D2.8 Workforce demand evolution and distribution

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Abstract

This document aims at describing the evolution of workforce demand within the European space industry and anticipating its distribution across the value chain. First a clear understanding of the current workforce demand was required. S4S conducted a quantitative workforce demand & trends survey and presents the findings in this document. SSA analysed the workforce demand evolution through two key methodologies: the analysis of job adverts, and the analysis of CVs. PwC carried out an assessment of workforce demand evolution and geographical distribution integrating socioeconomic implications on European countries, regions and space industry sectors.

The quantitative workforce demand & trends survey revealed a dynamic sector with generalised high demand for high education profiles in all EU countries. Both technical and non-technical skills are highly required. Among the technical skills, interviewees stress the need for general problem-solving skills, rather than the need for specific knowledge, which tends to become outdated rapidly in time. AI engineering is enjoying a certain popularity as a technical skill. Among the non-technical skills, communication, creative thinking and teamwork and adaptability obtained a high score. Space employees build their careers both in private companies and in the public sector. Most private companies are SMEs; they employ roughly 50% of the private sector. Geographic brain drain from out of Europe is limited to a zero-sum effect. Inside the EU, some states – regions prove to offer more opportunities and attract more space employees to the detriment of others.

The financial condition, including low profitability of many space SMEs, is a point of concern. It may result in unwanted career moves. Moreover, the motivation to stay in the space sector may require some idealism of the space worker when other sectors prove to offer better and more stable personal incomes. The space public sector may offer a limited safe haven.

Keywords

Space applications, Space programmes, Space services, Space supporting technologies, European space ecosystem, Space skills, Space market dynamics, Space business trends, Space industry

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1. INTRODUCTION

1.1 Executive Summary

1.1.1 ASTRAIOS

ASTRAIOS[1] is a Horizon Europe Coordination and Support Action (CSA) which will identify the existing space-related education and training across Europe, project future demand for space skills from the European space industry and identify actions to align and improve the career pathways into the sector.

The project will characterise the demand from the European Space industry and identify actionable ways towards a better alignment between the educational offer and the skills required by the future European space industry. This will foster innovation and increase EU competitiveness in the space sector.

1.1.2 Overview

This report presents the results of a study undertaken to characterise the evolution of workforce demand within the European space industry and to anticipate its future distribution across the value chain. Against the backdrop of a rapidly changing global economy, accelerated technological advancements, including robotics and artificial intelligence, and an increasingly dynamic business environment, the European space sector is undergoing a transformation. These changes have significant implications for the structure, skills, and geographic distribution of its workforce.

Building upon the work carried out in previous tasks, we have explored the evolving context in which this demand is emerging, and identified key indicators that shape its distribution.

To achieve this, we conducted three complementary research activities. First, a quantitative survey gathered input from European space industry stakeholders, capturing data on workforce demographic and regional distinctions. Second, an analysis of job advertisements and CVs provided insights into skill trends, qualifications, and career trajectories. Third, a socioeconomic assessment examined the broader implications of workforce demand evolution in a wider world market perspective.

The findings from these activities have been consolidated in this report, which offers a detailed overview of workforce trends in the European space sector. It highlights key insights into current and future demand, regional distribution, and the global context in which the European space workforce is developing.

The "international element, focusing on the US space market, as well as middle east space markets" proposed as part of Activity 3 in WP2500 will be handled in a separate Astraios deliverable, not in this deliverable D.2.8.

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1.1.3 Main findings

- **Geographic distribution and mobility:**
    - A reasonably balanced representation of highly educated workers from different EU member countries, representing a range of ages and genders.
    - The sector is highly dynamic with frequent job changes, including geographic mobility between countries within the EU.
    - 64% of all CVs were from Italy, UK, Germany, France, and Spain. Germany, France, UK, Italy, and the Netherlands accounted for 78% of job adverts.
    - The space workforce is internationally mobile, but geopolitical and policy factors impact mobility. Migration dynamics are reshaping regional talent pools, with Luxembourg, Belgium, and Germany gaining at the expense of Eastern and Southern Europe.
    - The brain drain phenomenon towards non-EU countries is limited, resulting in a net close to zero employee loss effect, perhaps even with some positive knowledge exchange effects.
- **Emerging supply and demand for skills:**
    - An oversupply of those with an aero/mechanical engineering background.
    - An emerging demand for AI engineering skills.
- **Retiring space generation:**
    - No evidence of a retirement wave, with 41% of space workers being aged 35–49.
- **Sectorial brain drain:**
    - Private companies, over half of which are SMEs, employ almost half of the space workers.
    - The financial condition, including low profitability of many space SMEs is a point of concern. It may result in unwanted career moves. Moreover, the motivation to stay in the space sector may require some idealism of the worker when other sectors prove to offer a better and more stable salary.

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2. Quantitative Survey

2.1 Respondents Demographics and Geographical Distribution

2.1.1 Geographical location analysis

A workforce survey was conducted. The respondents received an invitation to fill-out a questionnaire they received, either by meeting an ASTRAIOS partner during a European space event or by visiting web content on the ASTRAIOS website or through social media like LinkedIn and X.

There were 98 respondents. The first question was related to the geographical location of the respondents. The respondents were all working in European countries. The answers were well spread over all EU countries; however, the number of participants was not high enough to provide for a spread which corresponds to actual space workforce geographic distribution over the different countries. That is why some countries are slightly better represented in the survey than others. E.g. the United Kingdom is rather well represented with 21% of the reported answers. See Figure 1.

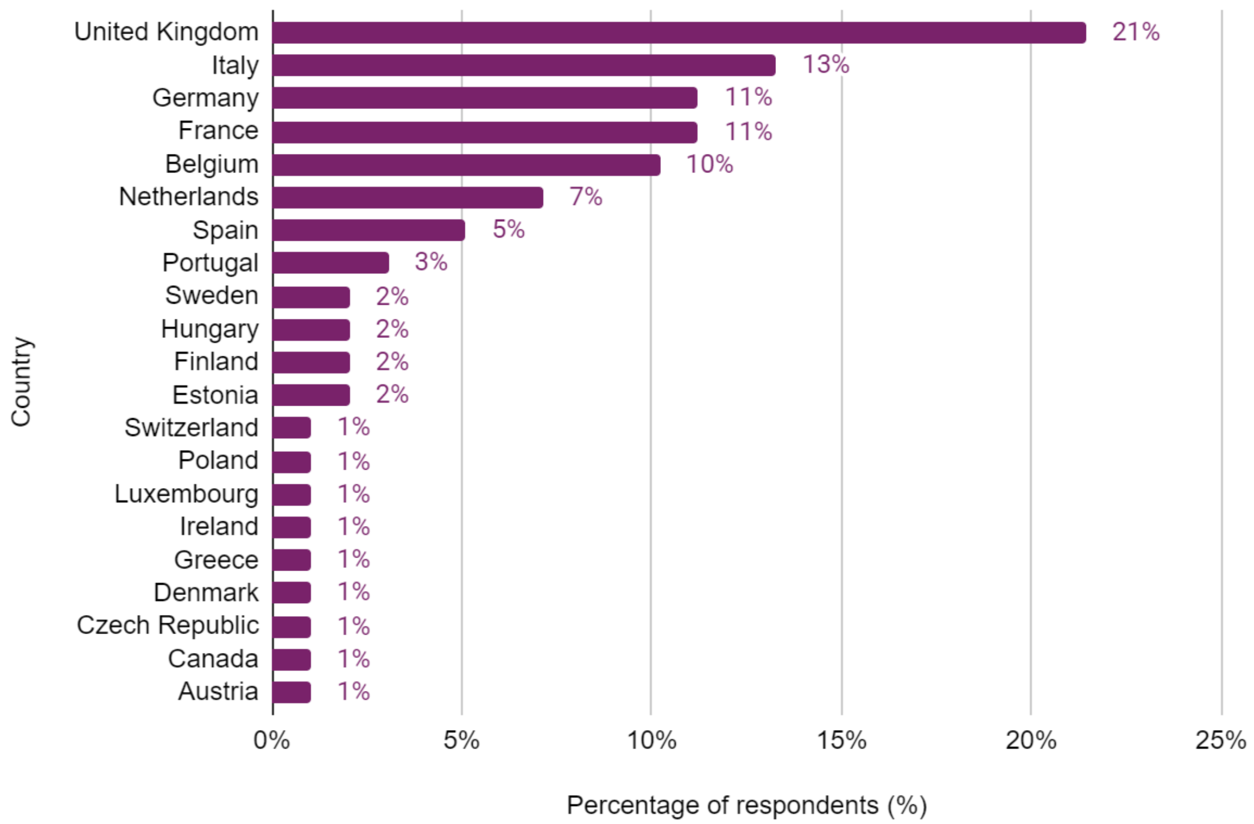

Figure 1: Geographic distribution of respondents (n=98).

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2.1.2 Gender distribution

The male/female ratio among the respondents was almost equal. 4% of the respondents answered X for the gender they identified with.

These ratios do not correspond to the ratios of the general space workforce, as estimated by Eurospace[1] where men are represented at 77% and women at 23%. This is likely due to the overrepresentation of men in technical space jobs. The latter group was proportionally less represented in this survey.

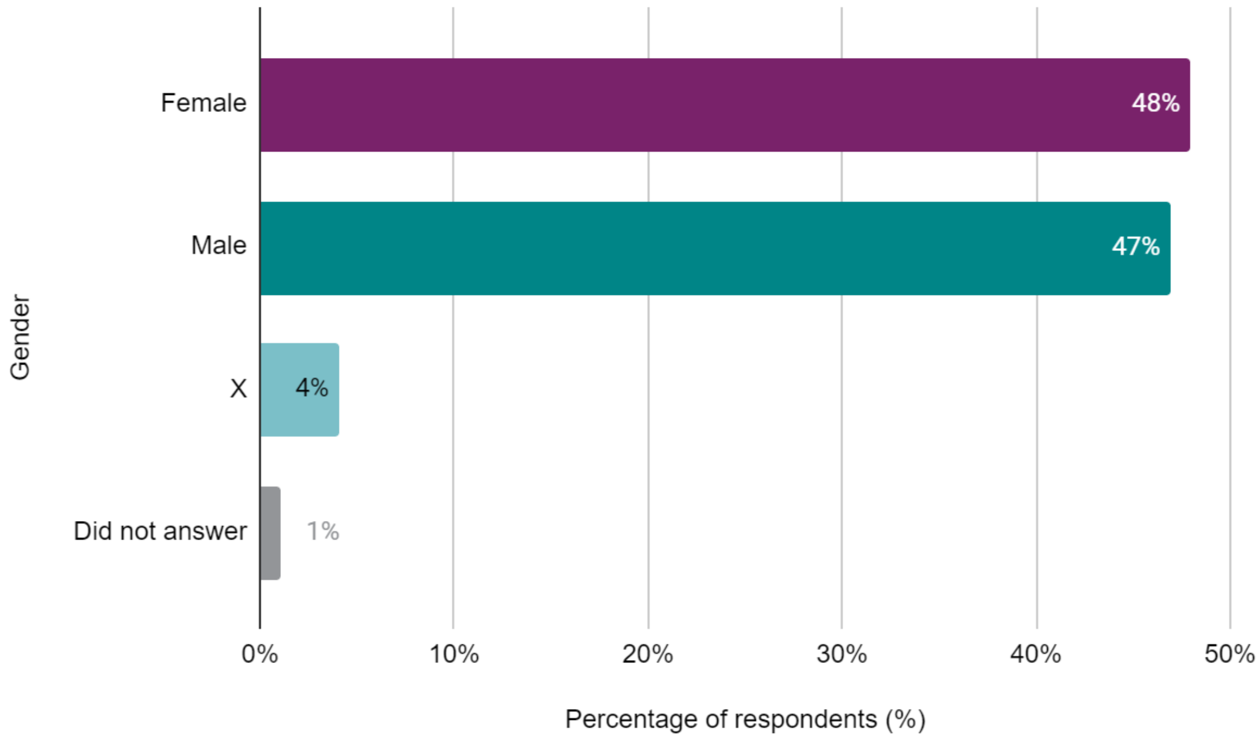

Figure 2: Respondent gender identity (n=97).

2.1.3 Experience

12% of respondents had more than 20 years of experience. 17% had less than 2 years of experience or none. 24% had 3 to 5 years experience and 26% had 10-20 years of experience.

[1] Eurospace Facts & Figures 2023, Eurospace, 2024, https://eurospace.org/publication/eurospace-facts-figures/ (Eurospace data is copyright by Eurospace, all rights reserved, reproduction forbidden.)

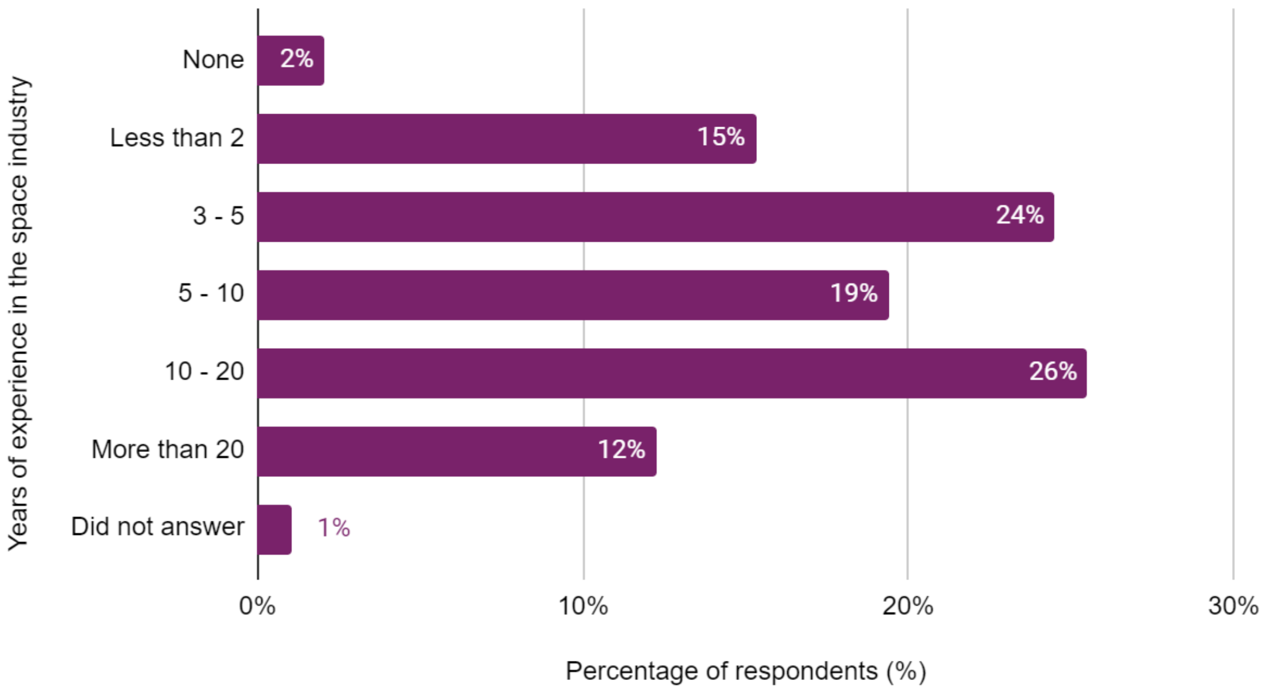

Figure 3: Experience expressed in number of years distribution in the space industry (n=97).

2.1.4 Education

The average education level of the respondents was relatively high. Around a quarter of respondents had a PhD degree. Most had a master's degree. Close to a quarter of respondents had a bachelor's degree. See Figure 4.

On the one hand, the high level of education of people working in the space sector can favour a competitive career environment, where high expectations are created for a limited number of career opportunities. On the other hand, this may discourage people to work in the space sector. Although it may have a profound impact on individual career decisions, the collective net effect of this phenomenon may be small..

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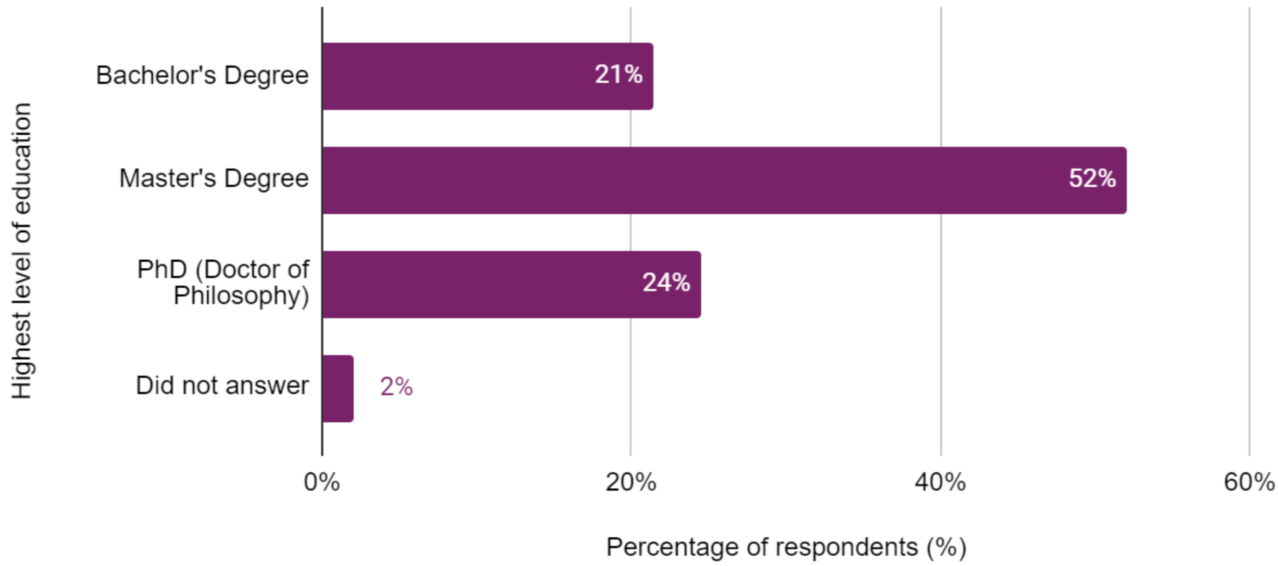

Figure 4: Education level distribution in the space industry (n=96).

2.1.5 Type of organisation

Space workers may be employed in several types of organisations. Possibilities include government agencies, international organisations, private companies, non-profit organisations, research centres, universities etc. Space workforce respondents were mainly active in: (see Figure 5)

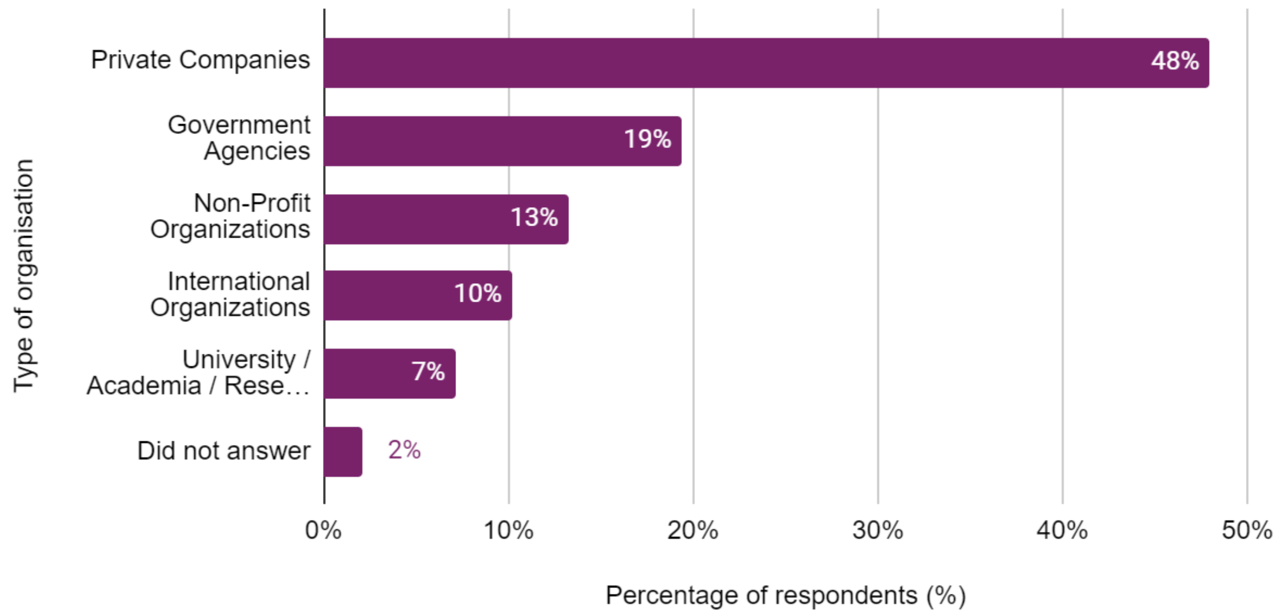

Figure 5: Type of organisations the space workforce respondents were active in (n=96).

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Close to half of the respondents (48%) were employed in private companies.

2.1.6 Space industry sector

Space workforce respondents were asked in which space industry sector they were working. See Figure 6.

Business, finance and law constitute important sectors of the space industry.

Space Applications refers to the increasingly important ecosystem of downstream space companies, where satellite communications, satellite navigation and earth observation applications are being developed.

Space Operations and Systems Engineering are jobs frequently encountered in large space corporations, like satellite operators or large-scale integrators.

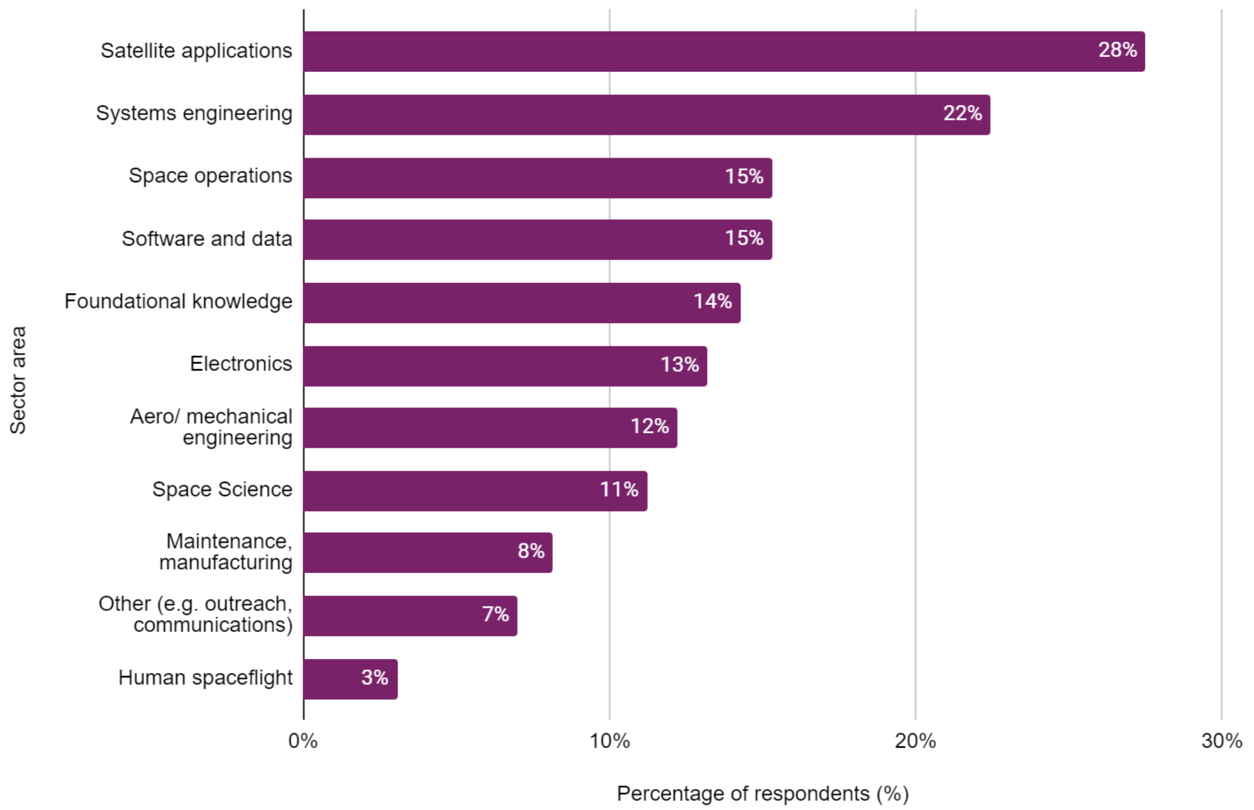

Figure 6: Distribution over the different sectors of the space industry (n=95).

2.2 Respondents Skills, Knowledge, and Abilities

Not surprisingly, engineering skills, both general and specialised, as well as ICT skills are the skills that have been identified as the most needed in jobs in the space sector. See Figure 7.

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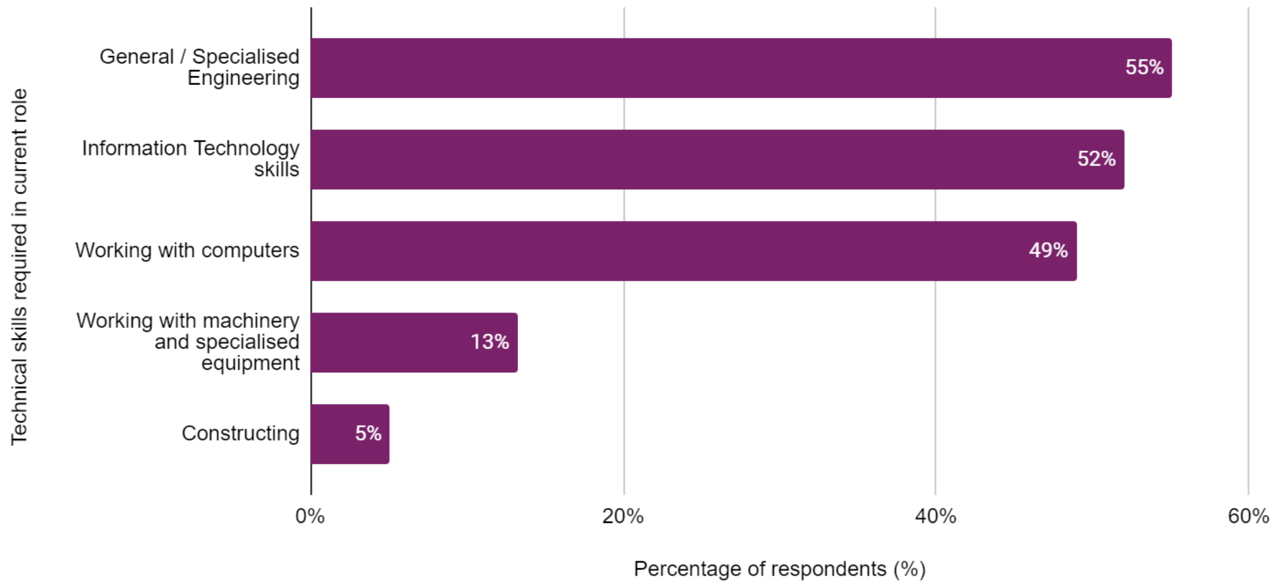

Figure 7: Skills required in current role (n=90).

The most valuable non-technical skills required are problem-solving (is also a technical skill), communication, creative thinking and teamwork. These are typically skills that support engineering activities, so the non-technical skills seem to be selected in function of the required technical work.

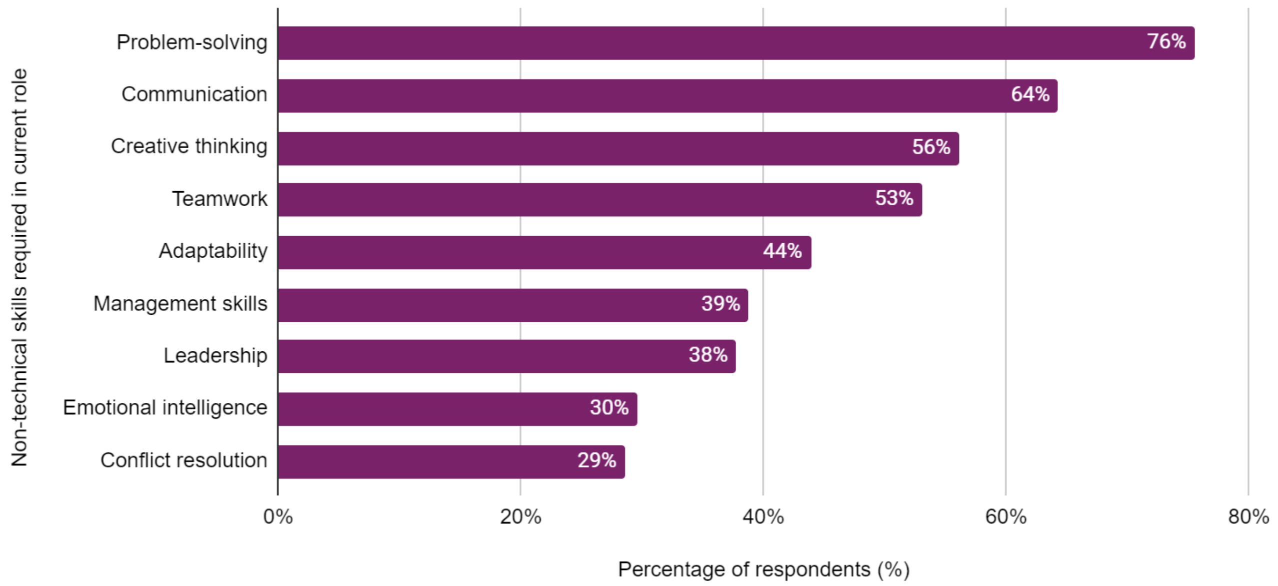

Figure 8: Most valuable non-technical skills for space job position (n=97).

Figure 9 shows the emerging technologies that respondents consider will be critical in the next 5-10 years for the space sector. Not surprisingly, artificial intelligence is considered as important by 38% of the respondents. Additive manufacturing techniques are also expected to play an increasingly important role in space.

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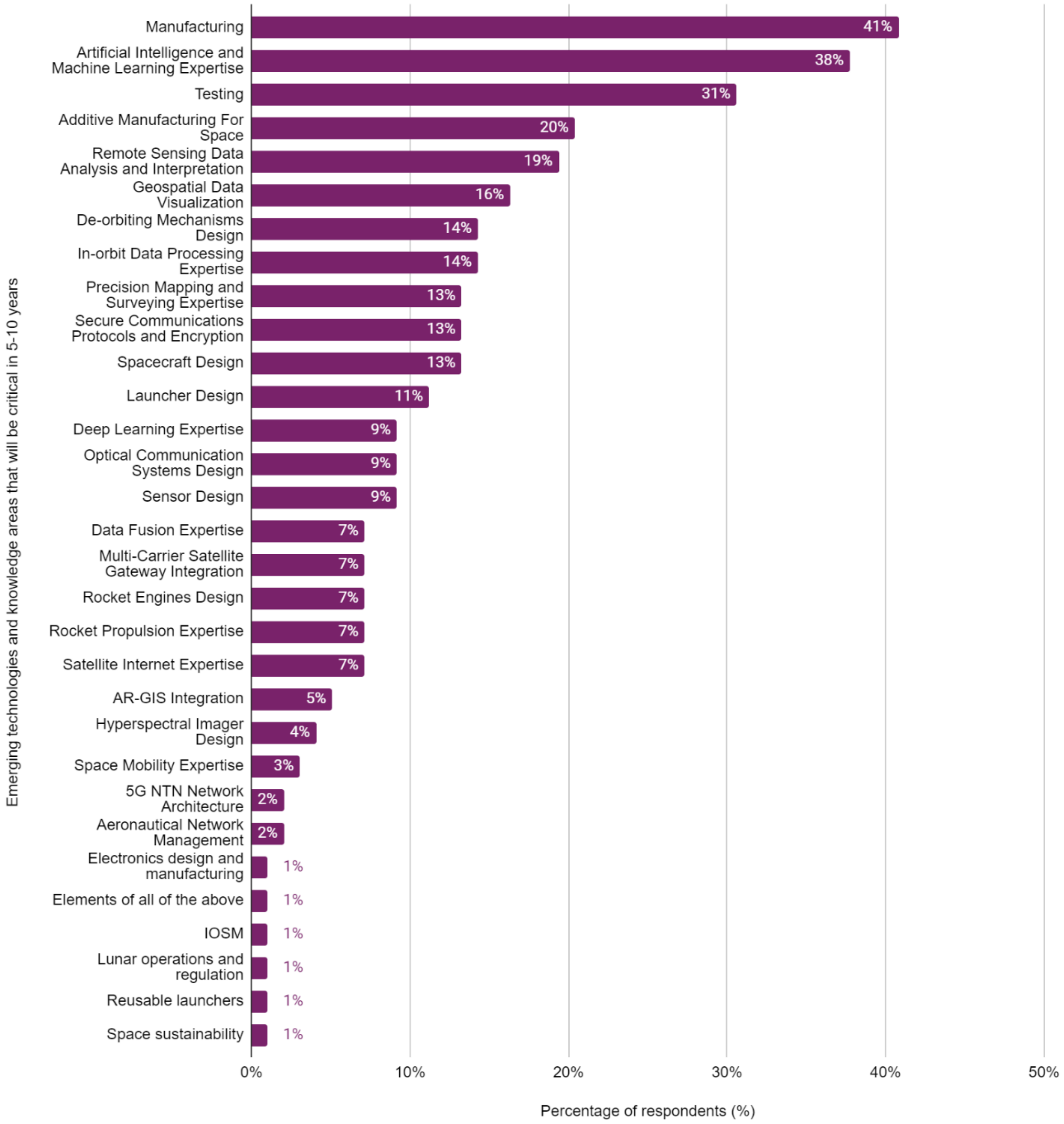

Figure 9: Emerging technologies in the space sector (n=88).

2.3 Respondents Mobility and Career Development

2.3.1 Changing role in the space sector

32% of the respondents have not changed roles in the past 5 years in the space sector. 68% have changed at least once in the past 5 years, as illustrated by Figure 10.

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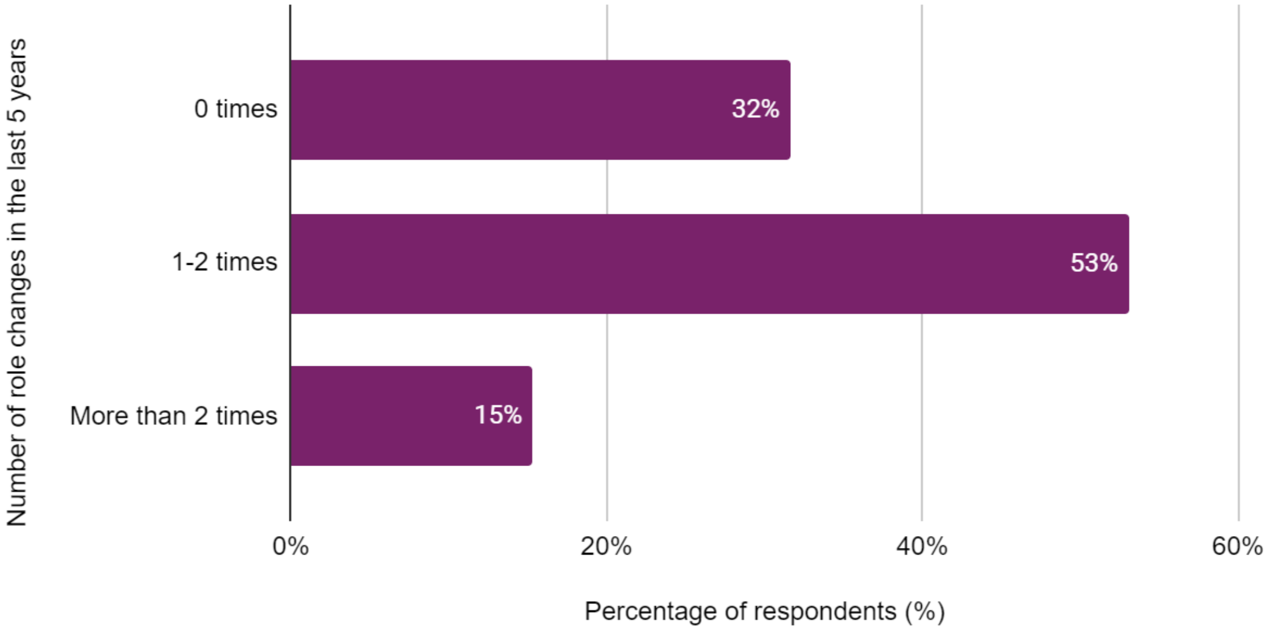

Figure 10: Changing role in the space sector (n=98).

Close to 50% of the respondents have changed company in the past 5 years, whereas slightly more than 50% of the respondents have not changed company in the past 5 years, as illustrated in Figure 11.

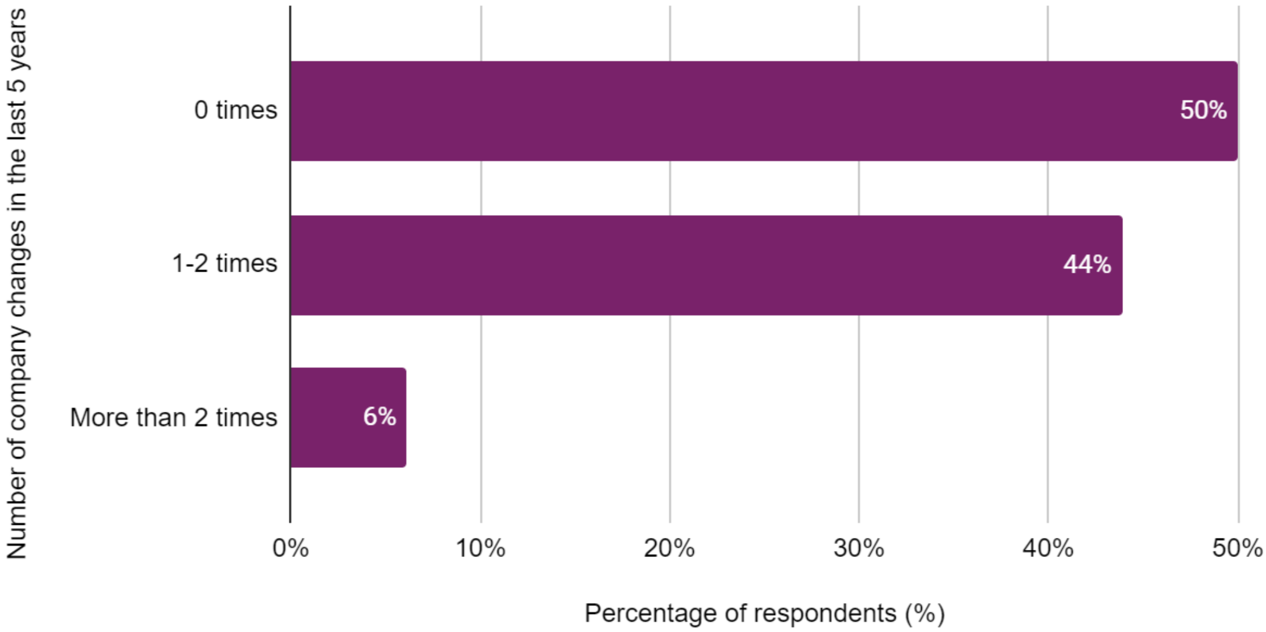

Figure 11: Changing company in the space sector (n=98).

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2.3.2 Relocation and professional development

Drivers for relocation in the EU may be better compensation or career progression, as can be seen in Figure 12.

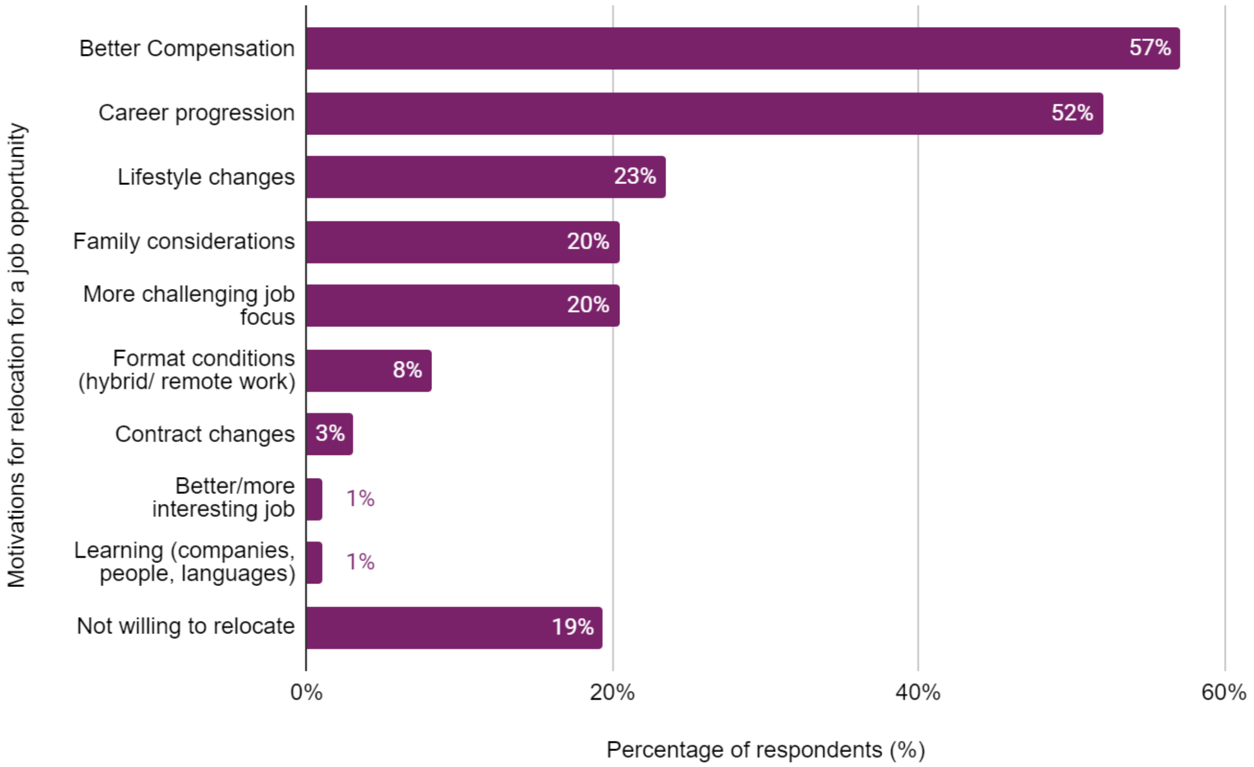

Figure 12: Motivations for relocation in the space sector (n=89).

Networking, mentoring and on-the-job training are considered as the most important needs for professional development, see Figure 13). This indicates that the respondents do not believe that a specific type of specialised training will help them long enough through their career. There is a general belief that trainings have a short expiration date and that continuous learning and relearning will be needed.

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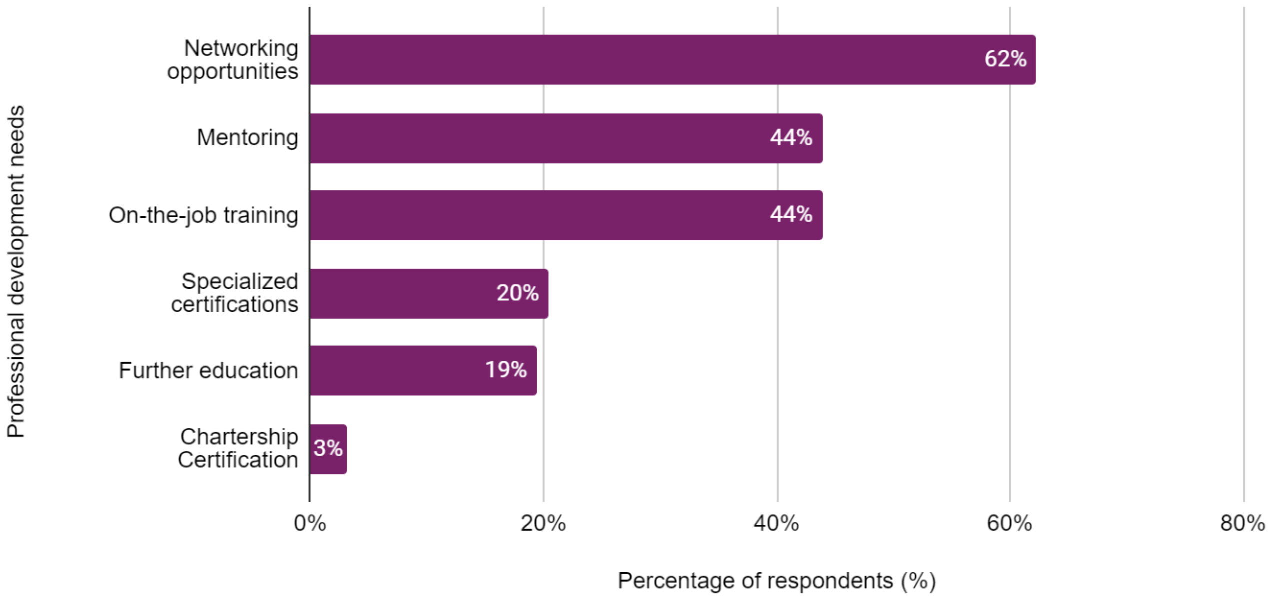

Figure 13: Professional development needs (n=91).

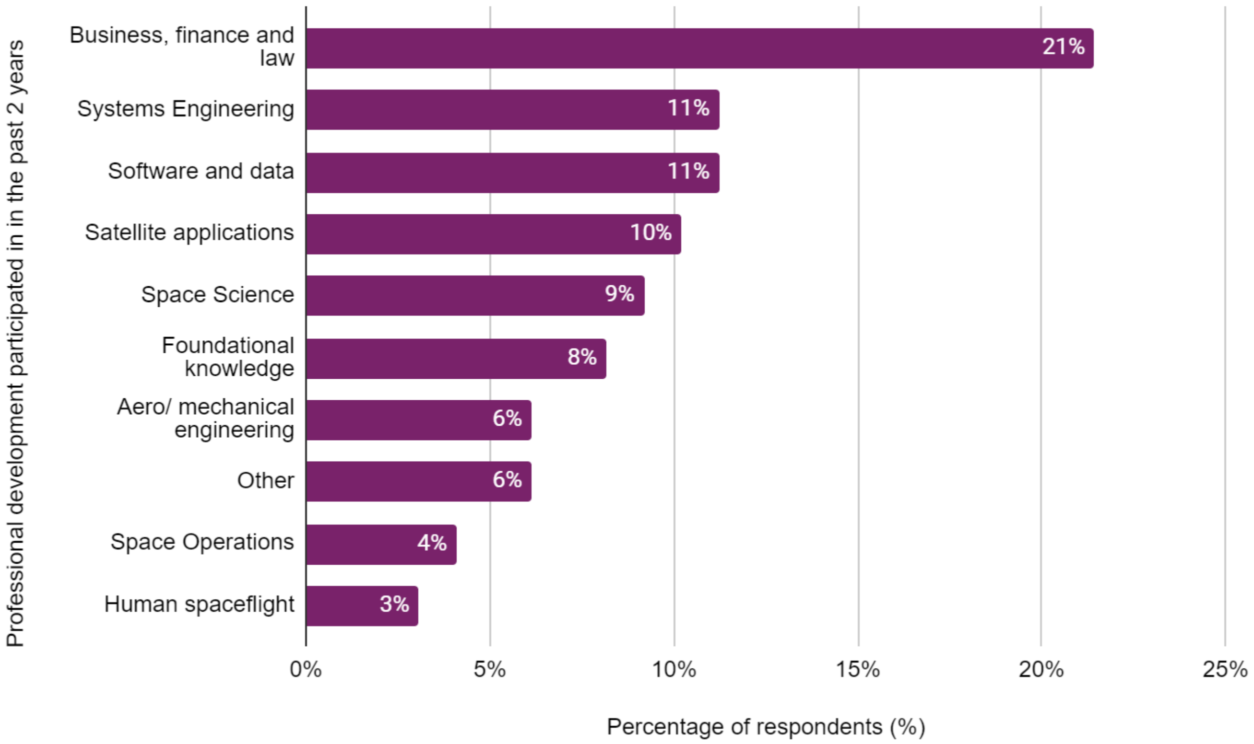

Figure 14: Professional development in the past 2 years (n=66).

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- ⇨ The collected data do not indicate a distinct retiring space generation. Space employees have seniority ages spread over the entire range [0-40] years. Major space companies may have introduction education and/or job specific training (e.g. satellite operations) in place, but most transfer of knowledge and expertise happens through on-the-job training in teams with different seniority levels. Some companies organise mentoring for their employees, typically at the moment of entry in the company. The continuity of this mentorship is usually left in the hands of the stakeholders.

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3. Skills Supply and Demand Analysis

3.1 Introduction

In this section, we investigated the supply and demand of skills in the space sector in the EU-27 and UK. By analysing job adverts and CVs posted by those looking to work in the space sector, as well as complementary data sets, we aim to understand the following:

The geographic distribution of the space workforce and their movement

Trends in keywords in jobs and CVs

The age profile of the space workforce

This will allow us to make predictions about the evolution of the space workforce, both from a skills and a geographic perspective.

3.2 Data sources

To identify the supply and demand for skills in the European space sector, we used four primary data sources: SpaceCareers.com (http://space-careers.com/), SpaceCareers.uk (https://spacecareers.uk/), Space Individuals (https://spaceindividuals.com/), and LinkedIn Talent Insights (https://business.linkedin.com/talent-solutions/talent-insights). These data sources were chosen because they provided easy-to-access data about job adverts and CVs for the EU-27 and UK.

Although other sources such as We Work In Space (https://www.weworkinspace.com/) and Space Crew (https://spacecrew.com/) were investigated, the data was either difficult to extract or focused too heavily on the US space sector, so was less suitable for this project. Where relevant, results from our investigation are compared to other sources such as Eurospace's Facts & Figures reports, the UK's Space Census and Space Sector Skills Survey, and EARSC's Industry Surveys.

3.2.1 Space-Careers.com

Space-Careers.com is a global jobs board designed to connect professionals in the space industry with job opportunities, predominantly featuring job opportunities from across Europe.

Historically, Space-Careers.com maintained a publicly accessible repository of CVs posted by individuals looking for work in the space sector. However, following a website update in 2023, these CVs were removed from public access. Despite this, over 5,000 CVs remain accessible through the Internet Archive, covering the period from 2005 to 2022.

3.2.2 Space Individuals

Space Individuals is another international job board and CV database. As of June 2024, the platform housed over 2,000 CVs, with around 1,400 of these containing accessible information. The available details included a short biography, years of experience, current country of residence, and the date the CV was posted.

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3.2.3 SpaceCareers.uk

SpaceCareers.uk is a website which provides a jobs board, careers advice, and events to support people to get a job in the space sector. It is primarily focused on the UK but occasionally also advertises international jobs. The platform provides a structured categorisation of job advertisements, with 21 distinct categories that are closely aligned with the EU-TaSK framework[2]. Each job posting is assigned to a single category.

For the purposes of this analysis, we acquired a dataset from SpaceCareers.uk which includes job advertisements posted between July 2022 and December 2024. This dataset includes 1,856 job adverts, predominantly focused on opportunities within the UK. The data provided comprises the following fields: job title, job advert text, organisation, location, category, and posting date.

3.2.4 LinkedIn Talent Insights

LinkedIn describes itself as 'the world's largest professional network', with roughly 950 million users in more than 200 countries and territories worldwide. Users of LinkedIn provide information about their job titles, employment, education, skills, volunteering experience, certifications, and more, amounting to over 12 billion data points[3]. LinkedIn uses artificial intelligence and machine learning to classify each user's data into standardised and searchable terms.

This data is fed into the LinkedIn Talent Insights tool, which allows users (typically recruiters) to analyse characteristics such as skills, education, and location of potential candidates. This project uses Talent Insights to identify large-scale trends across the space sector, including the demographics, hiring trends, salaries, and growth of different industries. This tool is therefore a practical means to examine the workforce of the European space sector without having to survey companies or individuals.

Further information about the use of LinkedIn Talent Insights in this work can be found in the ASTRAIOS deliverable 'D1.3 EU Space Sector Demographics Database'[4].

3.3 Methodology

3.3.1 Data acquisition and permissions

We contacted the listed jobs boards to seek permission for data usage and potential purchase. Two websites, SpaceCareers.uk and Space Individuals, were responsive and supportive, agreeing to collaborate with the ASTRAIOS project. SpaceCareers.uk entered into a formal data sharing agreements, and Space Individuals provided complimentary access to their database of profiles. To extract CV data from Space-Careers.com, we used web scraping techniques to obtain information from the Internet Archive.

3.3.2 Data scraping

To access the CVs posted on Space-Careers.com, we used custom-written web scraping tools. The CVs available on the Internet Archive follow a standard format, including sections for personal information and a

[2] D1.2 European Space Sector Skills Taxonomy, 2024, https://www.astraios.eu/public-deliverables
[3] LinkedIn Talent Insights, LinkedIn, 2023, https://business.linkedin.com/talent-solutions/talent-insights
[4] D1.3 EU Space Sector Demographics Database, 2024, https://www.astraios.eu/public-deliverables

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free text section that candidates could customise. 5,182 CVs were accessible, and the HTML content of these was extracted.

For CVs posted on Space Individuals, we used custom-written web scraping tools to extract the key information and short summary from 2,002 individuals.

3.3.3 Data cleaning

In the data cleaning process, we removed CVs that were blank, inaccessible, contained broken links, spam information, or insufficient details for accurate classification. Any identifiable personal information, such as names and contact details, was also removed to ensure privacy. Duplicate entries were identified and eliminated, and data formats were standardised for consistency, including locations and posting dates. For Space-Careers.com, 97 CVs were removed, leaving 5,085 CVs. For Space Individuals, 610 CVs were removed, leaving 1,392 CVs.

To ensure accuracy, we cross-checked a sample of CVs on the Internet Archive (for Space-Careers.com) and profiles posted on the website (for Space Individuals) against the extracted information, to ensure that the extracted information was correct.

3.3.4 Data categorisation

The CVs, profiles, and job adverts were classified against the EU-TaSK taxonomy using AI-assisted methods, followed by a manual verification process. Job levels (such as student, graduate, researcher, and intern) and country were also classified. As a result, 1,856 job adverts (from SpaceCareers.uk) and 6,477 CVs (from Space Individuals and Space-Careers.com) were categorised.

3.4 Results

3.4.1 Geographic distribution

3.4.1.1 Employment

We used LinkedIn Talent Insights (see deliverable D1.3) and data from the annual reports of Eurospace and EARSC to baseline the geographic distribution of the EU27+UK space workforce. LinkedIn Talent Insights provides a broad view of the sector, Eurospace considers the upstream space sector, and EARSC considers remote sensing (or downstream).

Unsurprisingly, the largest workforces are those of France, the UK, Germany, Italy, and Spain. These five countries make up between 70 – 88% of the EU-27+UK space sector, depending on the dataset used. The remaining 23 countries make up about 12 – 30% of the sector.

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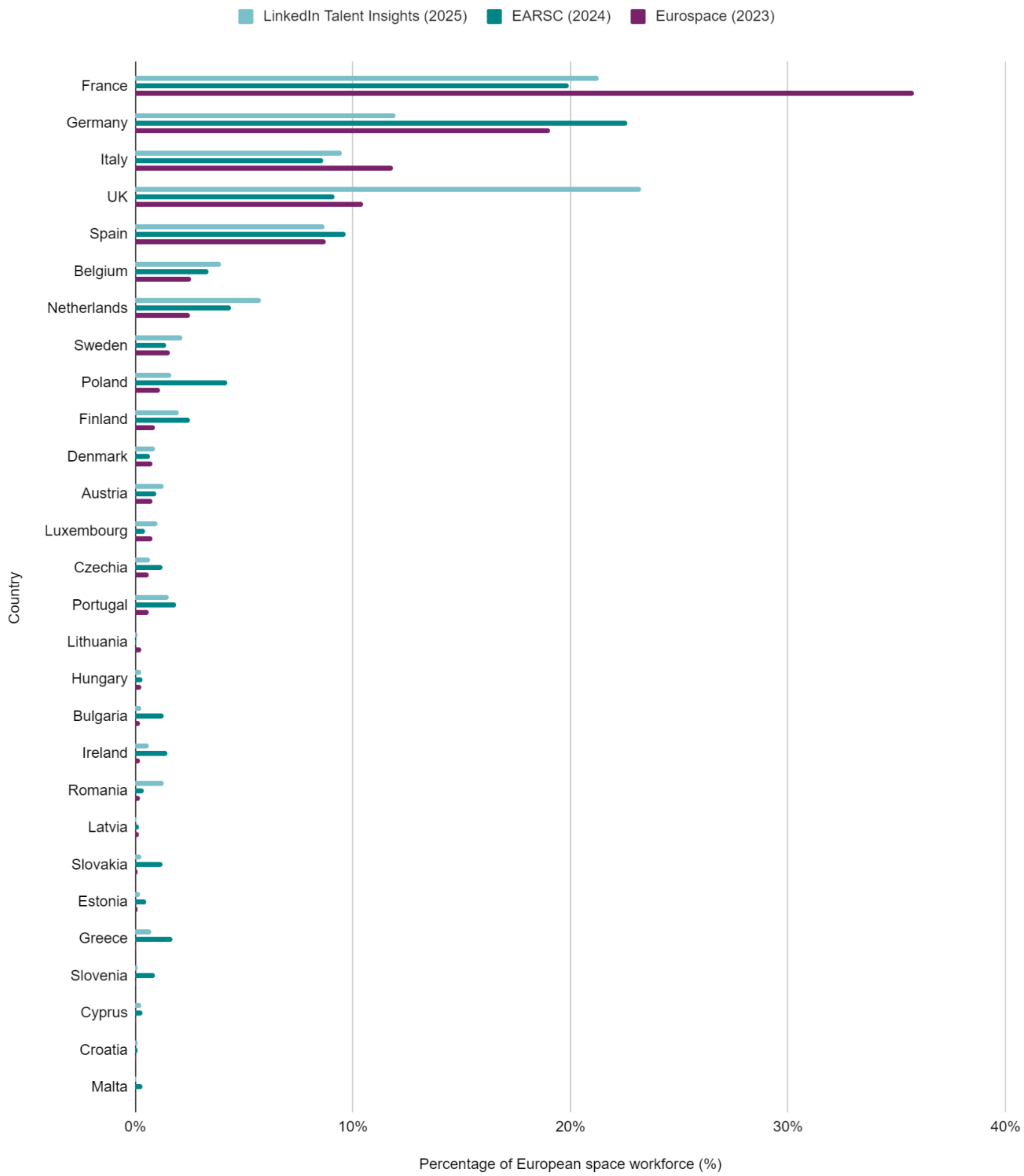

Figure 15: Percentage of European space workforce in each of the EU27 and UK.

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3.4.1.2 CVs posted

From the Space Individuals website, we extracted the most recent location information of individuals who posted their CVs between 2005 and 2024. Unsurprisingly, the countries with the largest space workforces were found to contribute most CV postings. The top five countries in terms of CV submissions were Italy, the UK, Germany, France, and Spain. These five nations accounted for 64% of all CVs posted during this period.

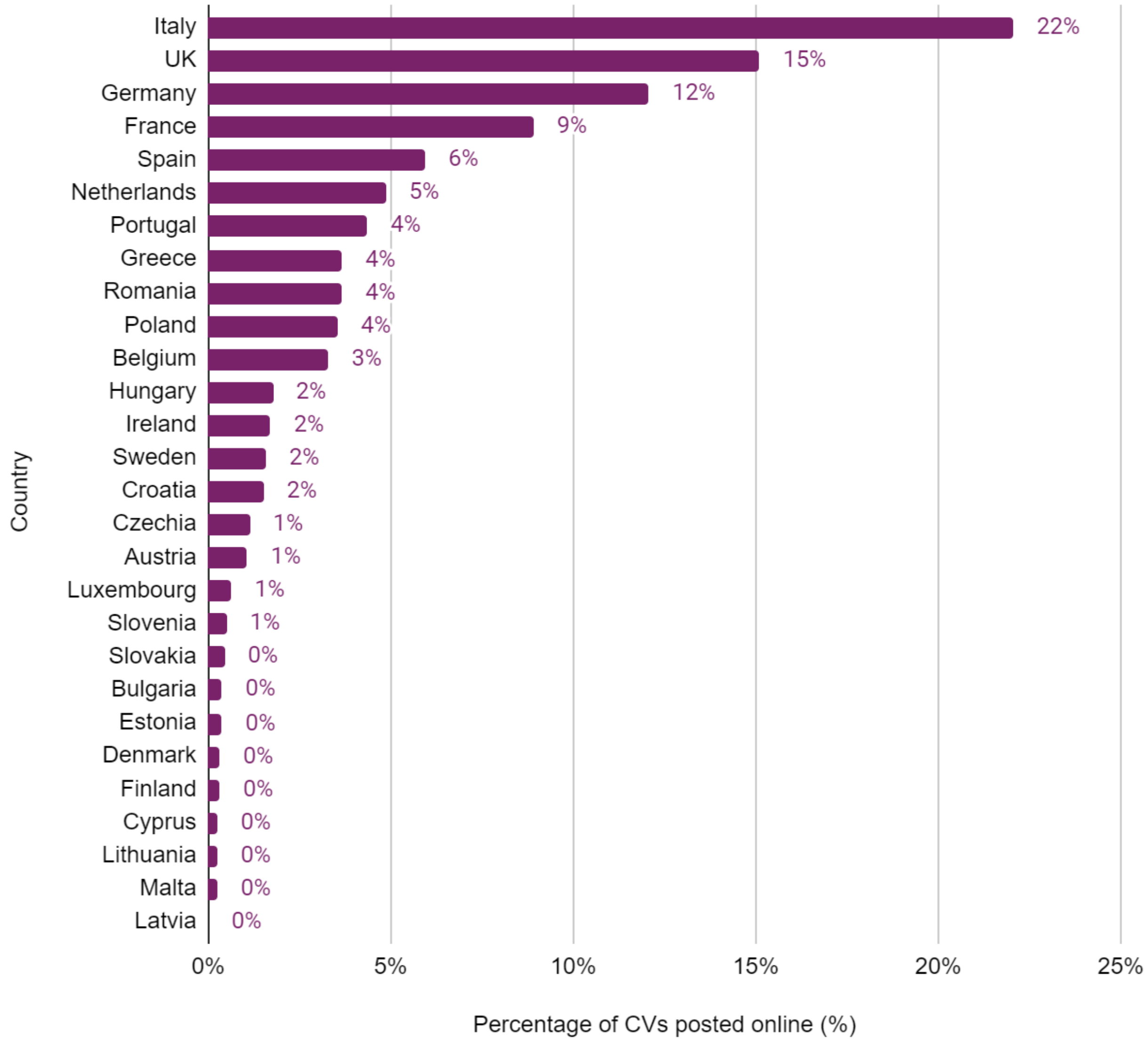

Figure 16: Percentage of CVs posted by country (n=1,392).

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3.4.1.3 Job adverts

We also analysed job postings data from LinkedIn Talent Insights over the past 12 months. The top five countries for space sector job postings were Germany, France, the UK, Italy, and the Netherlands, which together represented 78% of all jobs posted on LinkedIn Talent Insights within the last year.

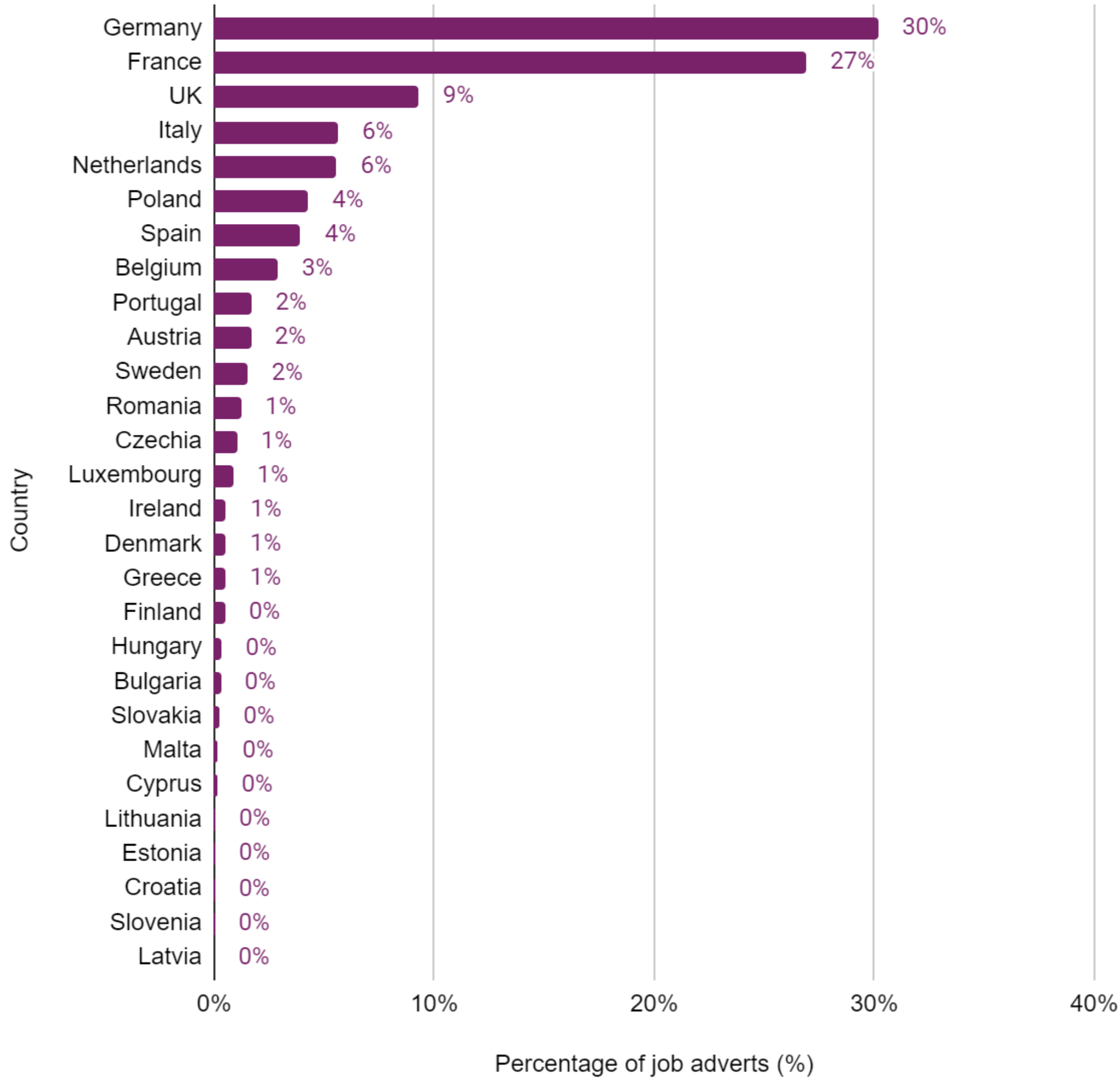

Figure 17: Percentage of job adverts posted by country (n=42,084).

3.4.1.4 Summary

Although we must be careful when comparing different datasets and sources, several patterns emerged from this data, particularly in the relationship between the number of employees, jobs posted, and CVs submitted. The data reflects a correlation between countries with larger space workforces and those posting more CVs

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and job opportunities. However, notable discrepancies, particularly in France, Germany, Italy, and the UK, highlight imbalances in the supply and demand of talent in the sector.

France accounted for the greatest proportion of employees and jobs posted. About one fifth of employees and a quarter of jobs in the European space sector are based in France. However, only 9% of CVs posted online on Space-Careers.com and Space Individuals were from France. This could suggest that while there is a high demand for talent in France, there may be a shortage of professionals actively seeking or posting their CVs, indicating that the country is hiring more people than there are candidates available.

Similarly, Germany had 12% of employees and 12% of CVs posted, yet 30% of the jobs posted on LinkedIn were from there. This indicates a similar trend to France, where demand for workers is high, but the supply of active job seekers posting CVs may not match the volume of available positions.

By contrast, Italy posted 22% of CVs despite having only 10% of the workforce and 6% of the jobs. This suggests that Italy has a relatively higher supply of professionals in the space sector compared to the number of available jobs, indicating a surplus of talent.

Like Italy, the UK had 23% of the workforce, but only 9% of the jobs posted and 15% of CVs. This suggests that there is an oversupply of talent in the UK relative to the number of job opportunities, with more professionals seeking roles than there are vacancies available. The UK's Space Sector Skills Survey 2023[5] found that there is an oversupply of graduates, which could align with our findings.

3.4.2 Workforce growth

We used LinkedIn Talent insights to understand workforce mobility trends and migration in the EU27+UK space sector in the 12 months between May 2024 and May 2025.

[5] Space Sector Skills Survey 2023, GOV.UK, 2023, https://www.gov.uk/government/publications/space-sector-skills-survey-2023

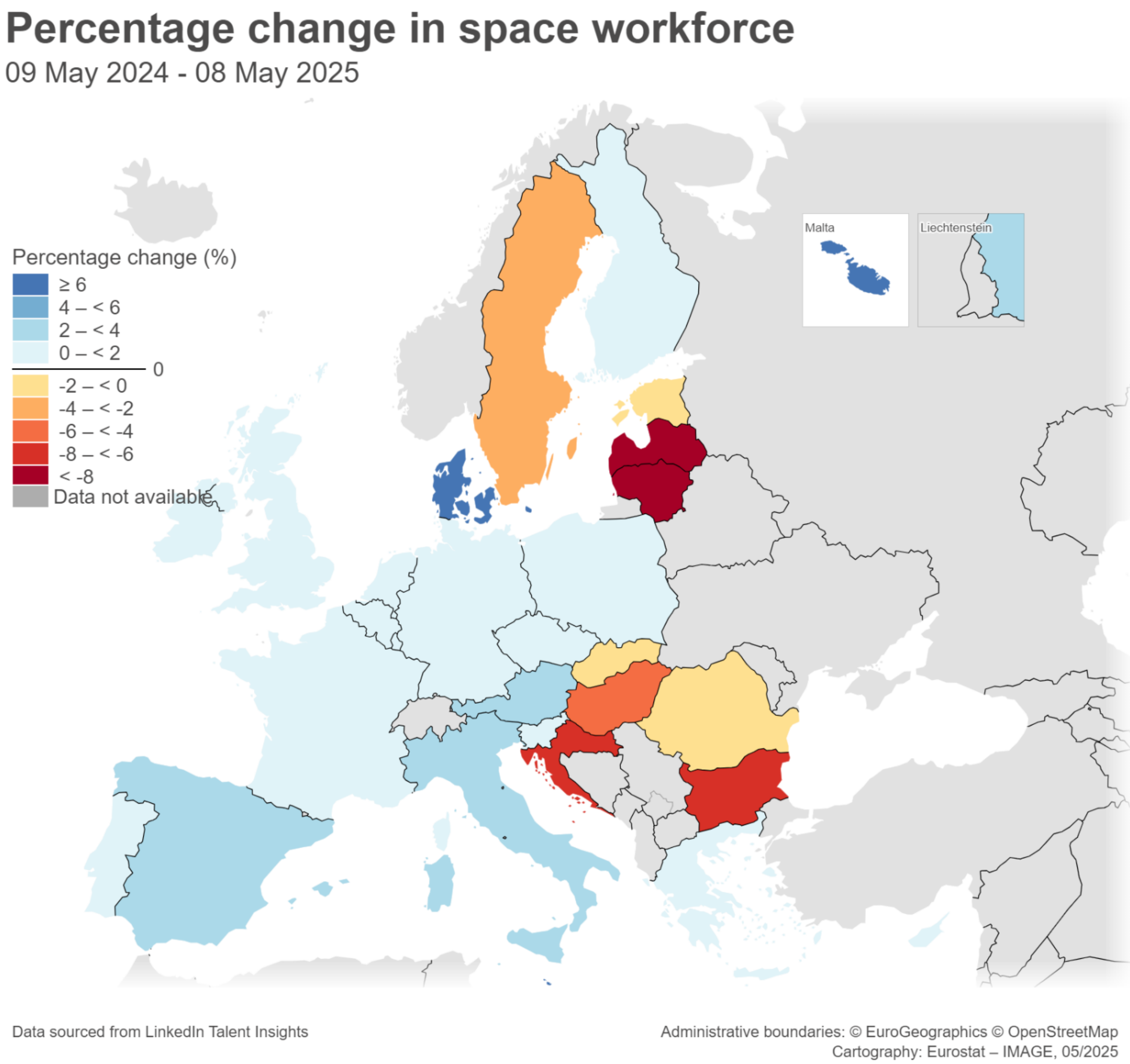

Figure 18: Percentage change in space workforce by country. Results also displayed in Table 1.

Analysis of percentage changes in the space workforce across European countries shows growth and decline across different nations. Most countries have experienced very modest growth of about 1% or stagnation. Some countries, such as Denmark (+8%), Malta (+8%), Italy (+4%), and Spain (+3%) showed an increase. This may be the result of targeted investment, a growing demand for skills as companies expand, or favourable labour market conditions for space professionals.

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Conversely, some nations, typically in Eastern Europe, have experienced workforce declines. Lithuania (13%), Latvia (-9%), Croatia (-6%), Bulgaria (-6%), and Hungary (-4%), show the largest percentage decreases in space sector employment. These trends may reflect the political landscape, economic pressures, outmigration of skilled workers, or limited domestic opportunities in the space industry.

We should caution that due to the small size of some countries' space workforces, even a small number of people leaving the workforce can make a significant change.

3.4.3 Geographic movement

We can use the same LinkedIn Talent Insights dataset to look at workforce mobility on a country-by-country basis and identify movements between countries.

Country	Lost talent to	Gained talent from	Total workforce	12-month workforce growth (%)	Workforce net gain or loss	Estimated workforce growth from migration (%)
Austria	Germany	Germany	2,391	-2%	149	7%
Belgium	France	France	7,224	2%	1478	26%
Bulgaria	Germany, Belgium	Germany	461	-6%	27	6%
Croatia	Germany	UK	220	-6%	-24	-10%
Cyprus	UK	UK	484	0%	94	24%
Czechia	Belgium	Slovakia	1,263	0%	47	4%
Denmark	Germany	UK	1,609	8%	8	0%
Estonia	Belgium, Finland	Belgium, France, UK	375	-1%	15	4%
Finland	Belgium	Germany	3,653	1%	16	0%
France	Belgium	Morocco	38,769	0%	96	0%
Germany	India	India	21,836	1%	951	5%
Greece	Belgium	UK	1,291	1%	-116	-8%
Hungary	Germany	Germany, US	477	-4%	-82	-15%
Ireland	UK	India	1,124	2%	-16	-1%
Italy	Belgium	UK	17,372	4%	-347	-2%
Latvia	Germany	Germany	52	-9%	-2	-4%
Lithuania	Belgium	India	203	-13%	-7	-3%
Luxembourg	Belgium	France	1,872	1%	566	43%
Malta	Netherlands	Philippines	86	8%	5	6%

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Netherlands	Belgium	India	10,503	1%	548	6%
Poland	Germany	UK	3,015	1%	39	1%
Portugal	Belgium	Brazil	2,804	1%	-138	-5%
Romania	Germany	UK	2,341	-1%	-19	-1%
Slovakia	Czechia	Czechia	464	-2%	-33	-7%
Slovenia	Belgium	US	192	1%	-2	-1%
Spain	Germany	Germany	15,811	3%	97	1%
Sweden	India	India	3,939	-3%	-59	-1%
UK	India	India	42,153	0%	39	0%
EU27 & UK	-	-	181,984	1%	-	2%

Table 19: Migration trends from LinkedIn Talent Insights[6].

According to LinkedIn Talent Insights, there was 1% growth in the number of workers in the EU-27 and UK space sector in the previous 12 months, with a 2% growth from migration.

Belgium is a key talent magnet, with 26% growth from migration, and being the primary draw of talent from ten countries while primarily contributing workers to only one. This aligns with Belgium's growing workforce figures and may be influenced by Brussels' prominence in European space institutions. Because growth of the overall workforce is much lower than the growth from migration, it suggests that much of the existing space workforce in Belgium is either leaving the sector, migrating to other countries, or retiring. Similarly, Luxembourg has seen a 43% growth from migration, but only a 1% growth in the total workforce.

Germany exhibits a similar trend, with 5% growth from migration and 1% total workforce growth. Nine countries primarily lose space sector professionals to Germany, and three countries gain talent from Germany. This suggests strong demand and competitive opportunities within Germany's space industry.

France presents a more complex picture, with almost no growth from migration or in the overall workforce. It is a source of talent for many countries, but only a primary source for Estonia. France's gain from Morocco reflects historical colonial ties and linguistic commonality.

The UK is primarily gaining and losing talent to and from India, although has almost no overall growth from migration or growth overall. Simultaneously, the UK is losing talent to several European nations including Italy, Croatia, Cyprus, Greece, Poland, and Romania. These patterns may be partially attributed to the impacts of Brexit and recent changes to immigration policy.

[6] The table shows the size of the workforce, the net loss or gain in talent from abroad, and the percentage net loss or gain from migration. It also shows which country is the greatest source or loss of talent. Data sourced from LinkedIn Talent Insights on 08 May 2025, covering the period 09 May 2024 - 08 May 2025.

Czechia benefits from talent inflows from Slovakia, likely due to geographic proximity and shared history. Similarly, Portugal's history with Brazil, and Malta's ties to the Philippines means that talent is drawn from non-European nations.

In the short term, current trends suggest we may see a continued growth of space sector expertise in the Benelux region, driven by strong inward talent flows and expanding workforce numbers. At the same time, several Southern and Eastern European countries appear to be experiencing a brain drain, with skilled professionals migrating to larger or more established space economies such as Germany and Belgium. Additionally, the data shows a steady import of talent from countries outside Europe, particularly India, indicating a globalised labour market in which European countries are actively competing for international talent.

Looking further ahead, long-term workforce mobility and distribution is much harder to forecast, as they will likely be shaped by broader geopolitical and immigration policy developments that fall outside the control of the space sector.

3.4.4 Supply and demand

3.4.4.1 Demand

To understand the demand of the types of skills in the EU-27 and UK space workforce, we classified the jobs posted on SpaceCareers.uk between 2022 – 2024 against the themes identified in EU-TaSK[7]. Although these roles are mostly UK based, they are likely to be representative enough of the types of jobs posted across the EU-27 and UK.

Around a third of jobs posted were in non-technical roles, classified as business, finance & law (29%), which encompasses all jobs focused on project management, business (such as HR and finance roles), economics, law, policy, and sector support.

The remaining 71% of jobs posted were in technical roles, with software & data (15%) and systems engineering (14%) making up the largest proportion. Aero/mechanical engineering, maintenance, manufacturing & materials, and electronics engineering roles each made up around (9%) of roles. There were very few advertised jobs in space science (3%) or human spaceflight (<1%).

[7] D1.2 European Space Sector Skills Taxonomy, 2024, https://www.astraios.eu/public-deliverables

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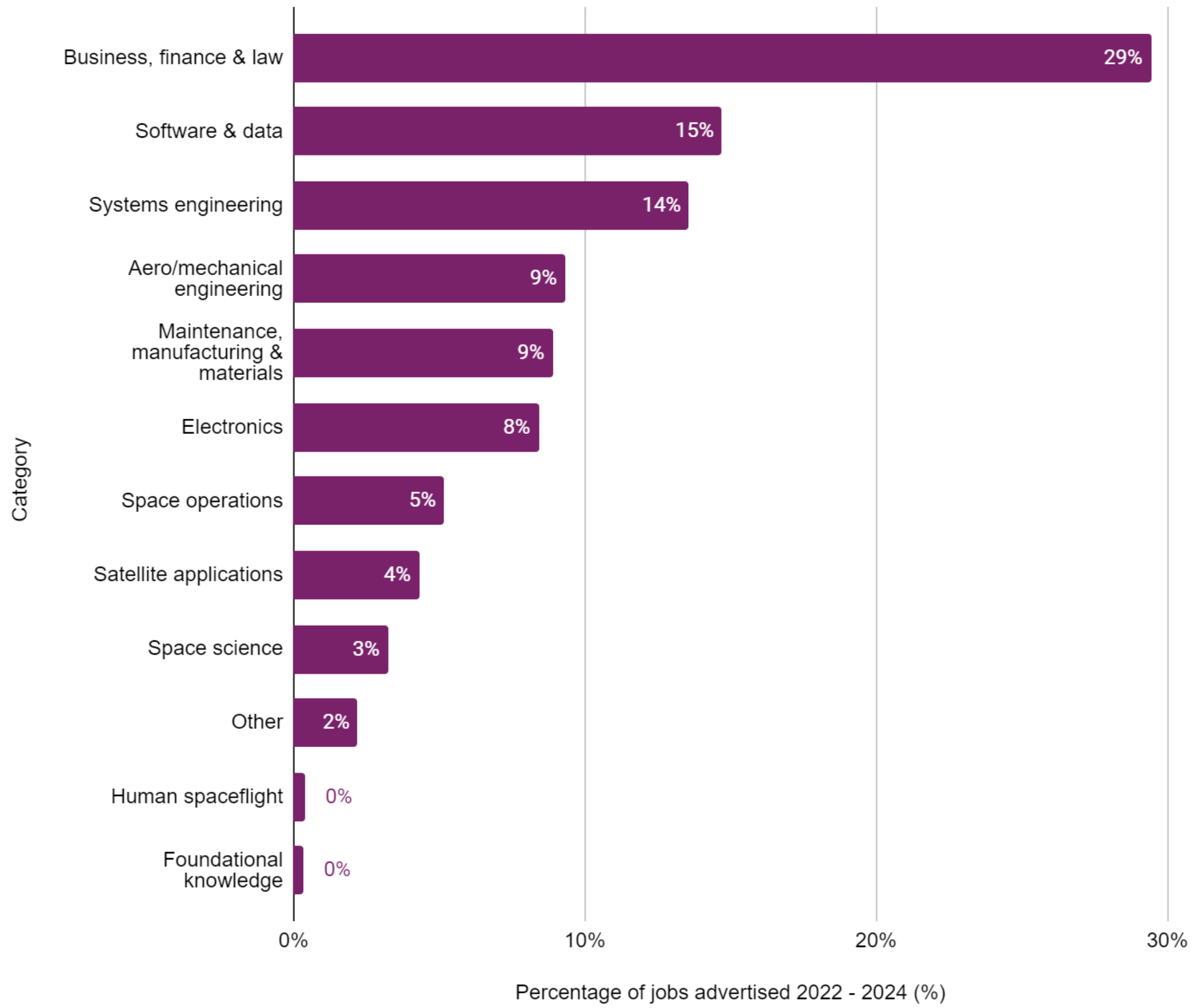

Figure 20: Percentage of jobs posted on SpaceCareers.uk between 2022 – 2024 classified by EU-TaSK theme (n=1,856).

3.4.4.2 Supply

To understand the supply of the types of skills in the EU-27 and UK space workforce, we classified the CVs posted on Space-Careers.com and Space Individuals between 2005 – 2024 against the themes identified in EU-TaSK[8]. CVs were posted from around 90 countries, with the majority being from the EU-27 and UK.

[8] D1.2 European Space Sector Skills Taxonomy, 2024, https://www.astraios.eu/public-deliverables

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Only 12% of CVs posted were from people with primarily non-technical skills, with the remaining 88% being from primarily technical backgrounds. Those with skills in aero/mechanical engineering made up for over a quarter (27%) of CVs posted, followed by software & data (19%), and systems engineering (12%).

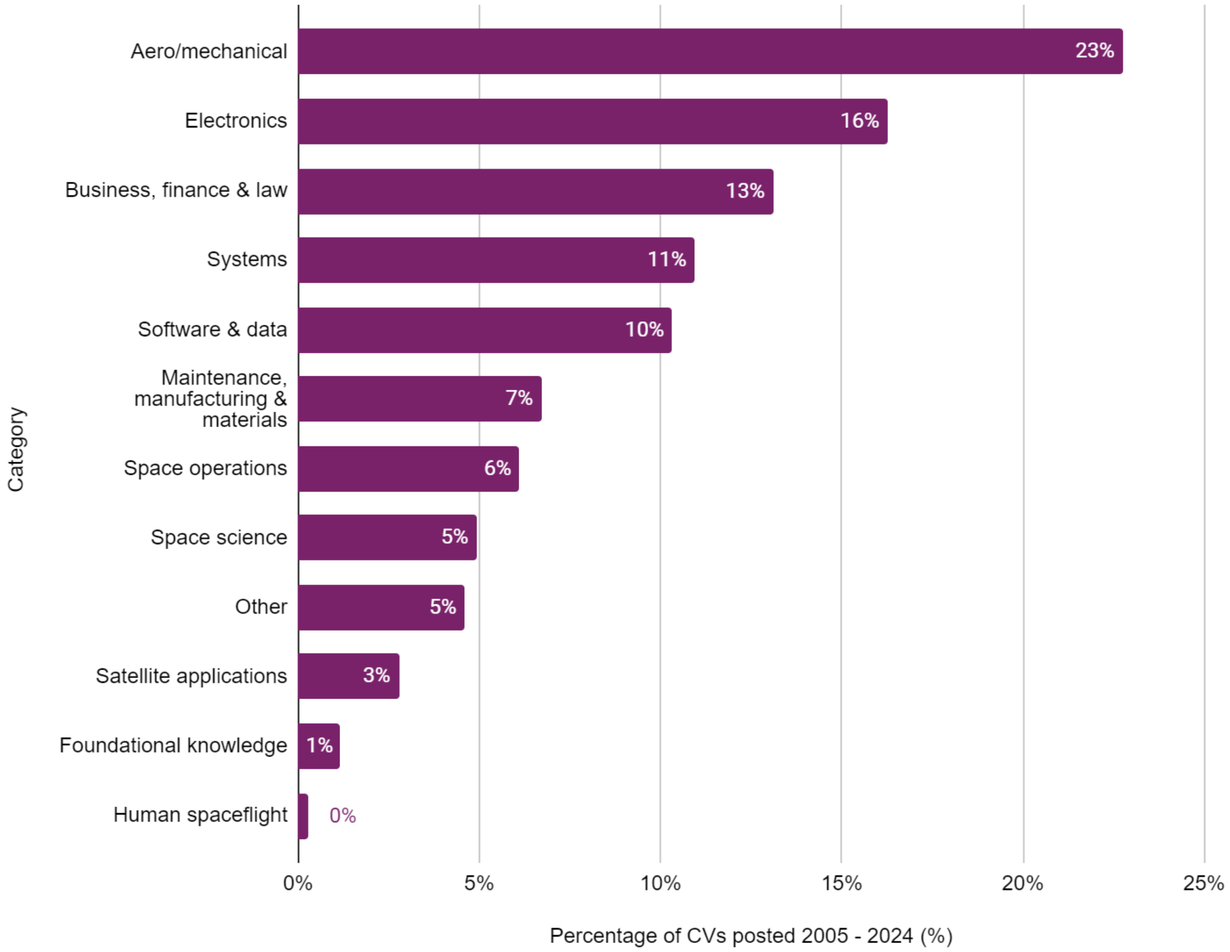

Figure 21: Percentage of CVs posted on Space-Careers.com and Space Individuals between 2005 – 2024 classified by EU-TaSK theme (n=6,477).

3.4.4.3 Comparing supply and demand

To assess the supply and demand of space skills in the EU-27 and UK, we compared the proportion of CVs and jobs posted between 2022 – 2024. Although a rough metric, this allows us to extract some information about the supply and demand of skills.

The proportion of jobs posted compared to CVs is quite closely matched for the themes of software & data, systems engineering, maintenance, manufacturing & materials, electronics engineering, space operations, satellite applications, space science, human spaceflight, and foundational knowledge.

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This comparison suggests that there is generally a balanced supply and demand for most technical space-related skills in the EU-27 and UK. However, there are two notable areas of imbalance that may warrant attention from policymakers, educators, and industry stakeholders.

Between 2022 – 2024, 29% of jobs posted were in non-technical domains (business, finance & law), compared to only 12% of CVs posted. This may be because jobs in non-technical domains may not be advertised on the more technical and space-specific jobs boards. At the same time, 27% of CVs posted were in aero/mechanical engineering, compared to only 9% of jobs.

The significant undersupply of CVs in non-technical domains suggests a potential talent gap that could hinder the commercial and regulatory growth of the space sector. Conversely, the oversupply of candidates in aero/mechanical engineering relative to job availability points to a need for better alignment between educational pathways and labour market demands.

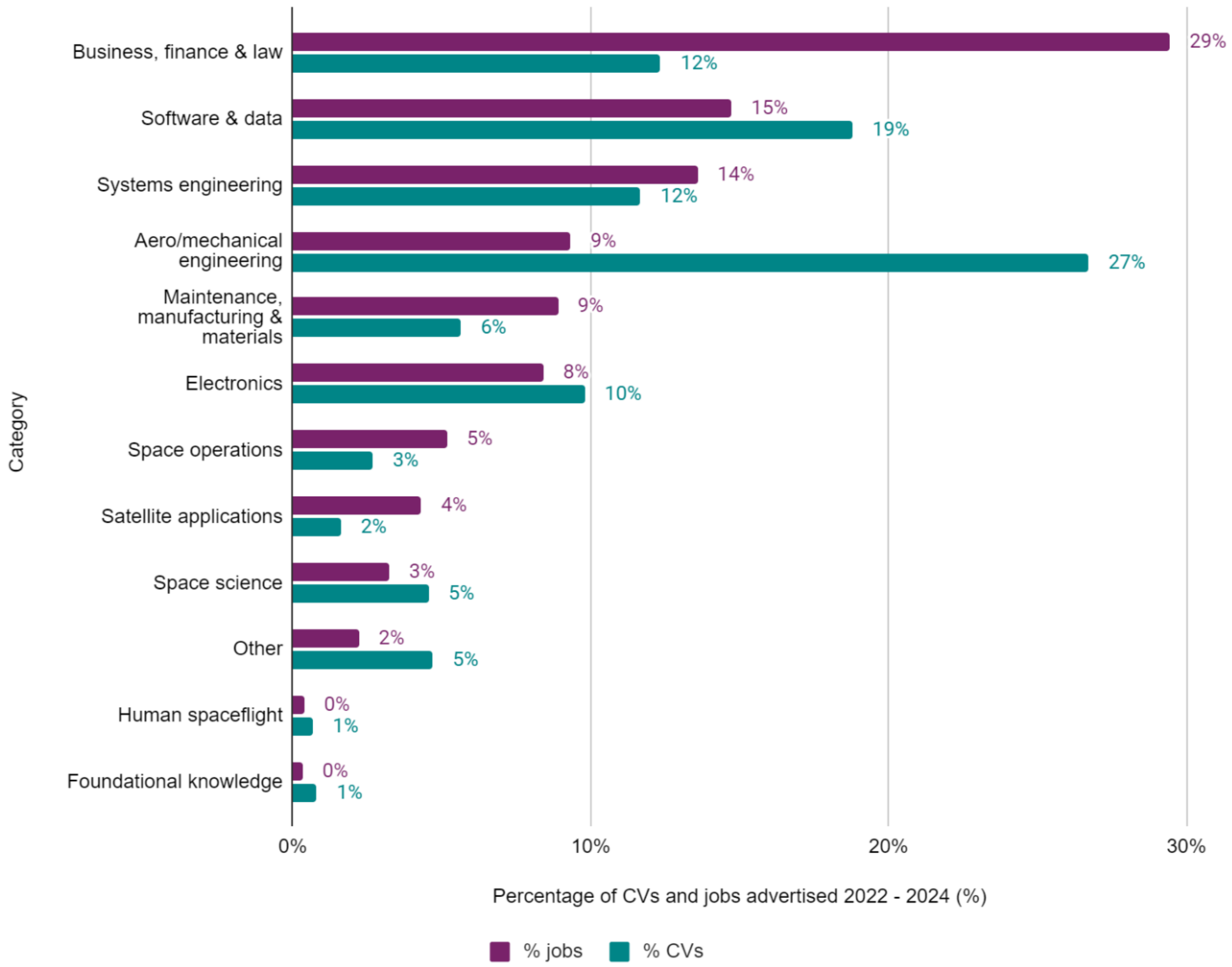

Figure 22: Percentage of CVs posted on Space Individuals and Space-Careers.com (n=745) compared to the percentage of jobs posted on SpaceCareers.uk (n=1,855), between 2022 – 2024, classified by EU-TaSK theme.

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3.4.5 Age profile

To better understand the demographic composition of the space workforce, we analysed age distribution data from multiple sources, focusing on the EU-27 and UK and separately, the UK specifically, due to the big availability of data for the UK. The EU-27 and UK data was sourced from the Eurospace Facts and Figures 2023 report[9] and focuses on the upstream space sector, while UK-specific data came from the Size and Health of the UK Space Industry 2023 report[10] and the UK's Space Census 2024 dataset[11].

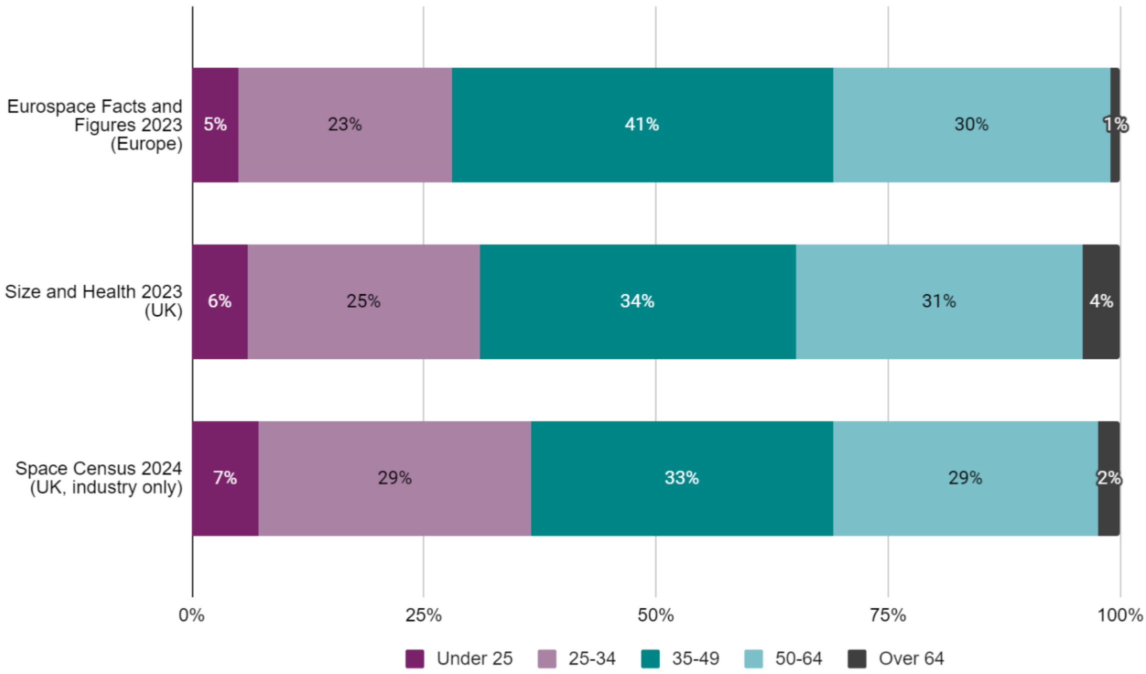

Figure 23: Age breakdown of the European space workforce[12].

Across all datasets, the largest proportion of the workforce falls within the 35–49 age range. However, this cohort is more pronounced in the Eurospace data (41%) than in either UK source (33–34%). Both UK sources report a slightly younger workforce compared to the broader European average. The proportion of workers under 35 is higher in the UK (31–37%) than in the EU-27+UK overall (28%). The proportion of individuals aged 50 and above is similar across datasets. This suggests that the European upstream space sector may have a more mature workforce compared to the UK's overall space sector.

[9] Eurospace Facts & Figures 2023, Eurospace, 2024, https://eurospace.org/publication/eurospace-facts-figures/ (Eurospace data is copyright by Eurospace, all rights reserved, reproduction forbidden.)
[10] The Size and Health of the UK Space Industry 2023, GOV.UK, 2023, https://www.gov.uk/government/publications/the-size-and-health-of-the-uk-space-industry-2023
[11] Unpublished results of the 2024 Space Census, Space Skills Alliance, 2024, https://census.spaceskills.org/
[12] Eurospace data is copyright by Eurospace, all rights reserved, reproduction forbidden.

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Additionally, the age and experience profile of the EU-27+UK workforce remains relatively stable and has been since 2009[13]. This data suggests that there is no evidence of a retirement wave, despite previous warnings across the sector.

[13] Europe's space workforce: Same age, less crisis, SpaceNews, 2018, https://spacenews.com/europes-space-workforce-same-age-less-crisis/

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4. Socioeconomic and Geographical Workforce Demand Evolution by Domain

4.1 Introduction

This section presents an in-depth assessment of the evolving demand for workforce within the European space sector and its geographical distribution across countries and regions. Conducted by PwC, the analysis aims to offer a comprehensive view of the sector's labour dynamics, integrating socioeconomic factors to highlight their implications on regional employment, industrial development, and European competitiveness.

With the space industry undergoing transformation—driven by technological advancements, increasing private sector involvement, and new European strategic priorities—the need to understand workforce trends has become essential. This assessment examines shifts in labour requirements by sector and evaluates the socioeconomic consequences, such as job creation, skills gaps, and opportunities for regional revitalization.

The outcomes of this section will support decision makers and industry leaders by providing actionable insights to ensure sustainable employment growth, regional economic resilience, and alignment of workforce skills with emerging industry needs. By bridging sectoral trends with socioeconomic data, this assessment will contribute to the design of targeted measures aimed at fostering Europe's long-term leadership in space innovation and development.

4.2 Access to Space

The access to space domain is undergoing rapid evolution, driven by the demand for cost-effective, sustainable, and innovative launch solutions. As Europe seeks to maintain strategic autonomy and competitiveness in the global space sector, technological advancements such as reusable rockets, advanced propulsion systems, and lightweight materials are redefining the industry landscape. This section examines key trends within the upstream value chain, including innovations in launcher design, propulsion, and space tourism infrastructure, alongside the critical workforce skills required to support these developments.

The current trends highlight a shift towards reusable and sustainable launch technologies, with an emphasis on reducing costs and improving operational flexibility. As new applications emerge, including suborbital transportation and space tourism, the need for specialized technical expertise in areas such as rocket propulsion, composite materials, and advanced manufacturing has intensified. Additionally, cross-disciplinary skill sets—combining engineering, design, and strategic planning—are becoming essential as the sector diversifies and expands.

The following table provides the list of general skills related to Access to Space and Launchers according to the ESCO skill type taxonomy.

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Value Chain Segment	Area	Item	General Skill	ESCO Skill Type
Upstream	Technology	Super heavy launch vehicles	Launcher Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Kinetic launch system	Launcher Design, Manufacturing, Testing	S7 – constructing
Upstream	Application	European launch autonomy	Launcher Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	LEO launch	Launcher Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Reusable launchers	Launcher Design, Manufacturing, Testing	S7 – constructing
Upstream	Application	3D-printed launcher structures	Additive Manufacturing For Space	S8 - working with machinery and specialised equipment
Upstream	Technology	Stratospheric balloons	Stratospheric Balloons Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Hypersonic spaceplane	Hypersonic Spaceplane Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Aerospike engines	Rocket Engines Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Methalox propellant	Rocket Propulsion Expertise	S8 - working with machinery and specialised equipment
Upstream	Technology	Rotating detonation rocket engine	Rocket Engines Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Carbon-fiber–reinforced plastic	Composite Materials Expertise	S7 – constructing
Upstream	Technology	Reusable rocket engine	Rocket Engines Design, Manufacturing, Testing	S7 – constructing
Upstream	Application	Rocket carriers and launches from a “near-space” environment	Launcher Design, Manufacturing, Testing	S7 – constructing
Upstream	Application	Suborbital flight & ultra-hight speed transportation	Suborbital Vehicles Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Single-stage-to-orbit launch vehicles	Launcher Design, Manufacturing, Testing	S7 – constructing
Upstream	Application	Reusable rockets' propulsion	Rocket Propulsion Expertise	S8 - working with machinery and specialised equipment

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Upstream	Application	Light-weight rocket's upper stage	Launcher Design, Manufacturing, Testing	S7 – constructing
Upstream	Application	Space tourism	Space Tourism Infrastructure Planning	S4 - management skills

The table highlights a diverse set of technologies and applications within the upstream value chain of the access to space domain, emphasizing a concentration on emerging innovations such as reusable launch systems, advanced propulsion methods, and material innovations. Below is an analysis of the industry trends and their corresponding workforce skill demands:

4.2.1 Dominant trends

Shift towards Reusable and Sustainable Launch Systems: Items such as reusable rockets, methalox propellant systems, and reusable rocket engines indicate a growing emphasis on reducing launch costs and increasing operational sustainability.

Skill Need: This trend drives demand for expertise in rocket propulsion systems, advanced manufacturing, and maintenance of reusable machinery.

Advancements in Propulsion Technologies: Propulsion technologies like rotating detonation engines and hypersonic spaceplanes signify a move toward high-efficiency, next-generation propulsion.

Skill Need: Skilled labour in rocket propulsion expertise and specialized testing for high-energy propulsion systems is essential.

Material Innovation for Lightweight and Durable Structures: The inclusion of items like carbon-fiber reinforced plastics and 3D-printed launcher structures underscores the push for stronger yet lighter materials.

Skill Need: Expertise in composite materials and additive manufacturing is increasingly critical as companies integrate these innovations for cost-effective, high-performance designs.

Expansion of Space Tourism and Suborbital Transportation: Space tourism infrastructure and suborbital high-speed transportation reflect the sector’s growth beyond government and traditional commercial launches to private and recreational markets.

Skill Need: In addition to technical skills in launcher design and manufacturing, new applications will require management and infrastructure planning to support evolving business models.

4.2.2 Specific skill categories and their industry relevance

S7 – Constructing: The predominant ESCO skill type indicates that most activities related to access to space depend on engineering design, manufacturing, and testing capabilities.

Key Implications: These general skills are foundational, but specialization in areas like propulsion, aerodynamics, and material sciences is growing due to innovation-driven needs.

S8 – Working with Machinery and Specialized Equipment: Required for tasks related to complex assembly, maintenance, and integration, such as aerospace engines and additive manufacturing.

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Trend Implication: As technologies like reusable systems grow, maintaining and refurbishing complex equipment will require specialized knowledge.

S4 – Management Skills: As seen in space tourism infrastructure planning, strategic management, and business development skills are increasingly important as the industry diversifies into commercial sub-segments.

4.2.3 Anticipated shifts and gaps

Cross-Disciplinary Integration: The convergence of materials science, advanced propulsion, and space infrastructure demands broader skill sets that combine mechanical, aerospace, and systems engineering.

Emerging Gaps: Areas such as hypersonic spaceplane design and additive manufacturing may face short-term skill shortages, as these require advanced technical expertise and experience with novel technologies.

4.2.4 Regional implications

Regions with established aerospace clusters, such as Occitanie and Bavaria, are likely to maintain leadership due to their existing skill bases and manufacturing ecosystems. However, regions that strategically invest in additive manufacturing and reusable system maintenance capabilities could capture new opportunities.

4.2.5 Macro-impacts of Access to Space

European leadership: Europe, led by key players like ArianeGroup and national space agencies (e.g., CNES, DLR), maintains strong leadership in developing launch vehicles through programs such as Ariane and Vega. While the U.S. and China remain dominant, Europe is recognized globally for reliability and technical expertise.

Industry competitiveness: Europe faces growing competition from emerging private launch providers, especially from the U.S. (SpaceX, Rocket Lab) and India. To enhance its competitiveness, Europe is supporting startups like Isar Aerospace and PLD Space to complement traditional players.

European independence and sovereignty: The Ariane 6 program is critical to ensuring Europe's autonomous access to space, reducing dependency on non-European launch services. However, delays in launch schedules highlight risks to maintaining full independence.

International collaboration & space diplomacy: Europe is an active participant in international collaborations, including launching scientific payloads for global missions. Agreements with agencies like NASA and emerging collaborations with African nations strengthen diplomatic ties through space.

> To support the evolving demands of the access to space domain, workforce development strategies should emphasize specialized training in propulsion, composite materials, and sustainable launcher systems. Investments in cross-sector collaboration between industry, academia, and regional programs will be key to addressing emerging skill gaps and ensuring the continued growth of Europe's competitive edge in space.

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4.3 SatCom

The satellite communications (SatCom) domain is experiencing rapid technological advancements, with shifts driven by increasing demand for high-speed connectivity, secure communications, and integration with terrestrial networks. The attached table outlines a comprehensive range of technologies, services, and applications across the upstream, midstream, and downstream value chains, highlighting key trends and the corresponding skills required to support the growth of this critical sector.

Value Chain Segment	Area	Item	General Skill	ESCO Skill Type
Upstream	Technology	Optical communication/inter-satellite communication	Optical Communication Systems Design	S1 - communication/collaboration/creativity
Upstream	Technology	Flexible satellites	Spacecraft Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Electronically steered antenna	Spacecraft Subsystems Design, Manufacturing, Testing	S1 - communication/collaboration/creativity
Upstream	Technology	Very High Throughput Satellites (VHTS)	Spacecraft Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Satellites based on Quantum Key Distribution (QKD)	Quantum Communication Systems Design	S1 - communication/collaboration/creativity
Midstream	Application	Space & ground network optimization	Optimizing Space and Ground Network Connectivity	S1 - communication/collaboration/creativity
Downstream	Application	Broadband and mobile connectivity	Radio Frequency Engineering	S1 - communication/collaboration/creativity
Upstream	Technology	Adaptive digital beamforming and channelization with power and spectrum control	Adaptive Digital Beamforming and Channelization Expertise	S5 - working with computers
Upstream	Technology	Quantum communication network	Quantum Communication Systems Design	S1 - communication/collaboration/creativity
Downstream	Service	In-flight entertainment & connectivity (IFEC)	IFEC Systems Integration	S1 - communication/collaboration/creativity
Downstream	Service	Maritime infrastructure & crew connectivity	Maritime Satellite Communication Systems Integration	S1 - communication/collaboration/creativity

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Downstream	Service	Data-relay	Inter-satellite Network Management	S1 - communication/collaboration/creativity
Downstream	Service	Communication on the move (COTM)	COTM Systems Integratoin	S1 - communication/collaboration/creativity
Downstream	Service	Aeronautical connectivity	Aeronautical Network Management	S1 - communication/collaboration/creativity
Downstream	Service	Crisis management	Satellite Network Resource Allocation	S1 - communication/collaboration/creativity
Downstream	Service	Government/military communication	Secure Communications Protocols and Encryption	S1 - communication/collaboration/creativity
Midstream	Technology	Optimized video software solutions	Development of Optimized Video Software	S5 - working with computers
Midstream	Technology	DVB-S2 (Digital Video Broadcasting - Satellite) and HEVC standards (High Efficiency Video Coding)	HEVC Expertise	S5 - working with computers
Midstream	Technology	5g Non-Terrestrial Network (NTN) & Orthogonal Frequency Division Multiplexing (OFDM)	5G NTN Network Architecture	S1 - communication/collaboration/creativity
Midstream	Application	Satellite-based high-precision geo-tagged live video compression and streaming	Data Processing Expertise	S2 - information skills
Midstream	Application	Video applications (DTH, broadcasting, OUTV)	Satellite Broadcasting Expertise	S1 - communication/collaboration/creativity
Midstream	Application	Interconnectivity with terrestrial 5g networks	5G NTN Network Architecture	S8 - working with machinery and specialised equipment
Midstream	Application	Satellite-enabled devices	Satellite-enabled Devices Design, Manufacturing, Testing	S8 - working with machinery and specialised equipment
Midstream	Application	Direct-to-device communication	Direct-to-device Network Architecture	S8 - working with machinery and specialised equipment
Downstream	Service	Satellite TV (UHD)	Satellite Broadcasting Expertise	S1 - communication/collaboration/creativity

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Midstream	Service	Satellite backhaul for 5g	5G NTN Network Architecture	S8 - working with machinery and specialised equipment
Midstream	Service	Satellite broadband services	Satellite Internet Expertise	S1 - communication/collaboration/creativity
Midstream	Service	Interoperability and roaming between networks	Satellite Communications Protocols and Standardization Expertise	S1 - communication/collaboration/creativity
Midstream	Technology	Multi carrier satellite gateway	Multi-Carrier Satellite Gateway Integration	S1 - communication/collaboration/creativity
Midstream	Technology	Edge computing both in-space & on ground	Edge Computing Expertise	S5 - working with computers
Midstream	Application	End-to-End multimedia integrated support, including OTT integration	End-to-End Multimedia Integration	S1 - communication/collaboration/creativity
Midstream	Application	Multi-stream reception and transmission	Multi-Stream Satellite Communication Network Management	S1 - communication/collaboration/creativity
Midstream	Application	In-orbit data processing	In-orbit Data Processing Expertise	S2 - information skills
Midstream	Application	Real-time and autonomous identification of efficient/best-fit communication links across multiple-orbits & terrestrial networks	Machine Learning Expertise	S5 - working with computers
Downstream	Service	Direct To-Home (DTH) video delivery	Satellite Broadcasting Expertise	S1 - communication/collaboration/creativity
Downstream	Service	Direct-To-Tower (DTT) video & audio delivery	Satellite Broadcasting Expertise	S1 - communication/collaboration/creativity
Downstream	Service	Live, on-demand OTT distribution	Satellite Broadcasting Expertise	S1 - communication/collaboration/creativity
Downstream	Service	End-to-End managed network services	End-to-End Network Management	S8 - working with machinery and specialised equipment

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4.3.1 Dominant trends in SatCom

Next-Generation satellite systems: Items such as optical inter-satellite communications, flexible satellites, and very high-throughput satellites (VHTS) reflect ongoing improvements in satellite design for higher capacity, flexibility, and low-latency communication.

Skill Needs: Demand is rising for skills in spacecraft design, manufacturing, and testing as well as optical communication systems design, which are crucial for next-generation satellite deployment.

Focus on IRIS²

The Infrastructure for Resilience, Interconnection, and Security by Satellite (IRIS²) initiative is poised to significantly influence Europe's satellite communications (SatCom) job market. With a substantial investment of €10.6 billion, IRIS² aims to establish a constellation of 290 satellites, enhancing secure and high-speed connectivity across the continent.

Job creation and skill development:

Engineering and Manufacturing: The design and production of the IRIS² satellite constellation will necessitate a skilled workforce in aerospace engineering, satellite manufacturing, and systems integration. This demand is expected to generate numerous engineering roles and stimulate advancements in related technologies.

Ground Infrastructure and Operations: Developing the supporting ground infrastructure and managing satellite operations will create positions in network engineering, operations management, and maintenance, ensuring the seamless functionality of the satellite network.

Cybersecurity and Data Analysis: Given IRIS²'s focus on secure communications, there will be a heightened need for cybersecurity experts to safeguard data transmissions, as well as data analysts to manage and interpret the vast amounts of information relayed by the satellites.

Stimulating the European space industry:

Industry Growth: The IRIS² project is anticipated to invigorate the European space sector, fostering innovation and encouraging the emergence of new companies and startups specializing in satellite technology and related services.

Competitive Edge: By developing its own satellite constellation, Europe aims to reduce reliance on non-European services, such as SpaceX's Starlink, thereby enhancing its strategic autonomy in space-based communications.

Secure and quantum-enhanced communications: Technologies such as quantum key distribution (QKD) and secure military/government communications highlight growing concerns around cybersecurity and secure data exchange.

Skill Needs: Specialized expertise in quantum communication systems, secure protocol development, and cryptography is critical for ensuring robust secure satellite networks.

5G Non-Terrestrial Networks (NTN) and terrestrial integration: Applications such as satellite backhaul for 5G and direct-to-device networks reflect the trend toward integration of SatCom with 5G to deliver global connectivity.

Skill Needs: Experts in 5G NTN architecture and satellite-enabled device design are required to develop solutions for seamless satellite-terrestrial connectivity.

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Emerging applications in Data Processing and Edge Computing: Technologies such as in-orbit data processing, edge computing, and autonomous identification of optimal links across networks demonstrate the growing role of data-driven technologies in enhancing network efficiency and reducing latency.

Skill Needs: There is increasing demand for machine learning, in-orbit processing expertise, and edge computing architecture to support these intelligent, autonomous systems.

Multimedia and OTT distribution services: The rise of satellite-enabled video applications, direct-to-home (DTH) broadcasting, and over-the-top (OTT) multimedia services demonstrates SatCom's role in delivering high-quality media content globally.

Skill Needs: Expertise in satellite broadcasting, multimedia integration, and network management is essential for managing end-to-end content delivery.

4.3.2 Specific Skill Categories and Their Relevance

S1 – Communication/Collaboration/Creativity: Predominantly listed across multiple technologies, this skill highlights the importance of collaborative work in SatCom, particularly in system design, integration, and network optimization.

S5 – Working with Computers: Found in applications related to data processing, software optimization, and machine learning, this skill type underlines the growing reliance on software-driven innovations within SatCom.

S8 – Working with Machinery and Specialized Equipment: Essential for technologies such as satellite-enabled devices and spacecraft manufacturing, this skill emphasizes the hands-on expertise needed for system development and maintenance.

4.3.3 Emerging Gaps and Future Skill Needs

Advanced system integration: With SatCom expanding into complex domains such as 5G integration, quantum communications, and edge computing, there is a growing need for cross-functional skills combining hardware, software, and network design.

Cybersecurity and Quantum expertise: As secure communications become a priority, expertise in cryptographic protocols and quantum key distribution will be essential. Current skill availability in these areas is limited, potentially creating a short-term gap.

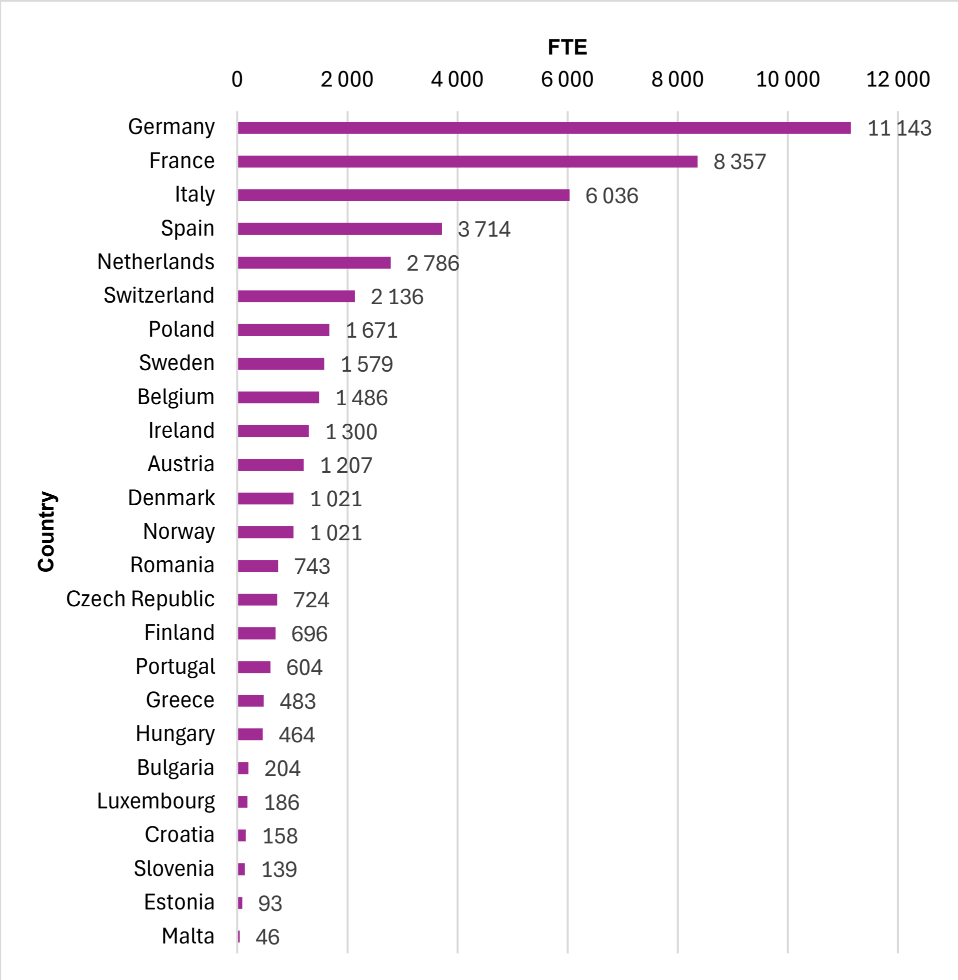
Data and AI-Driven applications: As in-orbit data processing and machine learning gain prominence, technical expertise in AI and big data analytics is expected to be a major area of growth.

4.3.4 Regional and sectoral considerations

The figure below presents the estimated workforce distribution[14] in Europe for the SatCom domain:

[14] PwC Analysis

Figure 24: SatCom domain estimated European workforce distribution in 2023



Regions with established satellite manufacturing ecosystems (e.g., Toulouse, Germany's Bavaria) are well-positioned to maintain leadership in upstream and midstream SatCom activities. However, countries investing in advanced computing, AI, and cybersecurity research could gain competitive advantages in downstream services and applications.

4.3.5 Macro-impacts of SatCom

European leadership: Companies like Eutelsat, SES, and Hispasat have positioned Europe as a global leader in providing satellite broadband, video distribution, and maritime connectivity. The EU's IRIS² programme reinforces Europe's ambitions for space-based internet networks, comparable to SpaceX's Starlink.

Industry competitiveness: Although Europe is competitive in the commercial SatCom sector, the dominance of non-European players such as SpaceX and Amazon in low Earth orbit (LEO) satellite constellations poses a challenge. European innovation in flexible satellites and 5G NTN is critical for maintaining market share.

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European independence and sovereignty: IRIS² plays a strategic role in Europe's digital sovereignty by ensuring secure satellite communications for military and civilian purposes. By reducing reliance on non-European networks, the programme enhances Europe's control over critical infrastructure.

International collaboration & space diplomacy: Through Eutelsat's merger with OneWeb and collaborations in broadband delivery to developing nations, Europe demonstrates leadership in fostering global connectivity. Diplomatic partnerships in regions like Africa highlight Europe's efforts to bridge the digital divide.

The SatCom domain is transitioning from traditional broadcasting toward an integrated, secure, and data-driven network infrastructure. To sustain growth, it will be critical to address skill shortages in emerging technologies, especially those related to 5G integration, quantum communication, and AI-powered data processing. Collaborative industry-academia partnerships and reskilling initiatives will be key to bridging these gaps and securing Europe's long-term position as a leader in satellite communications innovation.

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4.4 Satellite Navigation

The satellite navigation (SatNav) domain, encompassing upstream technology development, midstream services, and downstream applications, is pivotal for precise positioning, geolocation services, and critical safety-related systems. The table below highlights key technological innovations and applications, underlining the diverse and evolving skill needs across the value chain.

Value Chain Segment	Area	Item	General Skill	ESCO Skill Type
Upstream	Technology	Dual frequency (L1/L5 and E1/E5a) GPS + Galileo receiver	GNSS Receivers Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Use of 6 atomic clocks	Precise Time Reference Expertise	S8 - working with machinery and specialised equipment
Upstream	Technology	Dual frequency smart GNSS receivers	GNSS Receivers Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Galileo Second Generation	GNSS Spacecraft Design, Manufacturing, Testing	S7 – constructing
Downstream	Application	Positioning accuracy at the centimetre level	Precise Point Positioning Expertise	S2 - information skills
Downstream	Service	Positioning integrity for safety-critical sectors	Safety-Critical Positioning Expertise	S2 - information skills
Downstream	Service	Low-cost high positioning accuracy for land surveying	Precision Mapping and Surveying Expertise	S2 - information skills
Midstream	Technology	GBAS Approach Service Type F (GAST F)	GBAS Approach Service Type F (GAST F) Expertise	S8 - working with machinery and specialised equipment
Midstream	Technology	L1C	GNSS Signals Expertise	S8 - working with machinery and specialised equipment
Midstream	Technology	M-Code GPS signal	GNSS Signals Expertise	S8 - working with machinery and specialised equipment
Midstream	Application	Robustness against ionosphere and radio disturbances in multifrequency GNSS environment	Multi-frequency GNSS Signal Processing Expertise	S8 - working with machinery and specialised equipment
Midstream	Application	GPS interoperability with other GNSS constellations	GNSS Signals Expertise	S8 - working with machinery and specialised equipment
Midstream	Application	Encrypted signal for military receivers	GNSS Signals Protocols and Encryption	S8 - working with machinery and specialised equipment
Midstream	Service	Aircraft precision approach operations	Precision Approach Expertise	S2 - information skills

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Midstream	Service	High-precision surveying	Precision Mapping and Surveying Expertise	S2 - information skills
Midstream	Service	Secure cryptography architecture	GNSS Signals Protocols and Encryption	S8 - working with machinery and specialised equipment
Downstream	Technology	GNSS-blockchain integration	GNSS-Blockchain Integration Expertise	S5 - working with computers
Downstream	Technology	GNSS chip equipped smartphones	GNSS-enabled Devices Design, Manufacturing, Testing	S7 – constructing
Downstream	Technology	Certifiable on-board localization unit in the railway environment	GNSS Railway Integration	S8 - working with machinery and specialised equipment
Downstream	Application	Geolocation software	Geolocation Software Development	S5 - working with computers
Downstream	Application	Emergency alert transmission	Emergency Geospatial Positioning Expertise	S2 - information skills
Upstream	Technology	GNSS-based multi-sensor fusion architecture	Multi-sensor Fusion Positioning and Navigation System Design	S1 - communication/collaboration/creativity
Downstream	Service	Platforms with automated verification of data trustworthiness	Data Authentification Expertise	S2 - information skills
Downstream	Service	Emergency Warning Satellite Service	Emergency Geospatial Positioning Expertise	S2 - information skills
Downstream	Service	Train control system	GNSS Railway Integration	S8 - working with machinery and specialised equipment

4.4.1 Dominant Trends in Satellite Navigation

Advanced GNSS receiver development: Technologies such as dual frequency GNSS receivers and multi-frequency GNSS signal processing highlight the need for high-accuracy and robust receiver systems for various applications, from smartphones to safety-critical sectors like aviation and rail.

Skill Needs: Expertise in GNSS receiver design, manufacturing, and testing as well as multi-frequency GNSS signal processing is critical to support these advancements.

High-Precision and Safety-Critical positioning: Applications aimed at achieving positioning accuracy at the centimeter level and supporting safety-critical environments (e.g., autonomous vehicles, aviation, and rail) are a major focus.

Skill Needs: Precision mapping and surveying expertise, GBAS (Ground-Based Augmentation System) expertise, and safety-critical positioning expertise are essential for ensuring reliability and performance in critical sectors.

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Secure Navigation systems: Technologies like encrypted navigation services, secure cryptography architecture, and GNSS-blockchain integration reflect the growing emphasis on security, particularly in government and military applications.

Skill Needs: There is a rising demand for professionals skilled in GNSS signal encryption, cryptographic protocols, and blockchain integration to safeguard navigation services from spoofing, jamming, and interference.

Integration of Multi-Sensor Navigation and Data Authentication: As multi-sensor fusion and data verification become integral to SatNav, particularly for autonomous systems, robust integration of different technologies is necessary to ensure accuracy and trustworthiness.

Skill Needs: Skills related to multi-sensor fusion and data authentication expertise are critical, especially for emerging applications like autonomous vehicles and smart transport systems.

4.4.2 Specific Skill Categories and Their Industry Relevance

S7 – Constructing: This category is vital in the design, manufacturing, and testing of GNSS receivers, spacecraft systems, and enabled devices, reflecting its importance in upstream and midstream development.

S8 – Working with machinery and specialized equipment: Applicable to GNSS receiver design, spacecraft, and signal processing tasks, this skill type underlines the technical, hands-on expertise needed for hardware-related tasks in positioning and navigation.

S2 – Information skills: Central to downstream applications such as geolocation software and precision mapping, information skills are critical for tasks involving data processing and mapping.

S5 – Working with computers: Particularly relevant to secure cryptographic architectures and blockchain integration, this skill category supports emerging needs in secure and encrypted navigation systems.

4.4.3 Emerging Gaps and Future Skill Needs

Cross-Disciplinary expertise in navigation systems: As SatNav integrates more technologies (e.g., GNSS, sensor fusion, and blockchain), engineers and software developers will require cross-functional training to support development and integration.

Cybersecurity and signal encryption: The emphasis on security is driving demand for professionals skilled in cryptographic methods, but there is a limited talent pool available, particularly for advanced GNSS encryption and blockchain integration.

Data authentication and trustworthy navigation: With emerging autonomous applications, expertise in verifying data authenticity and ensuring positioning accuracy will be increasingly vital.

4.4.4 Regional and Sectoral Considerations

Regions with a strong aerospace and defense presence, such as Occitanie (France) and Bavaria (Germany), are likely to benefit from their existing expertise in GNSS and satellite systems. Countries investing in secure navigation and digital infrastructure will capture growth opportunities in secure, precision-based applications.

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4.4.5 Macro-impacts of Satellite Navigation

European leadership: The Galileo constellation provides Europe with its own independent and highly accurate global positioning system, comparable to GPS (U.S.) and BeiDou (China). Galileo is recognized for offering superior accuracy, particularly in urban and challenging environments.

Industry competitiveness: Europe's lead in civil-focused GNSS services is well-established, but future competitiveness depends on integrating Galileo into emerging technologies such as autonomous vehicles and IoT. U.S. dominance in chipset manufacturing remains a challenge.

European independence and sovereignty: Galileo is a cornerstone of European sovereignty, ensuring that Europe does not depend and rely on foreign GNSS systems for defense, critical infrastructure, and commercial applications. However, maintaining operational independence requires continuous investments in upgrades and security.

International collaboration & space diplomacy: Europe collaborates extensively with global satellite navigation networks to ensure compatibility and interoperability. Diplomatic agreements with regions such as Africa and Asia aim to extend Galileo's influence and expand adoption internationally.

> The Satellite Navigation domain is undergoing rapid innovation, with a clear focus on precision, security, and integration with advanced systems like autonomous vehicles and IoT. Addressing skill gaps in cybersecurity, signal encryption, and multi-sensor integration will be crucial to sustaining growth and enabling Europe to maintain its leadership in navigation technology. Collaboration between industry, academia, and governments will be key to fostering the workforce development needed to meet future challenges.

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4.5 Earth Observation

The Earth Observation (EO) domain is rapidly expanding, driven by advancements in satellite technology, AI, data processing, and geospatial applications. The following table outlines key innovations and applications across upstream, midstream, and downstream segments, highlighting critical skill areas essential for meeting the sector's evolving demands.

Value Chain Segment	Area	Item	General Skill	ESCO Skill Type
Upstream	Technology	Meteosat Third Generation Sounder (MTG-S) satellite	Remote Sensing Data Analysis and Interpretation	S2 - information skills
Upstream	Technology	46 MPixels sensors with video acquisition	Sensor Design	S7 – constructing
Upstream	Technology	32 small satellites fleet constellation	Space Systems Engineering	S7 – constructing
Upstream	Technology	Hyperspectral imagery	Hyperspectral Imager Design	S7 – constructing
Downstream	Application	Hourly data on tropospheric constituents over Europe for air quality	Remote Sensing Data Analysis and Interpretation	S2 - information skills
Downstream	Application	Daily global mapping of atmospheric gases	Remote Sensing Data Analysis and Interpretation	S2 - information skills
Downstream	Application	High resolution video of an extremely wide scene	Image Processing Expertise	S2 - information skills
Upstream	Technology	Very high resolution and rapid revisit RS	Space Systems Engineering	S7 – constructing
Downstream	Service	Weather and atmosphere monitoring	Remote Sensing Data Analysis and Interpretation	S2 - information skills
Downstream	Service	Video observation	Remote Sensing Data Analysis and Interpretation	S2 - information skills
Downstream	Service	Real-time commercial data products	Remote Sensing Data Analysis and Interpretation	S2 - information skills
Downstream	Service	Multipurpose hyperspectral data	Remote Sensing Data Analysis and Interpretation	S2 - information skills
Midstream	Technology	Bicubic-downsampled low-resolution image-guided generative adversarial network	Deep Learning Expertise	S5 - working with computers
Midstream	Technology	Efficient hybrid conditional diffusion model	Deep Learning Expertise	S5 - working with computers
Midstream	Technology	Onboard AI	Machine Learning Expertise	S5 - working with computers
Downstream	Technology	Super resolution imagery	Deep Learning Expertise	S5 - working with computers
Midstream	Application	Data processing onboard spacecraft	Data Processing Expertise	S2 - information skills

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Midstream	Service	Remote sensing image enhancement solutions	Image Processing Expertise	S2 - information skills
Midstream	Service	Efficient data transmission with reduced ground-based processing	Data Optimization Expertise	S2 - information skills
Downstream	Application	Integrated AI, cloud, and EO capabilities	Data Fusion Expertise	S2 - information skills
Downstream	Application	Geo-augmented reality	AR-GIS Integration	S5 - working with computers
Downstream	Technology	Copernicus Marine Data Store	Remote Sensing Data Analysis and Interpretation	S2 - information skills
Downstream	Technology	Sentinel Hub QGIS plugin	Data Fusion Expertise	S2 - information skills
Downstream	Application	Digital model of the Earth	Data Fusion Expertise	S2 - information skills
Downstream	Application	Mobile display tools	Geospatial Data Visualization	S2 - information skills
Downstream	Application	Cloud-based open access Sentinels data storage	Data Optimization Expertise	S2 - information skills
Downstream	Application	Graphical interface within Copernicus browser	Geospatial Data Visualization	S2 - information skills
Downstream	Service	Climate monitoring and change prediction	Remote Sensing Data Analysis and Interpretation	S2 - information skills
Downstream	Service	Advanced situational awareness and location information	Geospatial Analysis	S2 - information skills
Downstream	Service	Free marine data and metadata tools, downloads, and post-processing	Data Processing Expertise	S2 - information skills
Downstream	Service	Sentinel data search, integration, and visualization	Sentinel Data Interpretation	S2 - information skills

4.5.1 Dominant trends in Earth Observation

High-Resolution Satellite Imaging and Hyperspectral Sensing: Technologies such as the 46 MPixels sensors, small satellite constellations, and hyperspectral imagery emphasize the push for high-resolution, multi-spectral, and real-time data acquisition to support a wide range of applications, including environmental monitoring, disaster management, and agricultural forecasting.

Skill Needs: Expertise in sensor design, space systems engineering, and hyperspectral imager design is required to drive innovations in satellite hardware and sensor technologies.

AI-Driven Data Processing and Interpretation: EO increasingly relies on AI to process vast amounts of satellite data. Technologies such as onboard AI, low-resolution image-guided generative models, and efficient diffusion models are being deployed to enhance data accuracy and automate interpretation.

Skill Needs: There is strong demand for deep learning expertise, machine learning expertise, and data optimization to improve the speed and precision of EO data analysis.

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Integration of EO Data with Geospatial Platforms: Applications like AR-GIS integration and Copernicus marine data store illustrate how EO data is increasingly fused with other geographic information to deliver actionable insights for climate monitoring, urban planning, and resource management.

Skill Needs: Skills in data fusion, geospatial data visualization, and GIS integration are critical for creating user-friendly geospatial applications.

Efficient Data Transmission and Cloud-Based Processing: EO systems are leveraging cloud-based platforms and real-time processing tools for efficient data management and faster service delivery. Applications like remote sensing enhancement solutions and cloud-based data storage highlight this trend.

Skill Needs: Data processing, data optimization, and remote sensing data interpretation are key to ensuring scalability and efficiency in handling large datasets.

4.5.2 Specific skill categories and their relevance

S2 – Information Skills: Central to downstream applications such as data analysis, climate monitoring, and geospatial visualization, this skill type highlights the need for professionals adept in interpreting and processing EO data.

S5 – Working with Computers: Particularly important for AI, deep learning, and machine learning applications, this category reflects the growing reliance on software and automated solutions for EO data processing.

S7 – Constructing: Critical for upstream development of sensors, satellites, and imaging equipment, this skill type ensures innovations in satellite hardware design and deployment.

4.5.3 Emerging gaps and future skill needs

AI-Enabled Data Analysis: As EO increasingly adopts AI-driven data analysis, there is a growing demand for cross-functional experts with knowledge of both remote sensing and machine learning.

Real-Time and Cloud Processing Expertise: Given the growing reliance on cloud-based platforms for real-time EO data processing, professionals with experience in cloud computing and remote data handling are in high demand.

Geospatial Data Integration: With applications like AR-GIS integration gaining traction, geospatial data specialists who can work across different datasets and formats will be crucial.

4.5.4 Regional and sectoral considerations

The figure below presents the workforce distribution in Europe for the Earth-Observation domain:

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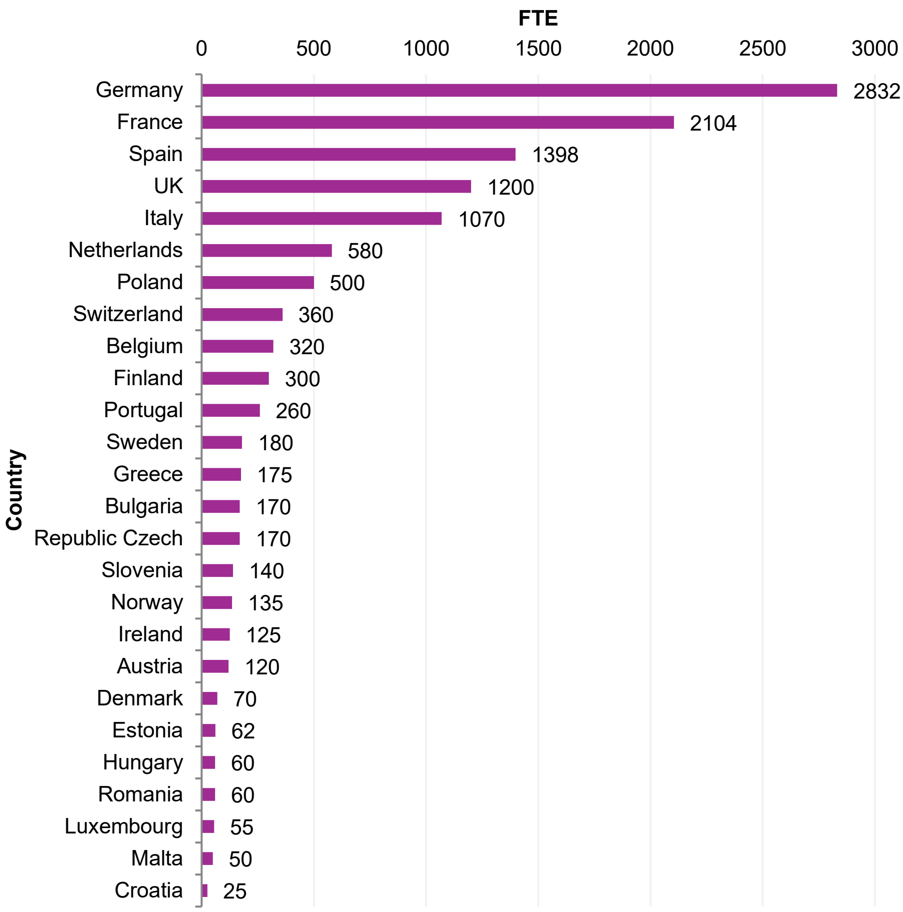
Figure 25: Earth-Observation domain European workforce distribution in 2023[15]



European regions with strong EO research and operational capabilities, such as Germany and France, are expected to maintain their leadership due to established institutions like the European Space Agency (ESA) and Copernicus programs. Emerging markets that invest in AI and cloud technologies will see growth opportunities in EO services and applications.

4.5.5 Macro-impacts of Earth Observation

European leadership: Europe leads globally through its Copernicus program, operated by the European Commission and ESA. The Copernicus Sentinel satellites provide comprehensive Earth observation data, supporting climate monitoring, disaster response, and resource management.

Industry competitiveness: The availability of free and open Copernicus data boosts European startups and SMEs in the EO sector. However, competition is intensifying, especially from commercial data providers like Planet Labs (U.S.) and emerging Asian players.

[15] EARSC (European Association of Remote Sensing Companies), Industry Survey, 2023

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European independence and sovereignty: Copernicus ensures that Europe maintains autonomous access to critical Earth observation data, reducing dependency on foreign satellite networks for monitoring environmental and security-related phenomena. Future investments will focus on enhancing data processing through AI.

International collaboration & space diplomacy: Europe's Copernicus data-sharing agreements with developing nations and its contributions to global climate monitoring demonstrate its leadership in space diplomacy. Collaborative efforts with the United Nations and international scientific institutions reinforce its role in tackling global challenges.

The EO domain is witnessing a technological shift toward high-resolution imaging, AI-driven data processing, and cloud-based integration with geospatial platforms. Addressing skill gaps in AI, data fusion, and real-time data transmission will be critical for sustaining growth. Collaboration between research centers, industry, and government bodies will help foster a workforce capable of driving innovation in Earth observation and its downstream applications.

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4.6 Space Safety

The space safety domain is becoming a vital area of focus as space traffic increases and risks associated with collisions and debris intensify. Key innovations and applications highlighted in the provided table show developments in active debris removal, AI-based detection systems, and collaborative space traffic management. This assessment evaluates the dominant trends and their corresponding skill needs across the upstream, midstream, and downstream segments.

Value Chain Segment	Area	Item	General Skill	ESCO Skill Type
Upstream	Technology	Tow truck spacecraft enabled with vision-based AI	Space Debris Capturing Spacecraft Design, Manufacturing, Testing	S7 – constructing
Midstream	Technology	Combination of SSA software and spacecraft propulsion control	Space Situational Awareness Expertise	S2 - information skills
Downstream	Technology	Open-Architecture Data Repository (OADR)	Open-Architecture Data Repository (OADR) Development and Management	S2 - information skills
Downstream	Technology	AI/ML-based prioritisation and classification of alerts	Artificial Intelligence and Machine Learning Expertise	S5 - working with computers
Upstream	Technology	Advanced radar and telescope system	Radar and Telescope System Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Advanced design standards reducing risk of onboard battery malfunctions	Spacecraft Propulsion Expertise	S8 - working with machinery and specialised equipment
Midstream	Technology	Collaborative AI agents optimizing sensing strategies for object detection	Artificial Intelligence Expertise	S5 - working with computers
Midstream	Technology	Space/ground-based laser nudging mechanisms to safely redirect space debris trajectories	Space and Ground-based Laser Nudging System Development	S7 – constructing
Upstream	Technology	Tethered-Net Removal	Space Debris Capturing Spacecraft Design, Manufacturing, Testing	S7 – constructing
Upstream	Technology	Removal docking plate bus equipment	De-orbiting Mechanisms Design, Manufacturing, Testing	S7 – constructing

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Upstream	Technology	Extra-vehicular general-purpose robotic arm and hand	Robotic Arm and Hand Design, Manufacturing, Testing	S7 – constructing
Downstream	Service	Integrated space mobility subscription	Space Mobility Expertise	S8 - working with machinery and specialised equipment
Downstream	Service	Streamlined space traffic management	Space Traffic Management Expertise	S4 - management skills
Downstream	Service	Warning system for public operators	Space Safety Alert System Development	S1 - communication/collaboration/creativity
Midstream	Application	Advanced algorithms discerning threat levels for potential collisions	Machine Learning Expertise	S5 - working with computers
Midstream	Application	Autonomous EU SST	Space Situational Awareness Expertise	S2 - information skills
Midstream	Application	Space sensor tasking	Space Sensor Tasking Expertise	S8 - working with machinery and specialised equipment

4.6.1 Dominant trends in space safety

Active Debris Removal and De-Orbiting mechanisms: With technologies such as tethered-net removal, tow truck spacecraft with vision-based AI, and space-ground-based laser nudging mechanisms, the emphasis is on minimizing orbital debris and ensuring safer orbits for existing and future assets.

Skill Needs: There is significant demand for professionals skilled in space debris capturing spacecraft design, de-orbiting mechanisms, and robotic arm development and testing to design and deploy effective debris-removal systems.

AI and Machine Learning for Sensing and Collision Avoidance: AI-enabled applications, such as AI/ML-based alert prioritization and collaborative sensing optimization, focus on predicting, classifying, and responding to potential threats autonomously.

Skill Needs: AI and machine learning expertise, combined with space situational awareness, are critical to develop automated and predictive systems capable of enhancing collision detection and response.

Collaborative Space Traffic Management and Open Data Systems: Technologies such as integrated space traffic management and open-architecture data repositories (OADR) highlight the need for cross-sector data sharing and coordination to maintain safe operations in increasingly congested orbits.

Skill Needs: Skills in space mobility, space traffic management, and open-architecture data repository management are essential for developing scalable and collaborative systems.

Propulsion and battery safety: Reducing onboard risks with innovations in advanced propulsion and energy safety systems is necessary to ensure long-term mission reliability and reduce failure risks in orbit.

Skill Needs: Expertise in spacecraft propulsion systems and onboard safety system design is required to minimize mission risks.

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Emergence of private companies developing space safety solutions

In recent years, the development of space safety solutions has seen significant contributions from private companies, marking a shift from primarily government-led initiatives to a more commercialized approach. These private entities are innovating in areas such as active debris removal, collision avoidance, and space situational awareness (SSA). Their activities are driving new job creation and introducing specialized roles across engineering, AI, and operations.

Key private players and their innovations:

ClearSpace SA (Switzerland): Leading the development of ESA's debris-removal mission, ClearSpace is working on capturing and de-orbiting defunct satellites using robotic arms. The company is pioneering active debris capture systems and de-orbiting solutions. ClearSpace is creating jobs for engineers skilled in robotic mechanisms, spacecraft design, and space traffic coordination.

D-Orbit (Italy): A space logistics company focused on in-orbit servicing, including de-orbiting missions, satellite deployment, and debris management. D-Orbit plays a key role in space sustainability through its ION Satellite Carrier system. D-Orbit's expansion is boosting job creation in satellite propulsion, debris management, and mission integration.

Look Up Space (France): Founded in 2022 by General Michel Friedling and Juan Carlos Dolado, Look Up Space aims to enhance space safety and sustainability by detecting and tracking objects in low Earth orbit (LEO). The company is developing a network of advanced radars to provide accurate and timely space situational awareness data. This initiative is creating opportunities for professionals in radar technology, data analysis, and SSA operations.

Aldoria (France): Established in 2017, Aldoria specializes in providing comprehensive SSA services, offering automated data for collision avoidance to ensure satellite safety. The company focuses on precise tracking and identification of space objects, including debris monitoring and trajectory predictions. Aldoria's growth is generating demand for experts in space surveillance, data processing, and aerospace engineering.

ArianeGroup (France): As a leading European aerospace manufacturer, ArianeGroup is involved in space safety through the development of a network of telescopes (HELIX). The company collaborates on initiatives aimed at reducing space debris and enhancing the safety of space operations. ArianeGroup's projects contribute to job creation in aerospace engineering, safety analysis, and mission planning.

Job market impacts:

Increased demand for specialized engineering roles: The development of robotic mechanisms, propulsion systems, and debris-capturing spacecraft requires engineers specialized in spacecraft design, mechatronics, and de-orbiting mechanisms.

Growth in AI and Data Analytics jobs: Companies like ArianeGroup, Aldoria Space and LookUp Space, rely on advanced algorithms and predictive models for collision detection and space traffic management. This is driving demand for AI specialists, machine learning experts, and data analysts.

Expansion of operations and mission control roles: As private companies take on operational roles previously handled by government agencies, there is increasing demand for professionals in mission control, operational planning, and satellite servicing.

Boost in collaborative opportunities: Private-public partnerships, such as ClearSpace's collaboration with ESA, are generating new positions in project management, policy development, and international coordination.

4.6.2 Specific skill categories and their industry relevance

S7 – Constructing: Required for building spacecraft, de-orbiting systems, and propulsion technologies, reflecting the engineering-intensive nature of space safety solutions.

S5 – Working with Computers: Central to AI, ML, and alert management systems, this skill type highlights the importance of computational and predictive analysis for threat detection.

S2 – Information Skills: Important for managing and analyzing large volumes of situational awareness data and open data repositories.

S4 – Management Skills: Required for coordinating warning systems and ensuring effective space traffic management across international operators.

4.6.3 Emerging gaps and future skill needs

AI-Engineering Cross-Functional Skills: Combining AI expertise with hardware design knowledge is critical for developing predictive sensing systems, creating a growing demand for cross-disciplinary professionals.

Data-Driven Decision-Making and Traffic Management: As data sharing and collaborative management systems expand, experts in data processing and traffic management will be needed to interpret, act on, and coordinate orbital safety.

Propulsion and Debris Capture Innovations: With the increased need for innovative debris removal solutions, engineers specializing in robotic arms, nets, and laser propulsion systems will be in high demand.

4.6.4 Regional and sectoral considerations

European regions with established aerospace industries and strong research networks, such as France, Germany, and Italy, are well-suited to address emerging demands. Collaboration through programs like ESA's Clean Space Initiative will further enhance regional expertise in space safety.

4.6.5 Macro-impacts of Space Safety

European leadership: Europe plays a central role in developing space safety protocols and technologies. ESA's Clean Space Initiative and collaborations with companies like ClearSpace SA and ArianeGroup position Europe at the forefront of active debris removal and space sustainability efforts.

Industry competitiveness: While Europe leads in regulatory and policy development, private companies from the US like LeoLabs, ExoAnalytics, and AGI, dominate the commercial space safety market. However, emerging European startups like ArianeGroup, Look Up Space and Aldoria are enhancing Europe's competitiveness in SSA and debris detection.

European independence and sovereignty: Europe's investments in space situational awareness (SSA) and debris mitigation aim to safeguard its satellite constellations and ensure that its critical assets remain protected from collisions and space debris. EU SST (Space Surveillance and Tracking) is a key component of this strategy.

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International collaboration & space diplomacy: Europe engages in space safety initiatives through partnerships with the U.S., Japan, and international organizations to set global norms for debris management. Diplomatic collaboration through the United Nations' Long-Term Sustainability of Outer Space Activities (LTS) guidelines positions Europe as a leader in responsible space use.

As the space environment becomes more congested, space safety demands will continue to rise, focusing on AI-based alert systems, debris removal technologies, and traffic management solutions. Addressing skill gaps in AI, data management, and propulsion system design will be essential for ensuring sustainable and secure space operations. Industry collaboration with academia and governments will be key to building a resilient and innovative workforce prepared to address future challenges.

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5. CONCLUSIONS

In this report, we have provided a comprehensive overview of the evolution and distribution of workforce demand in the European space sector with a specific focus on the influence of technological trends and industrial transitions. Drawing from a combination of surveying, data analysis, and case studies, it is evident that the sector faces both significant opportunities and structural challenges.

5.1.1 The question of a 'retiring' space generation

The question is whether there currently is a 'retiring' space generation and if yes, if this could lead to succession problems if the next generation is not ready to take over (shortage of people). How can knowledge be transferred between generations? Are there currently any good methods of doing so?

Although the sector has worried about a retirement wave, our analysis shows that most of the workforce is aged 35-49 and the age demographics of the sector have remained relatively stable for the past two decades.

Additionally, our survey data does not indicate the existence of a distinct retiring space generation. Space employees have seniority ages spread over the entire range [0-40] years. Major space companies may have introductory education and/or job specific training (e.g. satellite operations) in place, but most transfer of knowledge and expertise happens on-the-job, in teams with different seniority levels. Some companies provide mentoring for their employees, typically at the moment of entry in the company. The continuity of this mentorship is usually left to the employer's decision.

While there are no strong signs of a retiring generation, mentorship will be important to transfer knowledge to the incoming workforce.

5.1.2 Geographic distribution and mobility

What is the geographic distribution and mobility of the European space sector? Do we have a geographic brain drain in the space sector, both within the EU and in/out of the EU? Is the brain drain sufficiently compensated by brain input from other geopolitical powers?

Because of the high level of education of its workforce and the international nature of the space sector, we found that career mobility is common. This means that space sector workers are likely to change companies and countries, which could cause brain-drains in some nations and brain gains in others. While France, the UK, Germany, Italy, and Spain make up for the majority of the EU-27+UK space workforce, Luxembourg and Belgium are seeing a significant amount of migration, while Eastern Europe experienced loss of space workforce.

However, it appears that the brain drain may be sufficiently compensated by brain input from other geopolitical powers. See paragraph 3.4.3.

5.1.3 Sectorial brain drain

Do we have sectorial brain drain in 'bad' times? (People leaving the space sector for other sectors.) Is the space sector paying sufficiently well to keep the employees in the sector?

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In the same way geographic mobility can cause brain drain and brain gain, there are also risks of sectoral brain drain (talent leaving the space sector) due to financial instability in smaller firms.

In this case, we cannot rely on data from our quantitative survey, but we have some indications[16]. The financial condition, including low profitability of many space SMEs is a point of concern. It may result in career moves which were not driven by positive motivations for other jobs, but rather by lay-offs or mildly forced resignations due to a temporary lack of financial resources.

There are indications that the motivation to stay in the space sector may require some idealism of the space worker when other sectors prove to offer better and more stable personal incomes, especially if the required skills are similar and in high general demand (hardware and software design, AI engineering). However, there is no clear sign that the financial advantage in other sectors has an impact on the space sector.

5.1.4 Emerging supply and demand for skills

The European space sector is highly qualified, with most people holding advanced degrees, and we found that engineering, ICT, and problem-solving were key technical and soft skills needed.

Our analysis of CVs against job adverts suggests that there is generally a balanced supply and demand for most technical space-related skills in the EU-27 and UK. However, there are two notable areas of imbalance that may warrant attention from policymakers, educators, and industry stakeholders: a potential talent gap in non-technical space skills, and an oversupply of candidates with a background in aero/mechanical engineering.

Additionally, critical future technologies such as AI, advanced materials, and autonomous systems will play a pivotal role in shaping future workforce requirements, particularly in R&D, engineering, and high-value manufacturing roles.

However, this means that the space sector will be competing with other highly qualified and highly paid sectors. Demographic shifts, geographic migration, and the evolving education system may impact the availability of appropriately skilled talents.

5.1.5 Brief recommendations and future work

To ensure the sustainability and competitiveness of the European space sector, it is essential to align education and training pathways with future skills needs, promote regional workforce mobility, and support proactive workforce planning at both industry and policy levels.

The findings presented here will inform the upcoming roadmap and strategic recommendations in deliverable D3.5 Final Recommendations report on continuing success of the European Space Sector, contributing to the broader objectives of the ASTRAIOS project in securing a resilient, skilled, and future-ready workforce.

[16] Executive Summary of Study on Economic Importance and Financial Health of the SMEs in the European Space Industry, SME4Space, 2024, https://www.sme4space.org/executive-summary-of-study-on-economic-importance-and-financial-health-of-the-smes-in-the-european-space-industry-2024/

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