisers	2%	University Lecturer	3%

Source: Frontier

Group D: Robotics and SLAM

Group D's most common occupation codes tend cover software developers and engineers, as well as a wider group of engineers and IT professionals. The most common job title are Information Analyst and Software Engineer.

Figure 61 Group D Occupational Breakdown

SOC Occupation Codes	% prevalence	Burning Glass Occupation Codes	% prevalence
Programmers and software development professionals	22%	Software Developer / Engineer	21%
IT business analysts, architects and systems designers	15%	Database Architect	9%
Engineering professionals n.e.c.	6%	Data / Data Mining Analyst	7%
Management consultants and business analysts	6%	Researcher / Research Associate	4%
Information technology and telecommunications professionals n.e.c.	5%	Accountant	3%
Business and related research professionals	3%	Industrial Engineer	3%
Chartered and certified accountants	3%	na	3%
IT engineers	3%	Hardware Engineer	3%
IT operations technicians	2%	Computer Systems Engineer / Architect	2%
Biological scientists and biochemists	2%	Robotics Engineer	2%

Source: Frontier

Group E: Surveyors

Postings in Group E tend to be for surveyors and related professions, as well as scientific / environmental roles. Common job titles include Land Surveyor, Ecologist, Utility Surveyor, and Site Engineer.

Figure 62 Group F Occupational Breakdown

SOC Occupation Codes	% prevalence	Burning Glass Occupation Codes	% prevalence
Chartered surveyors	30%	Land Surveyors	30%

SOC Occupation Codes	% prevalence	Burning Glass Occupation Codes	% prevalence
Biological scientists and biochemists	10%	Wildlife Biologist	10%
Conservation professionals	5%	Environmental Scientist / Specialist	6%
Civil engineers	5%	Civil Engineer	5%
Other skilled trades n.e.c.	4%	Surveying / Mapping / GIS Technician	4%
Draughtspersons	2%	na	3%
Electrical and electronic trades n.e.c.	2%	Utilities Technician	2%
Engineering professionals n.e.c.	2%	CAD Designer / Draughtsperson/Draughtsman	2%
Building and civil engineering technicians	2%	Civil Engineering Technician	2%
IT business analysts, architects and systems designers	2%	Researcher / Research Associate	2%

Source: Frontier

Group F: Miscellaneous

The most common occupation codes in this group refer to logistics and transport professionals. However, there is a diversity of roles identified across many different activities such as research and engineering. This reinforces the miscellaneous nature of this group. The most commonly observed job titles in this group are Logistics Analyst, and Mapping And Planning Specialist.

Figure 63 Group H Occupational Breakdown

SOC Occupation Codes	% prevalence	Burning Glass Occupation Codes	% prevalence
Transport and distribution clerks and assistants	13%	Logistician / Supply Chain Specialist	10%
Management consultants and business analysts	9%	na	7%
na	5%	Business / Management Analyst	6%
Physical scientists	4%	Researcher / Research Associate	4%
IT business analysts, architects and systems designers	4%	Scheduler / Operations Coordinator	3%
Biological scientists and biochemists	3%	University Lecturer	3%
Programmers and software development professionals	3%	Software Developer / Engineer	3%
Engineering professionals n.e.c.	3%	Project Manager	3%
Higher education teaching professionals	3%	Data / Data Mining Analyst	3%
Civil engineers	3%	Civil Engineer	3%

Source: Frontier

ANNEX B TRENDS IN GEOSPATIAL VACANCIES IN 2020

Covid-19 has had a significant impact on normal ways of working and will have profoundly affected the economy. The number of vacancies posted generally falls during a recession because employers are less likely to expand operations and current workers will be more reluctant to leave their positions. However, the recession triggered by Covid-19 is not a normal economic contraction. It features uneven sectoral impacts due to constraints on physical activity and variation of impact on business confidence due to ongoing uncertainty.

In this Annex section we provide an overview of recent trends in geospatial vacancy postings using data covering the first three quarters of 2020. As before Burning Glass data forms the basis of our analysis. All of the analysis in the main body of the report is based on data covering 2014-2019. Examining this more recent sub-set of data has allowed us to make inferences regarding the current geospatial labour market and quantify recent trends directly in light of the major economic disruption that has taken place in recent months. While we have included all available data clearly it is too early to determine what the final long-term impact of the current crisis will be on job vacancies.

We firstly present an overview of monthly variation in geospatial postings. We then compare this pattern to changes in the number of postings for our comparator occupations (see Section 3.4 for further details). To further contextualise these results we then examine how the rate of geospatial postings per 1,000 Burning Glass postings has varied in recent months. We then present an overview of descriptive changes in the most recent geospatial postings. This covers:

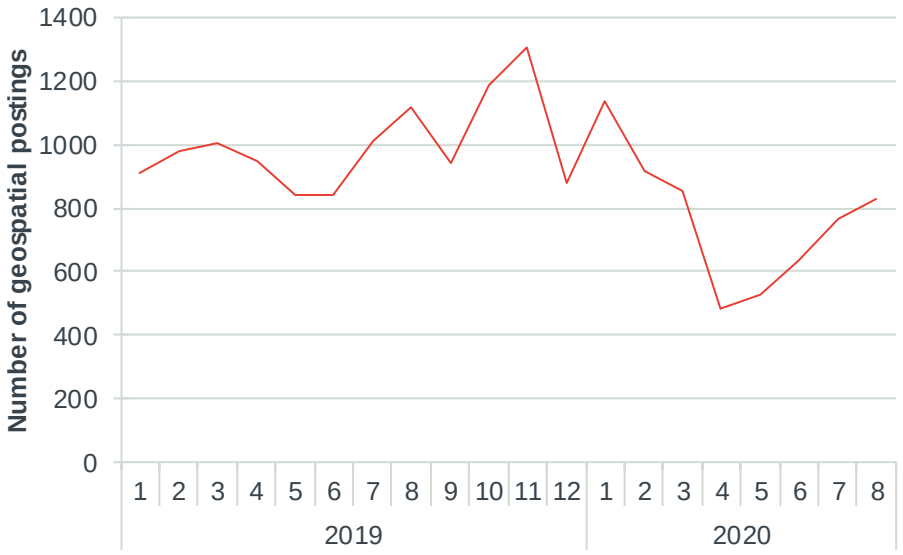
- seniority and salary;
- sectoral impacts;
- skills mix; and
- geographic impacts.

B.1 Volume of geospatial postings in 2020

B.1.1 Number of geospatial postings

Throughout 2019, there were around 1000 jobs geospatial jobs advertised per month on average. However, there was some month-on-month volatility around this average as we have illustrated in Figure 64 (the standard deviation was approximately 150 postings per month in 2019). As we would expect in April and May of 2020 the number of relevant postings were markedly down. Specifically during these periods the number of geospatial vacancies being advertised were only around 50% of the 2019 average. There was some recovery in June, where postings were 36% lower than the 2019 average. In the most recent months of July and August we can see a further narrowing of this gap (23% and 17% down on 2019 levels respectively) suggesting a relatively rapid recovery of most but not all of the drop in postings.

Figure 64 Number of geospatial postings per month

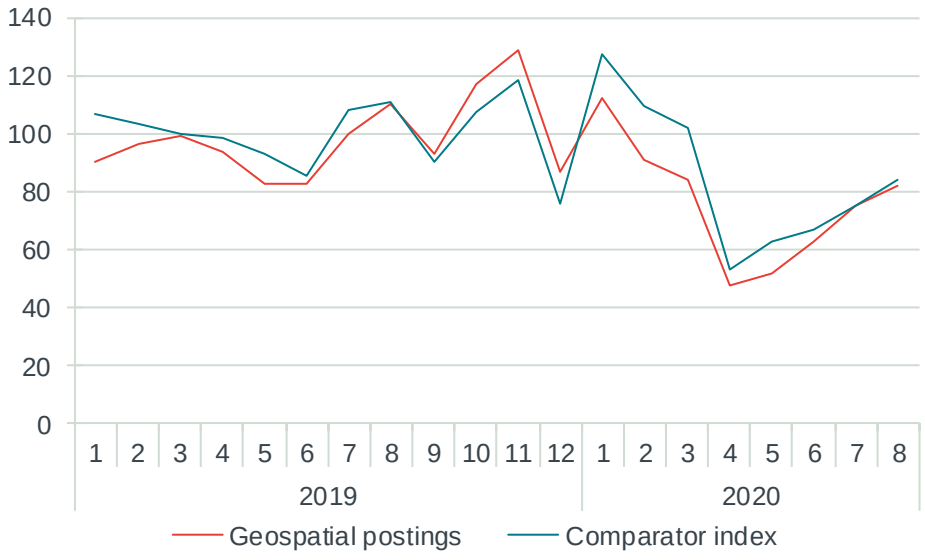


Source: Frontier analysis of Burning Glass data

B.1.2 Number of comparator postings

It is important to explore wider trends in the jobs market, to understand whether the performance of geospatial jobs simply reflects general trends in the economy, or shows any distinctive patterns that are specific to geospatial jobs. We have examined the number of postings for non-geospatial roles in similar occupations to see how these evolved over 2020 in comparison to our geospatial postings. As we have described in Section 3.4 we have built a comparator index for our geospatial sample of postings which is composed of non-geospatial postings in occupation groups where geospatial postings tend to appear. We have illustrated the recent trends in geospatial postings and postings for our comparator groups below in Figure 65.

Figure 65 Geospatial and comparator occupations postings



Source: Frontier analysis of Burning Glass data

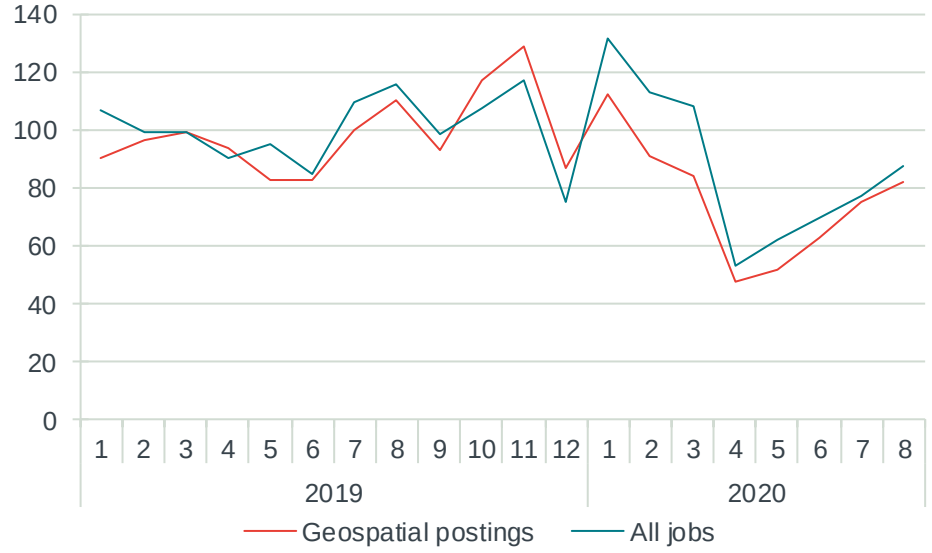
Note: 100 = 2019 annual average postings per month

We can see that the two series follow a very similar trend. This implies that for example vacancies for geospatial software developers fell to a similar extent in the second quarter of 2020 relative to non-geospatial software developers.

To aid comparability we have indexed the 2019 average number of monthly postings for both geospatial vacancies and comparator group vacancies to 100. In absolute terms the absolute number of comparator group vacancies is far higher than the number of geospatial vacancies in every month of 2019 and 2020.

We can also compare the geospatial trend with the wider jobs market, i.e. not focusing specifically on comparator jobs but examining all postings captured by Burning Glass. This overall rate of postings shows a very similar pattern to geospatial postings, with the same pronounced dip in April and subsequent recovery after several months.

Figure 66 Geospatial and all jobs postings



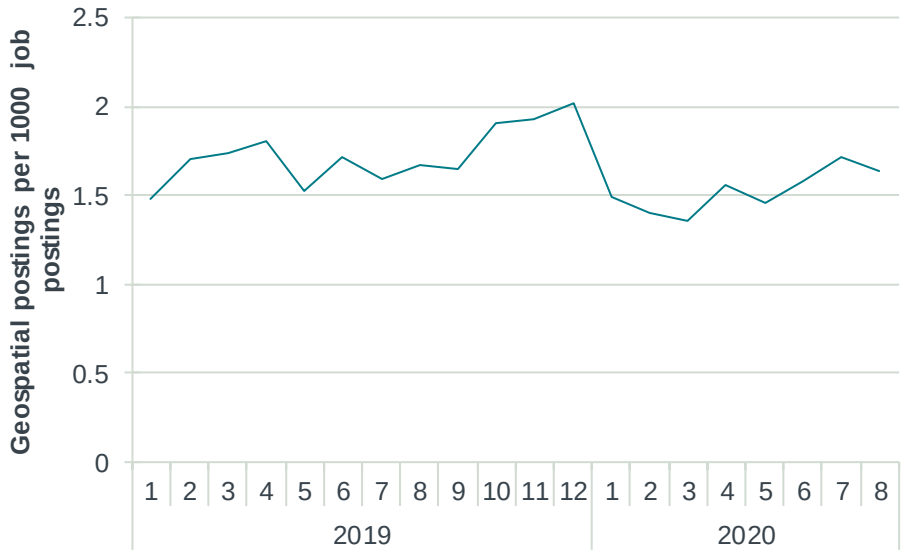
Source: Frontier analysis of Burning Glass data
Note: 100 = 2019 annual average postings per month

B.1.3 Rate of geospatial postings

To provide further context for the drop in number of geospatial postings and comparator vacancies we have also illustrated the trend in geospatial postings as a share of all jobs collected by Burning Glass.

The ratio of geospatial postings per 1,000 overall Burning Glass postings remaining close to the long-term average of 1.6 throughout the first eight months of 2020. This implies that the trends observed in relation to falls in the volume of geospatial postings were largely replicated across the wider economy.

Figure 67 Geospatial postings as a share of all jobs postings over time



Source: Frontier analysis of Burning Glass data

There is however a reasonable degree of month-on-month variation, with the ratio of geospatial postings per 1,000 adverts reaching 2 in the fourth quarter of 2019 and falling below 1.5 in early 2020 (before Covid-19 significantly impacted the labour market) and subsequently rising in the most recent months.

B.2 Characteristics of geospatial postings in 2020

B.2.1 Seniority and salary of geospatial postings

We have also explored whether recent reductions in volume of geospatial postings were more or less pronounced amongst different type of geospatial role. In particular we have examined the differential changes in demand over time for groups of jobs aimed at different levels of seniority as defined by the ONS's Standard Occupation Classification. We have distinguished between:

- managerial / executive grade;
- professional occupations;
- associate professionals; and
- other occupations.[43]

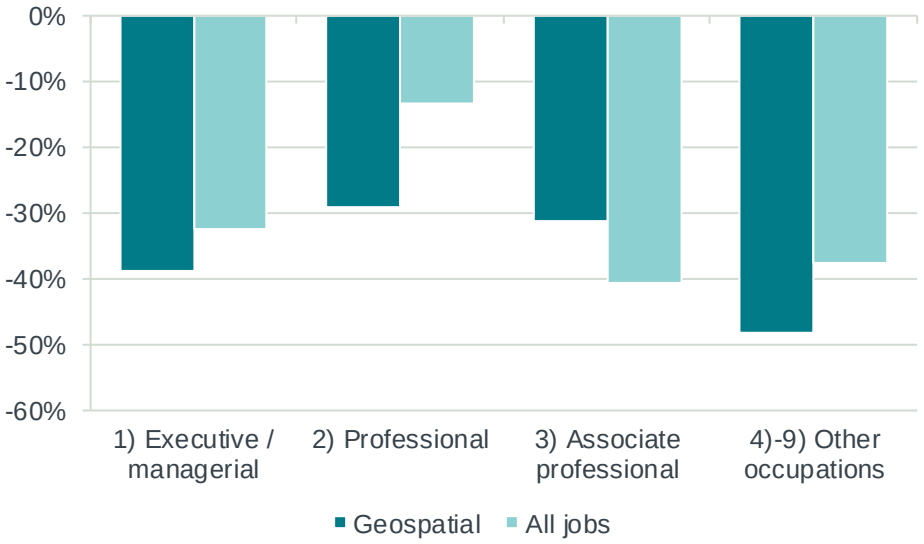
As we set out in Section 4 geospatial roles are heavily skewed towards the professional occupations. This category accounts for nearly two thirds of geospatial postings, but only one third of postings overall. Meanwhile the 'other' category accounts for 40% of all postings, but only 15% of geospatial postings.

In Figure 68 below we have illustrated the change in number of job vacancy postings over the April-August 2020 period relative to 2019 averages, broken out by seniority grade and whether or not the postings contained a geospatial skill. For

[43] Other occupations are the following codes 4) administrative and secretarial, 5) skilled trades, 6) care and leisure, 7) sales and customer service, 8) process plant and machine operatives, 9) elementary occupations.

executive / managerial and associate professional roles, the percentage decline in geospatial postings is similar to the decline for all postings. In the case of professional grade occupations, geospatial roles underwent a sharper decline, so too with 'other' occupations.[44]

Figure 68 Monthly volume of postings over April-August 2020 relative to 2019 average, by SOC seniority level



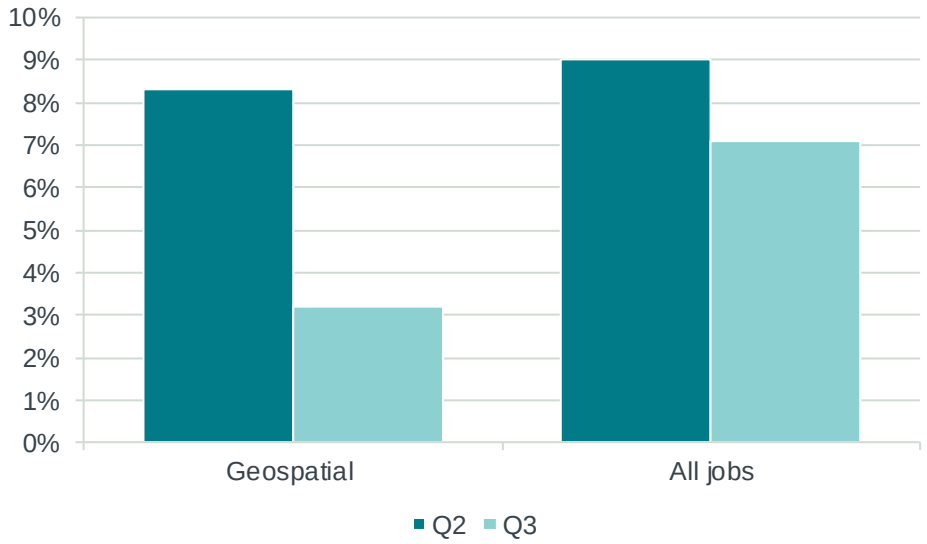
Source: Frontier analysis of Burning Glass data

We have also looked at the changes in salary offered in job postings. In the second quarter of 2020, geospatial salaries were actually 8-9% higher on average relative to 2019 levels (Figure 69). A similar pattern was also evident for all postings.

One possible explanation for this is that while companies were willing to delay non-urgent recruitment (as evidenced by the large drop in volumes of postings), the remaining postings were more urgent and employers were willing to pay more in order to secure an appointment. The salary uplift is somewhat reduced by the third quarter of 2020 this suggests a gradual return of non-urgent hiring.

[44] Note the apparent contradiction that geospatial vacancies as a proportion of all vacancies remained roughly constant, but within most seniority grades geospatial undergoes a sharper decline. This is explained by the fact that the wider jobs market is more heavily skewed towards seniority grades that underwent heavier decline. In particular groups 4-9 account for only 16% of geospatial postings, but 41% of all postings.

Figure 69 Starting salary in 2020 relative to 2019 average

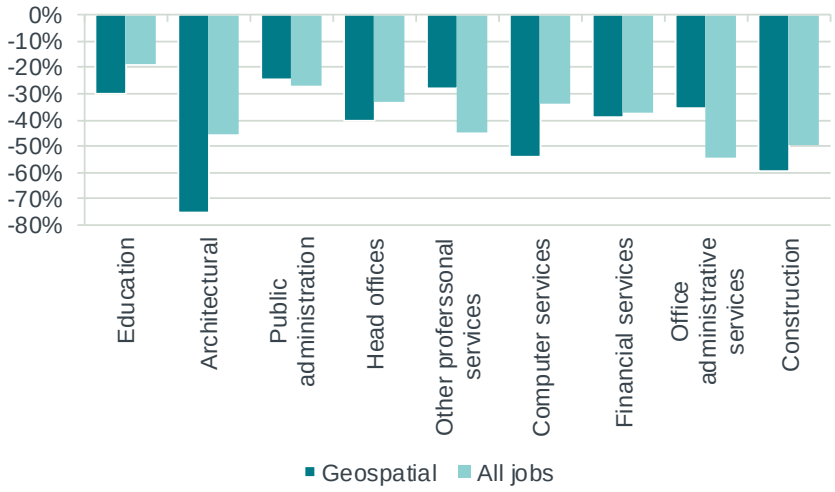


Source: Frontier analysis of Burning Glass data

B.2.2 Sectoral impacts

As we set out above the current economic contraction will be far more sever in some parts of the economy. We have examined the extent to which this is evident in geospatial postings. In Figure 70 below, we have illustrated how postings have evolved by sector, showing the top 2-digit SIC codes in terms of volume of geospatial postings.

Figure 70 Monthly volume of postings over April-August 2020 relative to 2019 average, by key 2-digit SIC codes



Source: Frontier analysis of Burning Glass data

The sharpest contractions were in architectural and engineering services and construction. Clearly, many roles in these areas would be directly carrying out or supporting activity that cannot be done remotely. By contrast, education and public administration (which will include local and central government) only underwent a moderate contraction.

In some cases the percentage geospatial reduction is larger than the percentage reduction in all jobs postings for that sector – notably in education, architectural and computer service sectors. One potential reason for this is that the geospatial roles may involve more physical presence than other roles.

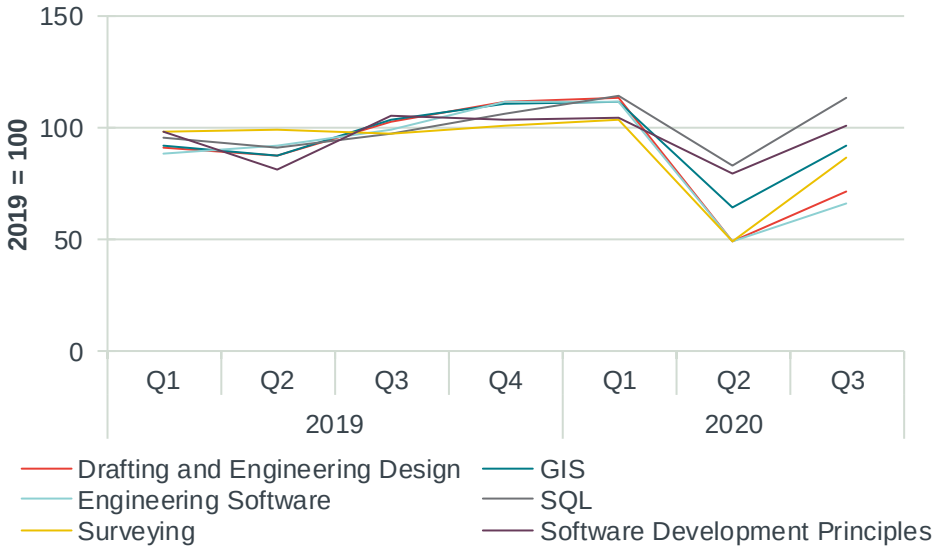
B.2.3 Changing skills mix

We have also explored whether certain geospatial skills have become relatively less prevalent in 2020. In keeping with the sectoral results we have presented above we can see that that jobs requiring skills used by the construction and engineering sectors have been impacted more heavily than jobs requiring for example GIS skills. This would support the hypothesis that construction and engineering sectors took a heavier hit, either due to reduced demand for these services, inability to work from home, or cashflow constraining recruitment.

In particular we have looked at the most prominent skill clusters which help us differentiate between different types of geospatial roles (e.g. GIS technician as opposed to surveyors). Figure 71 below shows the number of geospatial postings that require a skill in a specified cluster, standardised relative to 2019 volumes.

We see that surveying, drafting and engineering design, and engineering software were all 50% down in the second quarter of 2020 relative to 2019. By contrast, geospatial roles requiring GIS, SQL, and software development only fell in volume by between 17% and 35% in the second quarter of 2020 and were broadly back at 2019 averages later in the year. These findings are consistent with our sectoral analysis.

Figure 71 Trends in demand for key skills clusters among geospatial roles

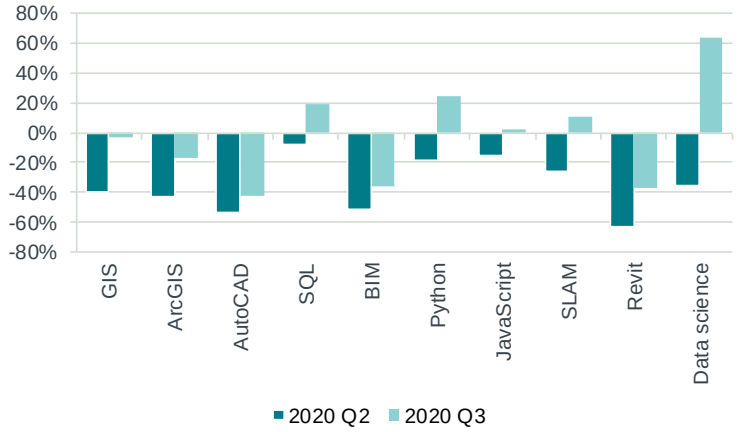


Source: Frontier analysis of Burning Glass data

We have also looked at the changing demand for specific skills (rather than skill clusters) in 2020 relative to 2019. In Figure 72 below we have shown percentage change in geospatial postings calling for a specific skill in 2020 relative to 2019 levels. For example ArcGIS experienced a decline in the region of 40% in the

second quarter of 2020, but with third quarter postings were similar to 2019. Software skills such as Python, SQL and JavaScript experienced more moderate declines. However, architecture/construction-related skills such as BIM, AutoCAD and Revit all showed sustained heavy declines initially and so far the third quarter of 2020 has been barely any stronger.

Figure 72 Trends in demand for specific skills among geospatial roles

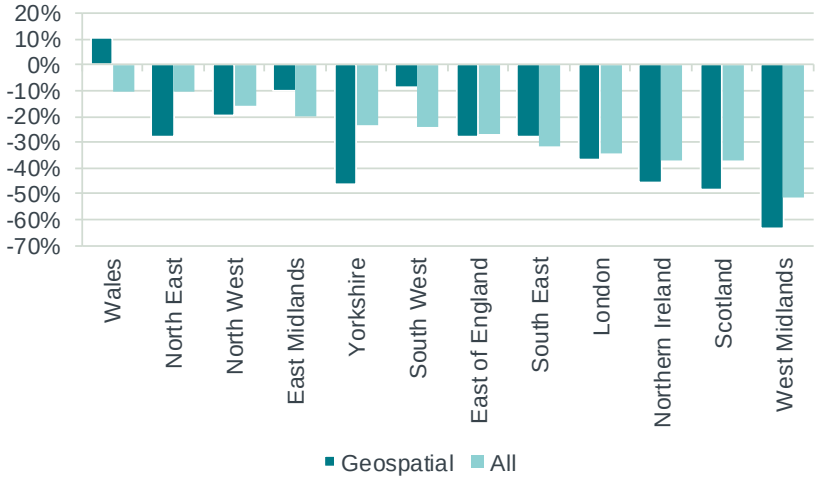


Source: Frontier analysis of Burning Glass data

B.2.4 Geographic impact

Finally we have explored whether certain geographic regions have been associated with larger declines in the volume of geospatial postings. In Figure 73 below we have shown the regions ranked in terms of percentage change in all job postings between 2020 and 2019.

Figure 73 Number of postings in 2020 Q2-Q3 vs 2019 average by region



Source: Frontier analysis of Burning Glass data

In terms of all postings (rather than just geospatial postings) Wales experienced the smallest relative reduction (-10%) whereas as the other end of the spectrum the total volume of postings associated with employers in the West Midlands fell by 52%.

In general, the rate of geospatial reductions is similar to the rate of change for all postings. However, it is important to note that some regions (notably Wales, Northern Ireland, and the North East) have very low numbers of geospatial postings, so will be sensitive to changes in any given month, which may explain some of the discrepancies. For example, the number of geospatial postings actually rose slightly in Wales over the period in question which is counterintuitive.

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