TOWARDS A SKILLED EUROPE FOR SPACE INNOVATION

ASTRAIOS

Analysis of Skills, Training, Research and Innovation Opportunities in Space

# D3.5 FINAL RECOMMENDATIONS REPORT ON CONTINUING SUCCESS OF THE EUROPEAN SPACE SECTOR



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## Abstract

This report presents the final set of recommendations developed through the ASTRAIOS project, synthesising evidence from all preceding deliverables to support the long-term success and competitiveness of the European space sector. Drawing on analyses of educational provision (D1.1), the European space knowledge taxonomy (D1.2), workforce demographics (D1.3), sectoral trends and technological developments (D2.1, D2.2), soft skills needs (D2.3), sustainability practices (D2.7), labour-market demand (D2.8), skills mismatches (D3.1), geographical disparities and mobility patterns (D3.2), and equality, diversity and inclusion challenges (D3.3, D3.4), the report consolidates a comprehensive evidence base to inform targeted action.

The recommendations address four stakeholder groups, policymakers, educators and universities, industry professionals, and individuals entering the space workforce, and are designed to strengthen skills pipelines, improve alignment between education and labour-market needs, reduce regional and demographic inequalities, and support sustainable, innovative sector growth. The document serves as the project's concluding synthesis, translating system-wide insights into actionable guidance for shaping Europe's future space workforce ecosystem.

## Keywords

skills development; workforce demand; space education; mobility; demographics; soft skills; EDI; sustainability; taxonomy; knowledge framework; labour-market trends; recommendations;

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## Information Table

| | |
|---|---|
| **Contract Number** | **101082636** |
| **Project Acronym** | ASTRAIOS |
| **Project Title** | Analysis of Skills, Training, Research, And Innovation Opportunities in Space |
| **Topic** | HORIZON-CL4-2022-SPACE-01-72 |
| **Type of Action** | HORIZON-CSA |
| **Start date of project** | 1 January 2023 |
| **Duration** | 36 months |
| **Project Coordinator** | ESF |
| **Version** | 1.4 |
| **Responsible Partner (organization)** | ESF |
| **Actual Date of Delivery** | 22/12/2025 |
| **Dissemination Level** | **PU** |

## Document History

| Version | Date | Status | Author | Description |
|---|---|---|---|---|
| **1.0** | 28.04.2026 | final | Nepheli Kardassi,<br>Mari Kolehmainen | Final version ready for publication |

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## List of Abbreviations

| | |
|---|---|
| AI | Artificial Intelligence |
| BoK | Body of Knowledge |
| CV | Curriculum Vitae |
| EU-TaSK | European Taxonomy of Space Knowledge |
| EARSC | European Association of Remote Sensing Companies |
| EDI | Equality/equity, Diversity and Inclusion |
| EPICUR | Partnership for an Innovative Campus Unifying Regions |
| EO | Earth Observation |
| ESA | European Space Agency |
| ESCO | European Skills, Competences, and Occupations |
| ESG | Environmental, Social and Governance |
| EUCOR | European Confederation of Upper-Rhine Universities |
| EUSPA | European Union Agency for the Space Programme |
| GI | Geographic Information |
| GNSS | Global Navigation Satellite System |
| ISU | International Space University |
| KA | Knowledge Areas |
| KD | Knowledge Domains |
| MOOC | Massive Open Online Course |
| OECD | Organisation for Economic Co-operation and Development |
| R&D | Research & Development |
| SME | Small and Medium-sized Enterprises |

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| | |
|---|---|
| SSA | Space Situational Awareness |
| STEM | Science, Technology, Engineering, and Mathematics |
| UKSEDS | UK Students for the Exploration & Development of Space |
| WPs | Work Packages |

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# 1. INTRODUCTION

This report presents the final consolidated recommendations of the ASTRAIOS project, bringing together the extensive evidence base developed across Work Packages (WPs) 1000–3000 (Figure 1) to support the success, resilience and competitiveness of the European space sector. Its purpose is to integrate findings from earlier deliverables - spanning education and training provision, workforce demographics, labour-market needs, soft skills requirements, geographical and demographic disparities, and sectoral trends - into a coherent set of actionable proposals for stakeholders across policy, education, industry and the wider talent pipeline.

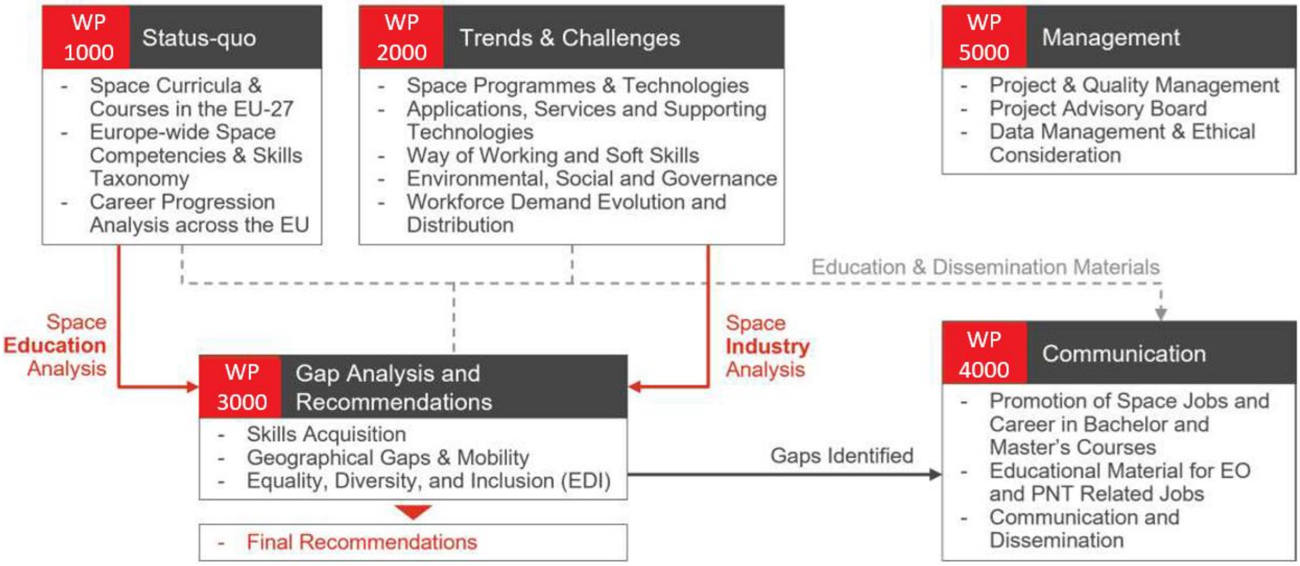


Figure 1: Interrelation among WPs

The report begins with a Terms of Reference section, which establishes a shared vocabulary and conceptual framework for interpreting the findings and recommendations that follow. Summaries of all preceding ASTRAIOS deliverables are subsequently provided, offering a structured overview of the evidence on which the final recommendations are based. Each summary explains the context and gap addressed, the objectives, the methodology, key results and the strategic outcomes of the deliverable. This approach allows for clarity in how each component of the project contributes to the overall analysis, how complementary datasets and methods were combined, and how the final recommendations draw directly from empirical findings in areas such as educational provision [D1.1], workforce demographics [D1.3], sector trends [D2.1], soft skills [D2.3], workforce demand [D2.8], and geographical or demographic imbalances [D3.2, D3.3].

The final section presents the recommendations, grouped by stakeholder category: policymakers, educators and universities, people already working in the space industry, and individuals seeking to enter the sector. These recommendations operationalise the project's findings, translating system-level evidence into concrete, actionable steps tailored to the needs and responsibilities of each audience. They aim to strengthen the space-skills pipeline, improve alignment between education and labour-market demand, widen participation, and support innovation, sustainability and long-term workforce resilience.

Together, these components - conceptual foundations, evidence summaries and targeted recommendations - provide a comprehensive, integrated resource. The report not only puts together the analytical outputs of

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ASTRAIOS but also equips stakeholders with the clarity, context and practical guidance needed to implement measures that will reinforce Europe's leadership and competitiveness in the space domain.

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## 2. Terms of Reference

This section establishes a shared vocabulary for skills gaps analysis in the European space sector. Each definition is drawn from authoritative European sources or sectoral evidence and includes a citation to facilitate traceability.

### 2.1 Education and qualifications terminology

| | |
|---|---|
| Competence | The proven ability to use knowledge, skills and personal, social and methodological abilities in work or study situations and in professional and personal development, typically expressed in terms of responsibility and autonomy [1]. |
| Informal learning | Learning resulting from daily activities related to work, family or leisure, which is not structured and usually does not lead to certification [2]. |
| Joint programme | Higher education courses jointly designed and delivered by multiple institutions, often across countries, to provide shared accreditation and training opportunities [3]. |
| Knowledge | The theoretical and factual body of understanding that a learner acquires through education and training, described within learning outcomes and linked to qualification levels [1]. |
| Learning outcomes | Statements of what a learner knows, understands and is able to do upon completion of a learning process, defined in terms of knowledge, skills and competence [2]. |
| Lifelong learning | All learning activity undertaken throughout life with the aim of improving knowledge, skills and competences from a personal, civic, social and employment perspective [2]. |
| Macro-areas | Categories used by ESPI to systematise space-related higher education, including aerospace engineering, space sciences, juridical/economic/social sciences, space applications, and multidisciplinary programmes [4]. |
| Multidisciplinary programmes | Space-related courses or curricula that integrate multiple academic domains, such as engineering, science, law, business, or social sciences [4]. |
| Non-formal learning | Structured learning that takes place outside formal systems and does not typically lead to certification, but contributes to competence development [2]. |
| Occupation | A set of jobs whose main tasks and duties are characterised by a high degree of similarity within the ESCO taxonomy of the EU labour market [5]. |
| Qualification | A formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards [2]. |
| Skills | The ability to apply knowledge to complete tasks and solve problems, expressed as cognitive (use of logical, intuitive and creative thinking) and practical (use of methods, materials, tools and instruments) [1]. |

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## 2.2 Labour market and skills analysis

| | |
|---|---|
| Attrition | The gradual reduction of the workforce due to retirement, resignations, or transitions to other sectors, creating replacement demand in addition to expansion demand [6]. |
| Labour market | The system in which the supply of workers and the demand for skills interact to determine employment, wages and occupational mobility [2]. |
| Retention | The degree to which workers remain employed within the sector over time, as opposed to leaving for other industries or retiring [6]. |
| Skills demand | The quantity and type of skills sought by employers to achieve organisational and sector objectives in a given time and place [2]. |
| Skills forecasting | The systematic estimation of future skills demand and supply, using quantitative models and expert judgement, to anticipate imbalances [7]. |
| Skills gap | The difference between the skills required by employers and the skills possessed by workers or jobseekers, which may be quantitative or qualitative [2]. |
| Skills intelligence | Synthesised and policy-relevant evidence on skills, jobs and labour market trends, produced from multiple data sources and foresight to guide decisions by policy makers, providers and employers [8]. |
| Skills mismatch | Any misalignment between the skills held by individuals and those required by jobs, including vertical mismatch (overqualification and underqualification) and horizontal mismatch (field-of-study mismatch) [9]. |
| Skills shortage | A situation in which employers are unable to fill vacancies due to an absolute lack of suitably skilled candidates in the labour market [2]. |
| Skills supply | The availability of individuals possessing particular skills, shaped by education and training systems, migration and labour force participation [2]. |

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### 2.3 Space sector terminology

| | |
|---|---|
| Body of Knowledge (BoK) | A structured and shared knowledge base that organises domain concepts, competences and learning outcomes for curriculum and training design [10]. |
| Competence framework (space) | A taxonomy that defines and organises the competences required across space roles, linking knowledge, skills and behaviours to job functions and learning outcomes [11]. |
| Downstream | Activities that exploit space data and signals to deliver applications and services for end users in other sectors [12]. |
| Soft skills (space) | Non-technical abilities such as communication, teamwork, leadership, problem solving, adaptability and cultural awareness, which underpin collaboration in multidisciplinary and intercultural missions [D2.3]. |
| Space applications | Specific uses of space-derived data, technologies or capabilities that solve defined user problems or deliver public value [12]. |
| Space services and products | Solutions provided to end users by leveraging space assets or space-enabled technologies, including data, analytics, communications and navigation [13]. |
| Space value chain | The set of interlinked activities from Research & Development (R&D) and manufacturing through launch, operations, data processing and downstream service delivery [12]. |
| Space workforce demographics | The statistical profile of the space workforce, including scale, growth, functions, skills, qualifications and gender composition [D1.3]. |
| Supporting technologies | Cross-cutting technologies that enable or enhance the operation, accessibility or utility of space assets and services, across the value chain [D2.2]. |
| Upstream | Activities related to the design, development and manufacture of space assets, launchers and on-orbit infrastructure [14]. |

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### 2.4 Education–workforce pathways and inclusion

| | |
|---|---|
| Demographic characteristics | Attributes of the workforce such as age, gender, ethnicity, disability, sexuality, religion, nationality, and socio-economic background [15]. |
| Equality/equity, diversity and inclusion (EDI) | Principles and practices that ensure fairness, equal opportunity and representation of diverse groups in education and employment, including monitoring and targeted action to address underrepresentation [16] [17]. |
| Equality | The condition or fact of having the same rights, advantages, or opportunities as others or another, especially regardless of differences in gender, ethnicity, class, etc. [18]. |
| Equity | The quality of being equal or fair; fairness, impartiality; even-handed dealing. The recourse to general principles of justice to correct or supplement the provisions of the law. Equity of a statute refers to the construction of a statute according to its reason and spirit, so as to make it apply to cases for which it does not expressly provide. [18]. |
| Education pipeline | The progression of individuals through formal and non-formal education into the labour market, with attention to transition points and attrition [19]. |
| Early career programmes | Structured graduate or trainee routes into the sector that combine learning and supervised practice, for example European Space Agency's (ESA) Young Graduate Trainee programme [20]. |
| Pathways | Structured routes that learners and workers follow through education, training and employment, supported by mobility, work-based learning and placement opportunities [21]. |
| Protected characteristics | United Kingdom: Categories defined by the UK Equalities Act 2010 (e.g., age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, and sexual orientation) [15]. |
| | European Union: Although the Charter does not explicitly label them as "protected characteristics," Article 21 of the EU Charter of Fundamental Rights lists several grounds on which discrimination is prohibited, including sex, race, colour, ethnic or social origin, genetic features, language, religion or belief, political or other opinions, membership of a national minority, property, birth, disability, age, and sexual orientation [22]. |
| Reskilling | Learning undertaken to acquire competences for a different occupation or field, often at a different qualification level [2]. |
| Transversal skills | Abilities broadly applicable across sectors and occupations, such as teamwork, communication, and problem solving. In ESCO these are defined as learned and proven abilities which are commonly seen as necessary or valuable for effective action in virtually any kind of work, learning or life activity [23]. |
| Upskilling | Learning undertaken to deepen or expand competences at the same qualification level in order to meet changing job requirements [2]. |

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# 3. Deliverable Summaries

This section presents concise summaries of all ASTRAIOS deliverables in WPs 1000-3000. Each summary follows a common structure that outlines the context and gap addressed, the objective of the work, the methodology applied, the key results obtained and the main outcomes.

## D1.1: Structured data set of HEIs and other institutions/organisations and offered space-relevant curricula/courses

### 1. *Context and gap addressed*

Across Europe, space-related education has developed through a wide range of higher education institutions, training providers, and continuing education initiatives. Programmes span multiple levels, from undergraduate degrees to postgraduate research and professional training, and address different parts of the space value chain, including upstream engineering disciplines, midstream systems and operations, and downstream applications. Previous EU-funded projects and thematic studies (for example in Earth Observation (EO), Geographic Information (GI), aerospace engineering or specific technology domains) have provided valuable insights into subsets of this landscape.

At the same time, information on educational provision has typically been published through institutional catalogues, project reports or sector-specific initiatives, each reflecting its own scope, terminology and classification approach. This diversity is highlighted as a characteristic of the European space education ecosystem, noting that educational offerings are shaped by national priorities, institutional missions and domain-specific traditions [24]. Taken together, these sources provide a broad but heterogeneous picture of space-related education across Europe.

### 2. *Objective*

In line with WP1000, D1.1 set out to systematically collect and structure information on space-relevant curricula and courses across EU-27 and associated countries. The objective was to create a structured dataset covering upstream, midstream and downstream education offers that could serve as a shared reference for subsequent project activities, including skills mapping, workforce analysis and cross-domain comparison.

### 3. *Methodology*

Five main methodological components are used:

- A relational schema was developed in PostgreSQL to store institutions, programmes, courses, and their associations with defined Knowledge Domains (KDs) and Knowledge Areas (KAs).
- A KD/KA taxonomy was created, comprising 29 KDs and more than 100 KAs, each with descriptions and keyword lists to support robust and repeatable classification.
- Programme information was gathered through institutional desk research and a structured survey. Data included programme level, thematic orientation, duration, learning outcomes, internships, scholarships and lists of mandatory and elective courses.
- The dataset was released as linked data, with a publicly accessible SPARQL endpoint and an ElasticSearch API to enable semantic and full-text querying.
- Quantitative analysis was undertaken on 3,591 courses (1,059 Bachelor and 2,532 Master) to identify patterns in Knowledge Area coverage by thematic field and educational level.

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## 4. *Key results*

| | |
|---|---|
| Programme coverage | The dataset provides structured information on Bachelor, Master, PhD and continuing-education programmes across the EU-27 and the United Kingdom, including metadata such as country, level, language, tuition and sector orientation. |
| KD representation | Bachelor programmes collectively cover 68% of the KDs, while Master programmes cover 86%. Several domains, including metrology, oceanography, agricultural science and health-related topics, appear only rarely. |
| KA distribution | Remote sensing and GIScience are strongly represented, especially at Master level. Bachelor curricula are more focused on foundational engineering and applied mathematics, with notable variation across countries. |
| Programme characteristics | Many programmes include research theses and internships, indicating strong emphasis on practical components. Joint-degree formats are less common, suggesting limited inter-institutional collaboration. |

## 5. *Outcomes*

D1.1 offers a structured, Europe-wide overview of space-relevant education and establishes a common basis for analysing curricular content across countries and institutions.

The dataset, structured as shown below in Figure 2, provides clear evidence of where knowledge areas are well represented and where gaps exist, supporting evaluations of thematic balance and educational capacity.

Through its use of Linked Data, D1.1 also enables integration with external taxonomies and analytical tools. It provides a framework that can be updated and expanded, allowing ongoing observation of trends in Europe's space-education landscape.

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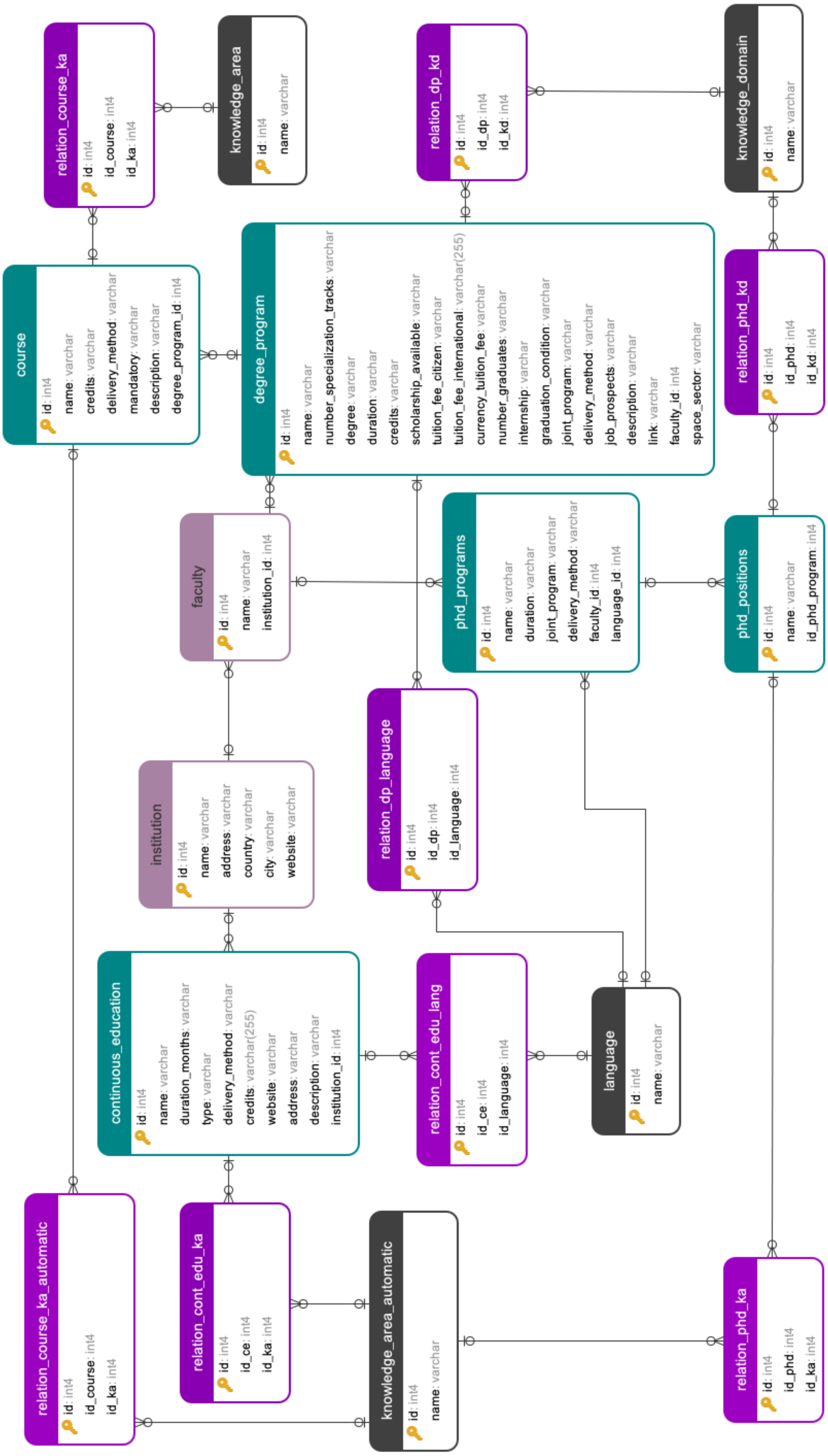


Figure 2: Database schema created and utilised as part of the work undertaken to complete D1.1

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## D1.2: European Space Sector Skills Taxonomy

### 1. *Context and gap addressed*

The European space sector already made use of multiple taxonomies, bodies of knowledge and classification frameworks, developed for different purposes and communities. These included occupational classifications (such as that of European Skills, Competences, and Occupations (ESCO)[1] or SpaceCRAFT[2] of Space Skills Alliance), domain-specific bodies of knowledge (notably in EO and GI), industry-led value-chain models, and technology-focused catalogues. Each of these frameworks supported analysis within its respective scope and has been widely used in education, workforce studies, programme design and market analysis.

This taxonomy landscape as rich but plural, with frameworks typically optimised for particular domains (often downstream) or policy functions, rather than for describing the full space value chain in a unified way [24]. Within ASTRAIOS, these existing resources formed an important starting point for analysing how skills and knowledge are defined, taught and referenced across education and industry.

### 2. *Objective*

As described in WP1000, the objective of D1.2 was to review and analyse existing taxonomies, bodies of knowledge and skills frameworks relevant to the space sector, and by building on this analysis, to develop a coherent, space-specific taxonomy encompassing upstream, midstream and downstream activities. This taxonomy was intended to provide a common reference framework for structuring data collected in WP1000 and WP2000, supporting alignment between education supply, workforce demand and later analytical work in WP3000.

### 3. *Methodology*

The work followed a structured process that combined review, design, and alignment activities:

- A detailed review of existing frameworks was carried out. This included ESCO, SpaceCRAFT, the EO Taxonomy, Copernicus services, EO4GEO's Body of Knowledge, the Space Capabilities Catalogue, and the Organisation for Economic Co-operation and Development's (OECD) classification of space activities.
- Design considerations were defined to develop EU-TaSK and ensure that would be clear, usable and aligned with recognised terminology. The taxonomy was designed to support classification across the full value chain and reflect both scientific and applied areas.
- An initial list of Knowledge Areas was drafted using the ASTRAIOS KD/KA structure from D1.1 as a starting point.
- The taxonomy was structured into upstream, midstream, downstream and ancillary themes, this allowed the scheme to consistent with existing downstream-specific taxonomies developed under previous projects. Each theme includes Knowledge Domains and associated Knowledge Areas.
- EU-TaSK was mapped to ESCO to identify alignment, partial matches and gaps. This analysis quantified where the space sector requires more detailed knowledge concepts than those currently provided in ESCO.

[1] More information on ESCO can be found online.
[2] More information on SpaceCRAFT can be found online.

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## 4. *Key results*

| | |
|---|---|
| Structure of the taxonomy | EU-TaSK introduces a two-level hierarchy of KDs and KAs that covers upstream, midstream, downstream and supporting activities in the European space sector. |
| Coverage and refinement | The taxonomy builds on the ASTRAIOS KD/KA structure and provides clearer definitions and a harmonised vocabulary for use in curricula, workforce analysis and sector mapping. |
| Alignment with existing frameworks | Mapping to ESCO shows that most domains align, but satellite engineering and space systems engineering have no direct match, demonstrating that existing general taxonomies do not capture key space-specific concepts. |
| Specificity of Knowledge Areas | A substantial share of KAs is more specialised than their nearest ESCO equivalents, confirming that the space sector requires a dedicated classification. |
| Usability | The taxonomy is structured for practical navigation and visualisation, supporting its application in training design, job-role mapping and skills analysis. |

## 5. *Outcomes*

D1.2 provides a coherent taxonomy, found below in Figure 3, that helps organise knowledge across the European space sector. It offers a sector-specific vocabulary that supports consistent classification of curricula, job roles and training content[3].

The taxonomy improves alignment with existing frameworks while highlighting where general-purpose taxonomies are insufficient for space-specific activities. The work identifies clear gaps in ESCO for areas such as space systems engineering.

EU-TaSK establishes a structure that can be used in future analyses and updated through stakeholder feedback. It forms a foundation for more accurate mapping of knowledge in both education and workforce data.

[3] It is also worth adding that EU-TaSK has been used by Space Skills Alliance to support development of the Space Training Catalogue and SpaceCRAFT, and by the Irish government in their latest space skills report [25].

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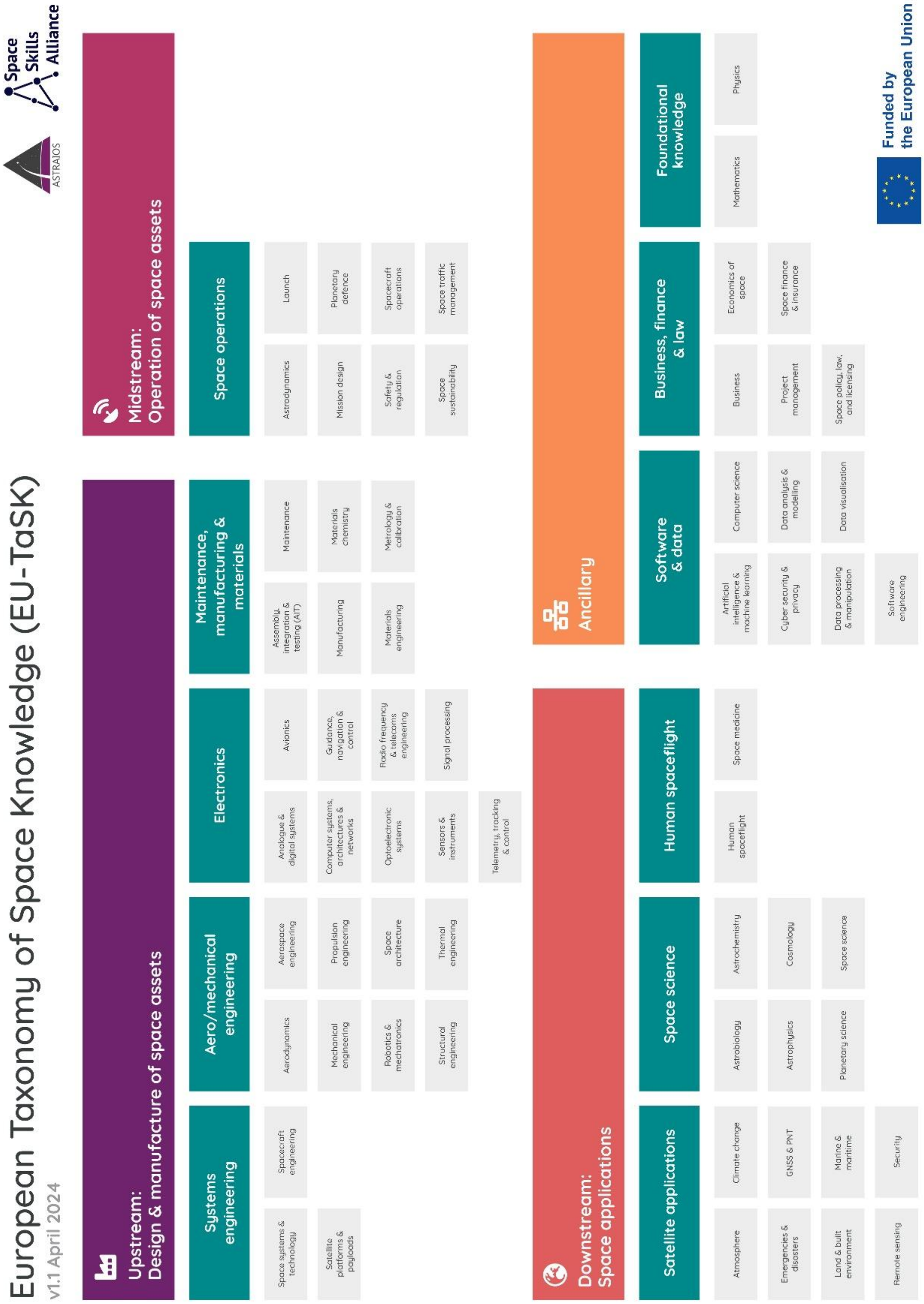


Figure 3: The EU-TaSK framework

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## D1.3: EU Space Sector Demographics Database

### 1. *Context and gap addressed*

Information on the characteristics of the European space workforce has been produced through a variety of channels, including institutional statistics, surveys, national studies and sector-specific reports. These sources have offered insights into workforce composition, career stages, mobility patterns and organisational structures, often focusing on particular countries, organisations or segments of the sector.

Such data plays an important role in understanding workforce dynamics, but is typically generated for specific analytical or policy purposes. Within ASTRAIOS, these existing sources provided a basis for examining demographic patterns alongside education and skills data, rather than being treated as standalone evidence.

### 2. *Objective*

In line with Task 1300, D1.3 aimed to gather, structure and organise demographic and career-path information on individuals working in the European space sector. The objective was to create a dataset that could be correlated with education, skills and demand data elsewhere in the project, supporting analysis of workforce composition, mobility and career progression.

### 3. *Methodology*

The deliverable draws on several complementary sources to create a coherent dataset:

- Sector-level reports were reviewed. These included Eurospace Facts and Figures, EARSC's Industry Survey, the EU Union of Equality report, and national studies such as the UK's Size and Health of the Space Industry.
- LinkedIn Talent Insights was used as the primary source for workforce-scale data. This tool analyses job titles, education, skills and employment information provided by 950 million users worldwide.
- A company database was assembled by gathering space-related organisations from national directories, membership lists and specialised websites. This produced a sample of more than 2,200 companies across EU-27 and the UK.
- Workforce information was extracted for employees within these companies using standardised filters based on job titles, skills and keywords linked to space activities. The search terms were iterated and validated to improve accuracy.
- Results were analysed for workforce scale, growth rates, job functions, skills, qualification levels, fields of study, gender, age and nationality. These indicators were presented consistently for all countries.

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## 4. *Key results*

| | |
|---|---|
| Workforce size and distribution | The dataset identifies approximately 172,000 professionals working in the European space sector across more than 1,800 companies. |
| Workforce growth | The sector shows an average annual growth rate of around 3%, with notable variation between countries, including rapid expansion in Lithuania, Spain and Germany. |
| Job mobility | 17% of professionals changed jobs within the past year, reflecting a highly dynamic labour market with substantial internal and cross-sector movement. |
| Functional distribution | Engineering, information technology and operations represent the dominant job functions in the workforce. |
| Skill characteristics | Skills related to software, data analysis and engineering are strongly represented, with Artificial Intelligence (AI)-related and data-intensive skills showing the fastest recent growth. |
| Educational background | Most workers hold higher education degrees, particularly at Master level. Common fields of study include computer science, general engineering and electronics engineering. Recent graduates show stronger representation in aerospace engineering. |
| Gender representation | Women constitute 24% of the workforce, with higher representation in agencies than in industry and with notable cross-country differences. |
| Age distribution | The workforce shows strong representation at early and late career stages, with fewer mid-career professionals, suggesting potential challenges in experience continuity. |
| Nationality patterns | The largest national groups include Italian, French, Spanish and German professionals, mirroring broader workforce distribution patterns across Europe. |

## 5. *Outcomes*

D1.3 provides a comprehensive demographic dataset available for the European space workforce. It consolidates information from several sources into a single, searchable database and establishes a replicable method for workforce analysis. However, it should be noted that it likely overestimates the space workforce but is useful for understanding some of the workforce nuances and movements.

The deliverable clarifies how the workforce is distributed across countries, functions and disciplines. It highlights differences in growth, educational backgrounds, gender balance and age structure. It also identifies where the sector may face future challenges, for example in mid-career capacity or in maintaining skills pipelines in key engineering domains.

By making the dataset accessible and clearly structured, D1.3 supports further analysis of skills supply, sector development and educational alignment across Europe.

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## D2.1: Overview of the trends and challenges for the European space industry

### 1. *Context and gap addressed*

European and national space institutions, agencies and research organisations regularly publish strategies, roadmaps, white papers and programme documentation outlining scientific priorities, technological developments and service objectives. These materials cover a wide range of domains, including exploration, Earth observation, satellite communications, navigation, launch and space safety.

The role of such documents in shaping expectations around skills, technology and workforce development is quite significant, as they reflect both long-term strategic ambitions and shorter-term programme priorities. Together, they form a substantial body of material describing how the European space sector is evolving from an institutional and policy perspective.

### 2. *Objective*

As described in Task 2100, D2.1 aimed to analyse and synthesise European and national space programme documentation in order to identify key trends in space programmes, technologies and associated skills needs. The objective was to provide a structured overview that could inform later analysis of workforce demand and skills alignment within the project.

### 3. *Methodology*

D2.1 synthesised information through three main activities:

- A review of scientific programmes of ESA and national space agencies, including ESA's Science Programme, Cosmic Vision, Voyage 2050 and mission roadmaps in astronomy, planetary science and high-energy physics.
- An examination of service and business domains. This included detailed mapping of the Earth observation, satellite communication, satellite navigation, access to space and space safety value chains. Market analyses, demand forecasts and supply-side developments were collected from ESA, European Union Agency for the Space Programme (EUSPA), EO and Satcom market reports and technical literature.
- Identification of emerging technologies, applications and services across upstream, midstream and downstream segments. Examples include hyperspectral imaging, onboard artificial intelligence, digital Earth models and advanced space traffic management concepts.
- The report combined qualitative evidence from agency strategies with quantitative indicators from market reports to produce domain-specific trend summaries.

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## 4. *Key results*

| | |
|---|---|
| Earth observation | The report summarises upstream developments, such as Sentinel missions and hyperspectral constellations, and downstream trends in data access, analytics and climate applications. EO demand is driven by climate monitoring, agriculture, security and environmental policy. Supply is shaped by new sensors, AI-enhanced processing and cloud platforms. |
| Satellite communication | Market analysis shows growing demand for broadband connectivity, 5G integration and secure communication services. ESA's Advanced Research in Telecommunications Systems - ARTES 4.0 programme structure is presented, including core competitiveness, future preparation and strategic lines such as optical and quantum communications. |
| Satellite navigation | The value chain includes Global Navigation Satellite System (GNSS) systems, augmentation services and downstream applications in transport, agriculture and timing services. The report reviews global systems and the European GNSS portfolio. |
| Access to space | Europe's launcher landscape is described across development, manufacturing and launch operations. Trends include reusability efforts, micro-launcher growth, 3D-printed components and new propulsion technologies. The report notes that the global launch market is expected to grow from 13.9 billion USD in 2022 to 47.3 billion USD by 2032. |
| Space safety | The analysis covers debris monitoring, collision avoidance, space traffic management and active debris removal. Developments include AI-supported tracking, advanced radar and telescope systems, non-contact debris nudging and in-orbit servicing technologies. |

Each domain is accompanied by a summary of demand and supply trends, showing how technological advances, market dynamics and institutional priorities interact.

## 5. *Outcomes*

D2.1 delivers a cross-domain overview that consolidates scientific, technological and market information into a single reference. It clarifies how upstream and downstream activities connect across value chains and describes the drivers shaping future development in Europe's major space domains.

The work highlights areas of rapid innovation, for example AI-enabled data processing, micro-launchers and new Space Situational Awareness (SSA) capabilities, and identifies pressures such as increasing data volumes, the need for secure connectivity and growing congestion in orbit.

By outlining demand and supply trends in each domain, D2.1 supports strategic planning and provides a structured basis for later analyses of skills, workforce needs and innovation opportunities.

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## D2.2: Applications, services and supporting technologies

### 1. *Context and gap addressed*

Applications, services and supporting technologies constitute a significant and diverse part of the European space ecosystem. Information on these activities is produced through industry reports, programme documentation, company material and market analyses, reflecting perspectives from Small and Medium-sized Enterprises (SMEs), large industry players, agencies and research organisations.

The Landscape Review describes this part of the ecosystem as particularly dynamic, with strong links to digital transformation, data-intensive services and cross-sectoral applications. Existing sources capture this diversity from different angles, depending on organisational focus and market segment.

### 2. *Objective*

In line with Task 2200, D2.2 aimed to gather industry-driven input through surveys and desk research to map current applications, services and supporting technologies across the European space sector. The objective was to structure this information in a way that supports analysis of expertise profiles and skills needs across domains and along the value chain.

### 3. *Methodology*

The deliverable is based on two main activities, which were later integrated:

- A structured European Space Ecosystem Survey ran for six weeks and targeted a wide range of organisations including, start-ups, SMEs, large companies, research centres and academic institutions. It collected information on active domains, applications and services under development, market dynamics and involvement in ongoing programmes. It covered domains such as Earth observation, satellite communication, satellite navigation, access to space, in-orbit servicing, space safety, space manufacturing, space exploration, ground segment, space science and satellite operations.
- To ensure consistency, the survey included clear definitions for applications, services, space-related activities and supporting technologies. This was intended to reduce ambiguity and standardise responses across different types of organisations.
- In parallel, a survey analysed applications, services and supporting technologies across five main domains: Earth observation, satellite communication, satellite navigation, access to space, and space safety. For each domain, the report examined demand and supply trends and mapped emerging technologies and applications in a catalogue format.
- The two strands were compared to identify mismatches between industry needs and current capabilities, as well as opportunities for future development.

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## 4. *Key results*

| | |
|---|---|
| Survey findings | The survey revealed active engagement across almost all major space domains, with strong representation in Earth observation, satellite communication and space manufacturing. Respondents described a wide range of applications and services and reported market dynamics that were generally increasing or stable. Several organisations noted gaps in supporting technologies, challenges in partnerships and the need for more collaborations and improved access to R&D facilities. |
| Value-chain challenges | Many organisations reported that missing technologies or weak collaborations limited their ability to scale services or expand applications. These included gaps in advanced analytics, testing facilities and certain enabling technologies. |
| Market and operational pressures | Respondents highlighted the need for flexible operational strategies to meet market demands. Some underlined challenges faced by SMEs, such as difficulty accessing financing in the range of 1–5 million euros or administrative complexity in funding applications. |
| Supporting technologies | The desktop research identified numerous emerging technologies across the value chain. In Earth observation, examples include hyperspectral imaging, onboard AI processing and super-resolution methods. In downstream contexts, developments include digital Earth models, cloud-based platforms and geo-augmented reality. |
| Catalogue of technologies, applications and services | The report presents domain-specific catalogues of emerging upstream, midstream and downstream developments. These provide a reference for understanding the direction of innovation and potential areas for capability development. |

## 5. *Outcomes*

D2.2 delivers a consolidated view of how European organisations use applications, services and supporting technologies across major space domains. It provides evidence on market dynamics, technological trends and operational needs, based on both company perspectives and structured research.

The deliverable identifies gaps in supporting technologies and collaboration, highlights organisational challenges such as access to finance and administrative burden, and captures where the sector is investing to prepare for future market developments. It also offers catalogues of emerging technologies and applications that can support strategic planning and future skills development.

By combining survey data with a detailed analysis of sector trends, D2.2 creates a foundation for understanding how applications and services are evolving and where additional support or capability building may be needed within the European space ecosystem.

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## D2.3: Space Sector Soft Skills Report

### 1. *Context and gap addressed*

Soft skills are increasingly recognised as essential for effective performance in technical sectors, including space. However, evidence on which soft skills matter most, how they are used in practice and how organisations assess them has been limited. Existing studies tend to focus on technical skills or on broad workforce trends [24], and many do not provide insight into interpersonal, organisational or behavioural competencies needed in space-sector roles. This makes it somewhat difficult to understand employer expectations, recruitment needs or the challenges employees face in developing and applying non-technical competencies.

### 2. *Objective*

As set out in Task 2300, D2.3 aimed to identify the most important soft skills for the space sector and examine how they influence recruitment, career progression and organisational effectiveness. The deliverable gathers employer perspectives to clarify how soft skills are valued, what challenges exist in assessing them and what training or support may be needed. The objective was to inform subsequent educational, training and dissemination activities within WP2000.

### 3. *Methodology*

The deliverable is based on structured consultation with industry stakeholders. Participants provided input on the relevance of soft skills, their role in recruitment, and the impact of evolving work environments, including remote and hybrid settings. The analysis focuses on employer views regarding:

- skills considered essential for professional success,
- the balance between technical qualifications and interpersonal competencies,
- recruitment practices and assessment methods,
- the influence of organisational culture and work modalities,
- the perceived need for training and development activities.

This evidence forms the basis for synthesising common patterns and identifying areas where further development or support is required.

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## 4. *Key results*

| | |
|---|---|
| Communication | Respondents noted that communication enables problem solving, negotiation, coordination and team management. Many described it as the skill with the strongest impact on professional success. |
| Teamwork, curiosity & adaptability | These skills were described as essential to collaborative projects, cross-functional work and innovation. |
| Soft skills in recruitment | Employers reported that interpersonal competencies are now integrated into job descriptions and selection processes. Technical qualifications remain essential but are complemented by behavioural indicators of teamwork, autonomy and communication. |
| Remote and hybrid work | Communication challenges arise more frequently in remote settings. Respondents described a need for training that supports effective collaboration, clarity in communication and management of dispersed teams. |
| Professional development | Employers stressed the need for continuous professional development in soft skills, particularly for early-career professionals. They also noted that soft skills are sometimes undervalued during formal education, which contributes to gaps at the start of employees' careers. |

## 5. *Outcomes*

D2.3 provides a clearer understanding of how soft skills function in the European space sector. It identifies communication, teamwork and professional curiosity as central competencies and shows that employers now expect these skills to complement technical training.

The report highlights the need for more systematic support for soft-skill development through training and workplace learning. It also shows that evolving work formats, including remote and hybrid arrangements, create new skill demands, especially in communication and team coordination.

The deliverable offers evidence that soft skills should be integrated into recruitment, professional development and educational pathways to support career success and organisational performance within the space sector.

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### D2.4: Profiles of success stories on EO and GNSS

#### 1. *Context and gap addressed*

EO and GNSS are increasingly integrated into non-space sectors such as agriculture, forestry, water management, disaster risk reduction, sustainability, and public services. Despite their growing relevance, awareness of concrete EO and GNSS use cases outside the traditional space community remains limited. Many potential users, students, and early-career professionals lack visibility on how these technologies are translated into operational solutions and real societal or economic impact.

Practical examples in illustrating how space capabilities translate into applications, business models and skills requirements are often of value, particularly for communication and outreach purposes.

#### 2. *Objective*

As part of Task 2300, D2.4 aimed to raise awareness and foster the uptake of EO and GNSS technologies by showcasing concrete European success stories. The deliverable sought to bridge the gap between academia, industry, startups, and public authorities by highlighting real-world applications, professional journeys, and innovation pathways enabled by EO and GNSS. The initiative also aimed to inspire students, early-career professionals, and non-space stakeholders by presenting accessible, practitioner-led narratives illustrating the value of EO and GNSS across multiple sectors.

#### 3. *Methodology*

The deliverable is based on a structured, interview-driven methodology designed to ensure coherence and comparability across all contributions. A common questionnaire guided each podcast episode, covering six thematic areas: professional background, success stories, technology and innovation, personal insights, impact and future vision, and inspirational reflections.

Interviews were conducted in a semi-structured, conversational format, allowing contributors to share authentic experiences while ensuring thematic alignment across episodes. Each podcast episode lasted approximately 25–30 minutes and was published on the ASTRAIOS YouTube channel to ensure open access and long-term visibility.

The dissemination strategy relied on a dual-format approach:

- a public podcast series to maximise accessibility and engagement,
- a dedicated book compiling the profiles to support long-term reuse for education, communication, and stakeholder engagement.

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### 4. *Key results*

| | |
|---|---|
| Diverse real-world applications | The success stories illustrate how EO and GNSS are applied across agriculture, forestry, water management, emergency response, sustainability, supply chains, and public services. |
| Human-centred innovation pathways | Contributors highlight professional journeys, challenges encountered, and lessons learned, providing relatable role models for students and early-career professionals. |
| Bridging sectors and stakeholders | The profiles demonstrate effective collaboration between academia, industry, startups, and public authorities, showing how space technologies are integrated into non-space contexts. |
| Technology uptake and impact | The stories underline how EO and GNSS enable improved decision-making, risk anticipation, environmental monitoring, and more sustainable resource management. |

### 5. *Outcomes*

D2.4 provides an accessible and practice-oriented overview of how EO and GNSS technologies are successfully deployed across Europe. By combining storytelling with technical insight, the deliverable enhances understanding of EO and GNSS value beyond the space sector.

The podcast series and accompanying book contribute to increased visibility of EO and GNSS applications, support skills development, and encourage technology adoption by showcasing credible, real-world examples. The deliverable reinforces the role of EO and GNSS as key enablers of innovation, sustainability, and societal impact, directly supporting the dissemination and impact objectives of the ASTRAIOS project

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## D2.5: European boot camp to bring European students/entrepreneurs together and be trained in transferable training skills

### 1. *Context and gap addressed*

Short-format training initiatives, workshops and collaborative learning activities are commonly used across Europe to support skills development, entrepreneurship and cross-sector interaction. Within the space sector, such formats are often used to complement formal education by fostering experiential learning and networking. Soft skills were identified as critical for future space-sector roles, yet evidence showed that these competencies are often developed informally and much later than needed [24]. Prior analysis highlighted gaps in communication, problem solving, teamwork, conflict resolution, adaptability, digital fluency and leadership, especially among early-career professionals.

Existing training formats in Europe tend to focus on technical content or theoretical instruction. Few initiatives offer intensive, practice-oriented formats that help students and young professionals develop interpersonal, collaborative and innovation-oriented skills in an interdisciplinary and international setting.

### 2. *Objective*

Building on findings from Task 2300, the objective of D2.5 was to design, implement and evaluate a three-day European Space Bootcamp aimed at strengthening key transferable skills among Master's students, PhD candidates, and early-career professionals. The Bootcamp intended to bridge the gap between scientific expertise and interpersonal competencies by offering immersive, hands-on training supported by experts from industry, research and entrepreneurship.

### 3. *Methodology*

The Bootcamp approach combined structured programme design, expert input and experiential learning:

- The programme was designed using a participant-centred approach, combining talks, workshops, panel discussions, case studies and networking opportunities.
- Topics were selected based on insights from earlier soft-skills analyses carried out in ASTRAIOS Task 2300. These emphasised communication, teamwork, problem solving, adaptability, emotional intelligence, leadership and diversity awareness.
- The three-day programme included themed days on leadership and collaboration, project management and innovation, and entrepreneurship and networking. Each day blended theoretical content with hands-on exercises.
- A communication and outreach strategy promoted participation across European institutions through networks such as European Confederation of Upper-Rhine Universities (EUCOR), European Partnership for an Innovative Campus Unifying Regions (EPICUR), and the International Space University's (ISU) LinkedIn presence.
- Participant feedback was collected through surveys, providing both quantitative ratings and qualitative testimonials.

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## 4. *Key results*

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| Training content and structure | The Bootcamp provided a three-day intensive programme combining expert talks, workshops and panel discussions covering leadership, interdisciplinary collaboration, communication, project management, open innovation, cultural intelligence, knowledge transfer, entrepreneurship and personal branding. |
| Participant profile | Fourteen participants attended from universities, companies and public institutions in France, Germany, Portugal, United Kingdom and Saudi Arabia. Gender distribution was 42.9% female and 57.1% male. |
| Satisfaction and perceived relevance | 95% of participants reported positive overall feedback. Topics were rated as highly relevant, and the programme was viewed as useful for career development and for providing real insights from industry practitioners. |
| Added value of specific sessions | Participants highlighted strong benefits from sessions on communication and leadership, multicultural teamwork, New Space organisational models, project management and entrepreneurship. These were considered especially impactful in linking soft skills with real-world practice. |
| Suggestions for improvement | Participants recommended more hands-on workshops, expanded content on start-up creation and greater interaction with the host institution's internal community. |

## 5. *Outcomes*

D2.5 demonstrates that intensive, practice-oriented formats can effectively support soft-skill development for future space-sector professionals. The Bootcamp provided participants with clearer insight into leadership, collaboration and innovation practices, while also strengthening their networks and career aspirations.

The deliverable offers evidence that small-cohort, mixed-format training can enhance engagement, facilitate peer learning and foster confidence in applying transferable skills. It also shows that cross-cultural and interdisciplinary exchanges contribute significantly to participants' professional development

The report presents recommendations for future editions, including maintaining an interactive format, increasing collaboration with local innovation ecosystems and integrating more entrepreneurship-oriented content. The Bootcamp provides a replicable model for supporting the next generation of Europe's space workforce and contributes directly to understanding how transferable skills can be taught effectively in short, intensive programmes.

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## D2.6: MOOC on soft skills and new way of working

### 1. *Context and gap addressed*

The European space sector is becoming increasingly interdisciplinary, digital and collaborative. This evolution increases the importance of soft skills such as communication, teamwork, leadership, adaptability and cross-cultural awareness.

Digital learning platforms and online courses are increasingly used to support continuous learning and skills development across Europe. Within the space sector, MOOCs and online modules have been developed by agencies, universities and international organisations to address both technical and transversal topics.

### 2. *Objective*

In line with WP2000, D2.6 aimed to design and deliver a Massive Open Online Course (MOOC) that strengthens transferable skills essential for interdisciplinary and international work in the space sector. The MOOC is intended to extend the reach of the European Space Bootcamp [D2.5] and to equip learners with competencies that support innovation, leadership and effective collaboration in both physical and virtual work environments. The objective was to complement existing training provision and support accessible learning opportunities for students and early-career professionals across Europe.

### 3. *Methodology*

The course was developed using a structured approach combining digital learning design, expert input and Bootcamp-derived insights, through the following main steps:

- Learning outcomes were defined based on soft-skills priorities identified through the Bootcamp and through employer and educator consultations in ASTRAIOS Task 2300.
- Course content was organised into modular units combining video lectures, case studies, applied examples, reflective exercises and downloadable resources.
- The instructional design emphasised learner-centred methods, using real-world scenarios and examples tailored to space and Science, Technology, Engineering, and Mathematics (STEM) contexts.
- Six core modules were created: leadership and team management, collaboration, communication, empathy, project management and equity, diversity and inclusion in STEM environments.
- Expert contributors, including ISU faculty and sector practitioners, provided thematic guidance and contextual insights.
- The final MOOC was built to be accessible asynchronously, enabling participation across countries and institutions.

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### 4. *Key results*

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| Course structure and content | The MOOC delivers six structured modules that address leadership, teamwork, communication, empathy, project management and EDI awareness. Each module uses sector-relevant examples to support application in real professional settings. |
| Accessibility and flexibility | The MOOC format increases access to soft-skills training for learners who cannot participate in in-person programmes. Its asynchronous nature enables self-paced learning and broad outreach, aligning with the needs of diverse and mobile space professionals. |
| Expert contributions | Course materials incorporate insights from leaders in space entrepreneurship, policy and management. Expert input reinforces the relevance of soft skills in the modern space workplace and adds depth through practical examples. |
| Alignment with sector needs | The competencies addressed mirror employer priorities identified in ASTRAIOS soft-skills research. Skills such as communication, teamwork, problem-solving, conflict resolution, adaptability and cultural intelligence are consistently recognised as critical across the sector. |
| Digital learning design | The course demonstrates how digital modalities can support large-scale soft-skills development. The design incorporates interactive elements and reflective exercises that encourage active engagement despite being online. |

### 5. *Outcomes*

D2.6 provides a scalable, accessible training tool that addresses recognised soft-skills gaps in the European space workforce. It strengthens the capacity of learners to operate in interdisciplinary, international and increasingly digital work environments.

The MOOC also establishes a reusable model that educational institutions and organisations can adopt to enhance professional development. By extending the reach of the Bootcamp’s learning outcomes, D2.6 supports the broader ASTRAIOS objective of improving alignment between educational preparation and evolving workforce demands.

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## D2.7: Environmental, Social and Governance Report in the Space Entrepreneurship Ecosystem: Trends, Challenges and Opportunities

### 1. *Context and gap addressed*

Environmental, Social and Governance (hereinafter ESG) considerations are increasingly shaping how organisations operate, compete and attract talent. In the European space sector, ESG principles are becoming relevant not only for compliance and reporting, but also for innovation, risk management and long-term sustainability[4]. However, ESG adoption across the space entrepreneurship ecosystem has been uneven, particularly among startups and SMEs, that often struggle to balance ESG reporting with day-to-day operational demands and face constraints in resources, expertise and regulatory clarity.

### 2. *Objective*

As defined in Task 2400, D2.7 aimed to analyse the state of ESG practices in the European space entrepreneurship ecosystem. The deliverable examined how companies engage with ESG practices, identified barriers and enabling factors for its implementation, and explored emerging trends and opportunities. Its objective was to inform and provide actionable insights to industry stakeholders, education providers and EU policymakers on how ESG can support a more competitive, resilient and sustainable space sector. It also underscored the lasting impact of ASTRAIOS by disseminating these insights through the ESG Space Industry Practices Book - a central legacy of this project.

### 3. *Methodology*

D2.7 is based on a qualitative, participatory approach that combines multiple sources of evidence:

- Three peer-to-peer learning workshops involving a diverse set of space (and to a less extent, non-space) companies, from early-stage startups to more established entities.
- Scouting surveys used to capture baseline awareness, assess participants' experience with ESG, their interest in the topic, and their willingness to learn, share insights and challenges related to ESG practices.
- One-to-one follow-up interviews to gather more in-depth insights, capturing detailed ESG practices information and missing skills that were not fully expressed in group settings.
- Desk research on institutional and regulatory frameworks relevant to ESG in the European context.

The data were analysed thematically to identify common ESG challenges, good practices, skills gaps and trends across the space industry.

[4] In addition to the information provided by space organisations that participated in the ESG peer-to-peer learning workshops and PwC's introductory presentation, several additional sources are incorporated in the research around ESG practices, listed in the references of Deliverable 2.7.

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## 4. *Key results*

| | |
|---|---|
| ESG as a strategic driver | ESG is associated with competitiveness, innovation capacity, talent attraction and retention, and long-term risk mitigation. |
| Implementation challenges | Key barriers include fragmented and inconsistent ESG data, regulatory complexity, missing universal ESG language, limited internal resources, lack of leadership engagement, and weak cross-departmental coordination, particularly in SMEs and startups. |
| Environmental practices | Companies report growing attention to space debris mitigation, circular economy, energy efficiency and environmental impact awareness, but note difficulties in defining measurable indicators and setting realistic targets. |
| Social dimension | The social pillar highlights issues related to workforce wellbeing, diversity and inclusion, organisational culture and skills development. Many companies recognise gaps in transversal skills, including communication, leadership, ESG literacy and essential human centred skills. |
| Governance practices | Governance challenges include limited formalisation of ESG responsibilities, unclear accountability structures, and difficulties integrating ESG into existing business processes, especially in early-stage organisations. |
| Emerging trends | Observed trends include increased standardisation of ESG frameworks, gradual automation of reporting processes, stronger emphasis on diversity and inclusion, short-term high-visibility ESG goals, and closer interaction between industry and academia to address space industry´s skills demands[5]. |

## 5. *Outcomes*

All insights have been consolidated and disseminated through two key outcomes:

- D2.7 provides a structured overview of how ESG is currently approached in the European space entrepreneurship ecosystem. It clarifies the practical challenges faced by companies and identifies ESG-related competencies that are becoming increasingly relevant for the space workforce.
- The ESG Space Industry Practices Book[6] is a storytelling-driven publication showcasing how leading ESG practices drive positive workforce change by aligning industry needs with academic curricula.

The results demonstrate that effective ESG integration requires both organisational change and targeted skills development. It highlights the need for education and training pathways that combine technical expertise with ESG awareness, governance understanding and transversal skills.

These two outcomes offer an evidence-based legacy to support EU policy development, curriculum adaptation, and initiatives aimed at strengthening sustainability, responsibility, and competitiveness in Europe's space sector. For companies, it is a strategic tool showing how ESG can be used to identify operational improvements and innovation; for academia, it serves to reflect the increasing demand for interdisciplinary

[5] It should be noted that beyond the existing gaps in ESG skills within the space industry ecosystem, the implementation of ESG practices helps companies become aware of the specific skills they lack, enabling them to clearly define workforce goals and strategies.

[6] The ESG Space Industry Practices Book can be found online on the ASTRAIOS website.

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skills, and adapt curricula to industry needs; and for policymakers, it provides insights to improve ESG frameworks, reduce administrative burdens, and design targeted support measures for startups and SMEs.

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## D2.8: Workforce demand evolution and distribution

### 1. *Context and gap addressed*

Workforce demand in the space sector is shaped by technological change, evolving business models and broader economic conditions. Industry surveys, labour-market data, job advertisements and professional profiles are commonly used to analyse skills needs and employment trends.

Understanding labour demand in the space sector requires coordinated data on job postings, skills requirements, mobility patterns and workforce characteristics. Prior analyses often relied on isolated sources such as industry surveys or employment statistics [24]. These sources did not provide a unified, Europe-wide picture of workforce demand, nor did they systematically compare job vacancies with available skills in the labour market.

### 2. *Objective*

In line with Task 2500, D2.8 aims to analyse the evolution and distribution of workforce demand in the European space sector. It examines job vacancies, skill requirements, labour mobility and employer expectations, and compares them with supply-side indicators such as CVs and workforce profiles. The objective was to support understanding of current and emerging demand patterns across the European space value chain.

### 3. *Methodology*

The deliverable integrates several complementary data sources:

- Job adverts from SpaceCareers.uk, covering 1,856 postings between 2022 and 2024. These were classified using the EU-TaSK taxonomy to identify themes and required competencies.
- CV data from Space-Careers.com and Space Individuals, covering 6,477 CVs posted between 2005 and 2024. These were also assigned to EU-TaSK themes to understand skill supply.
- LinkedIn Talent Insights, providing labour mobility indicators, experience levels, education backgrounds and organisation types
- A baseline workforce dataset used to compare changes in workforce size across EU-27 and the UK.
- Standardised metrics enabling comparison across countries, themes and skill categories.

These data sources were analysed quantitatively and aligned through the EU-TaSK taxonomy to assess demand, supply and gaps in skills.

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## 4. *Key results*

| | |
|---|---|
| Job postings distribution | SpaceCareers.uk data show strong demand for software and data, systems engineering, electronics, manufacturing, space operations, and satellite applications. These areas account for the highest proportion of vacancies in the sector. |
| CV supply distribution | CV data show that 88% of posted CVs come from individuals with technical backgrounds. The largest groups are aero and mechanical engineering at 27%, software and data at 19% and systems engineering at 12%. |
| Matching supply and demand | Several EU-TaSK themes show close alignment between the share of CVs and the share of job postings. These include software and data, systems engineering, manufacturing and materials, electronics engineering, space operations, satellite applications, space science, human spaceflight and foundational knowledge. |
| Skill imbalances | Only 12% of CVs belong to individuals with primarily non-technical skills. This indicates a potential shortage in business, management and other transversal competencies relative to emerging sector demands. |
| Workforce experience and education | Most workers have between 2 and 10 years of experience, and the majority hold higher-education degrees. Bachelor, Master and doctoral profiles are strongly represented. |
| Mobility and career change | The dataset shows notable mobility between roles and companies. Workers reported changes in job responsibilities and organisations over the past year, indicating a dynamic labour market with significant lateral movement. |
| Motivations for relocation | Key motivations include career opportunities, salary, quality of life and participation in leading innovation environments. |
| Professional development needs | Respondents reported strong interest in improving technical skills, project management, leadership, communication and team coordination. |

## 5. *Outcomes*

D2.8 provides a comprehensive assessment of workforce demand across the European space sector. The deliverable identifies which skills are most in demand and how these align with available talent. It highlights areas where supply and demand are well matched and where gaps exist, particularly for non-technical and interdisciplinary skills.

The work also reveals notable mobility patterns and identifies the types of roles and competencies that drive career changes. By integrating multiple data sources and classifying them consistently through EU-TaSK, D2.8 creates a robust evidence base for understanding skill needs, workforce flows and areas where additional training or policy support may be required

D2.8 therefore offers an analytical foundation for anticipating future workforce needs and supports strategic planning for education, recruitment and skills development across the European space ecosystem. Work completed as part of D1.3 and D2.8 also contributed to the compilation of 1-page infographics on skills and

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workforce composition in the UK and in a per-country basis[7] - an example of which may be found below in Figure 4.

[7] The full compilation of infographics can be found online.

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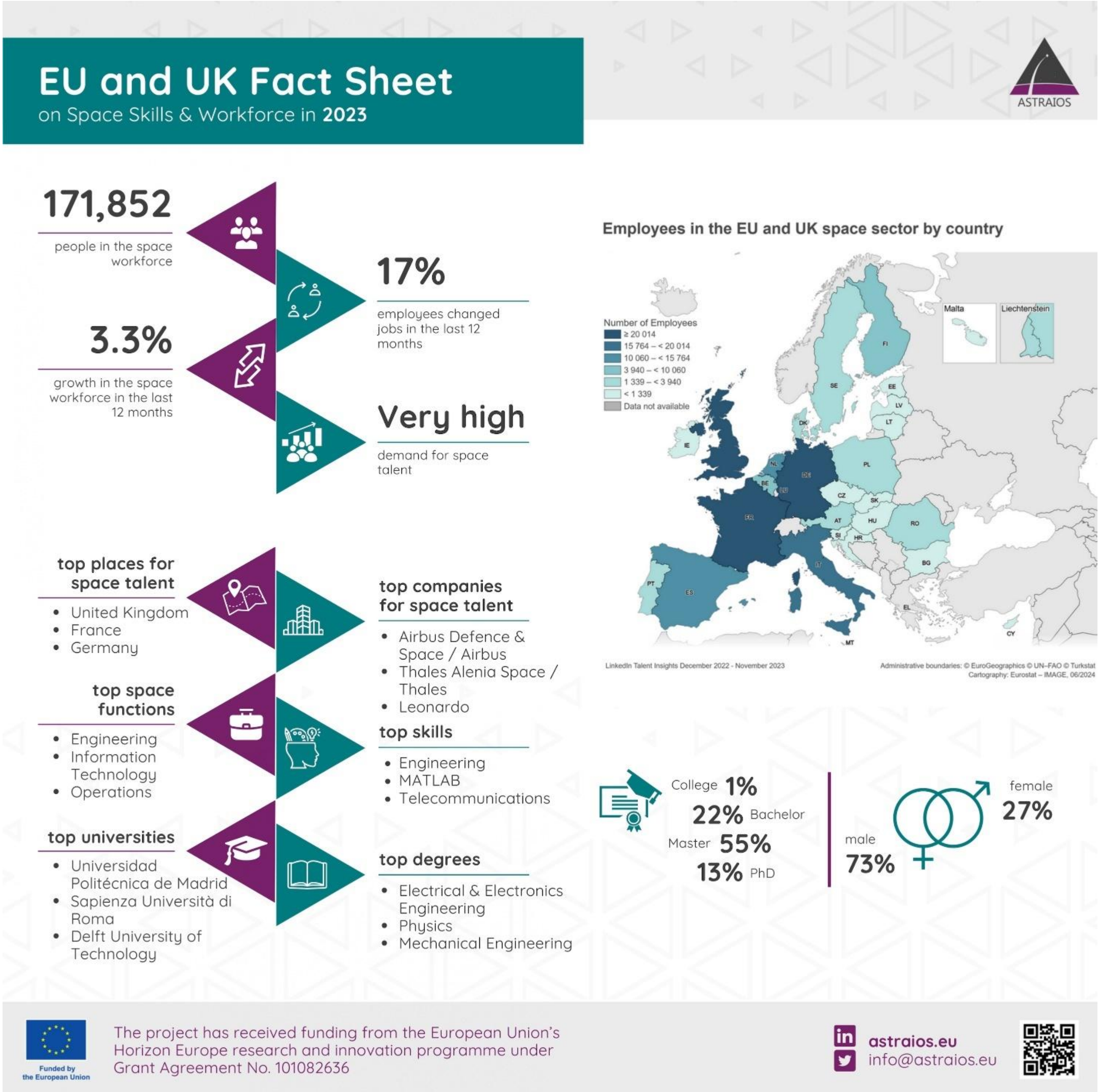


Figure 4: Skills & workforce infographic for the EU and UK space sector in 2023

## D3.1: Analysis report of skills demand and capabilities across sector

### 1. *Context and gap addressed*

Across the European space sector, a wide range of evidence has been produced on education provision, workforce characteristics, labour-market dynamics and skills needs. Studies and datasets have addressed topics such as workforce demographics, graduate outcomes, employer expectations, job vacancies and curriculum content, often focusing on particular segments of the sector or specific analytical questions.

This evidence base is both substantial and diverse, reflecting contributions from EU-funded projects, industry surveys, agency statistics and academic research [24]. At the same time, these sources tend to approach skills demand and capabilities from different perspectives (educational, occupational, organisational or market-oriented) using varying classifications and levels of granularity. Within ASTRAIOS, earlier work packages assembled structured information on curricula (WP1000), workforce demographics and mobility, sectoral trends, and applications and services (WP2000), providing complementary views on how skills are produced, demanded and utilised across the space value chain.

### 2. *Objective*

In line with WP3000, D3.1 aimed to bring together evidence from education, workforce and labour-market analyses to examine the relationship between skills demand and capabilities within the European space sector. The objective was to align data from multiple sources using a common analytical framework, supporting an integrated view of how education provision, employer needs and workforce characteristics relate to one another at European scale, and informing subsequent synthesis and recommendations.

### 3. *Methodology*

The deliverable integrates evidence from several sources:

- ASTRAIOS outputs, including mappings of degree programmes, the EU space skills taxonomy and workforce demographic and mobility analyses.
- Employer surveys and interviews capturing required skills, recruitment challenges and workplace expectations.
- Job market data from LinkedIn Talent Insights and space job portals, covering roles, skills and experience levels.
- Curriculum descriptors and module information from higher education institutions to evaluate content and pedagogical approaches.
- A comparative analytical framework aligning all sources with the EU-TaSK taxonomy to assess gaps in technical and transversal skills.

This mixed method approach allows quantitative indicators to be linked with qualitative insights on training practices and employer needs.

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## 4. *Key results*

| | |
|---|---|
| Workforce structure | The European space workforce continues to grow, with strong concentrations in specific countries. Many roles require advanced qualifications, especially in engineering and computing fields. |
| Technical skill needs | High demand exists for software engineering, systems engineering, mission operations, data analysis, modelling and digital technologies such as AI and autonomy. These areas show persistent shortages relative to employer expectations. |
| Non-technical skill needs | Communication, teamwork, adaptability and problem solving are essential for multidisciplinary work. Employers report that these skills are often underdeveloped in graduate profiles. |
| Sources of skills mismatches | The report identifies curriculum misalignment, limited practical training, uneven geographical distribution of programmes, lack of vocational routes and variable exposure to interdisciplinary practice as structural causes of current skill gaps. |
| Mobility and labour market dynamics | Internal mobility across organisations and roles is significant. Workers move toward regions with stronger industrial ecosystems. Competition from other technology sectors also influences retention. |
| Curriculum and pedagogy | Many programmes provide strong theoretical foundations but offer fewer applied or interdisciplinary learning opportunities. Exposure to emerging technologies, digital tools and project-based learning varies considerably. |

## 5. *Outcomes*

D3.1 provides a coherent assessment of skills demand and capabilities across the European space sector. It identifies where the education to workforce pipeline performs well and where it does not meet the needs of employers. The deliverable clarifies which technical and transversal skills are most needed and highlights the structural causes of mismatches.

It also offers an evidence base for curriculum reform, the design of upskilling and reskilling initiatives and the development of stronger cooperation between industry and education providers. By integrating multiple sources and aligning them to the EU-TaSK taxonomy, D3.1 establishes a foundation for subsequent recommendations on how Europe can strengthen its space workforce and respond to emerging skill demands.

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## D3.2: Analysis report of geographical gaps & student mobility characteristics

### 1. *Context and gap addressed*

The geographical distribution of space-related education and training opportunities across Europe has been shaped by historical, institutional and economic factors. Higher concentrations of programmes and research capacity are found in certain countries and regions, while others host more limited provision. At the same time, student and graduate mobility has long been a feature of European higher education, supported by formal mobility schemes, institutional partnerships and individual career choices.

Geographical patterns in education provision and mobility are relevant for understanding access to training, regional capacity building and longer-term workforce distribution. Existing studies have examined programme availability, mobility schemes, migration flows and workforce location, often addressing these topics separately or from different disciplinary perspectives [24]. Within ASTRAIOS, earlier deliverables provided structured information on curricula distribution, workforce demographics and mobility indicators, creating a basis for examining how these elements interact.

### 2. *Objective*

As described in WP3000, D3.2 aimed to analyse geographical patterns in space education provision alongside student mobility characteristics, drawing on structured curriculum data, workforce datasets and survey evidence. The objective was to explore how educational geography and mobility dynamics interact within the European space sector, and to provide evidence that could inform discussion on access, regional balance and education-to-workforce pathways.

### 3. *Methodology*

The report combines evidence from several sources:

- Desktop research on space education provision across EU-27 and the UK, building on earlier ASTRAIOS outputs.
- The ASTRAIOS Web Catalogue of space-related curricula, used to identify programme availability, tuition patterns and language of instruction.
- The EU Space Sector Demographics Report and Database, used to contextualise workforce distribution and regional imbalances.
- LinkedIn Talent Insights, providing indicators of graduate movement, migration flows and workforce mobility.
- Surveys, including the Mobility and Soft Skills survey and the Career Paths survey, capturing student motivations, barriers, demographics and movement histories.
- Analysis of mobility programmes such as Erasmus+ and a focused review of the UK Students for the Exploration & Development of Space (UKSEDS) student mobility survey.

These sources were synthesised to compare programme coverage, student behaviour and workforce outcomes.

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## 4. *Key results*

| | |
|---|---|
| Geographical coverage | The distribution of space education programmes is uneven. Western Europe holds the majority of Bachelor, Master and PhD offerings. Eastern and Southern Europe have limited provision and fewer specialised programmes, which creates structural gaps. |
| Mobility patterns | Students commonly relocate for higher quality programmes, better research facilities, stronger industry ecosystems and more internationally recognised qualifications. Figures in the report show notable outward movement from underrepresented countries toward Western hubs. |
| Drivers of mobility | Survey participants identified curriculum appeal, availability of specialised training, career prospects, language of instruction, financial considerations and cultural factors as major reasons for moving to another country. |
| Barriers to mobility | Financial cost, limited scholarships, language constraints, administrative burden and lack of awareness of opportunities were the most frequently reported obstacles. Erasmus+ is widely used but does not fully eliminate access barriers. |
| Workforce implications | Mobility contributes to brain drain from underrepresented regions. Workforce data show that graduates often remain in countries where they study, reinforcing regional disparities in workforce distribution. |
| Survey insights | Survey results highlight diverse demographic backgrounds, varying field of study patterns and extensive movement histories. Many respondents completed degrees outside their home country, often moving more than once during their studies. |

## 5. *Outcomes*

D3.2 provides a consolidated view of geographical imbalances in European space education and clarifies how mobility contributes to these patterns. It identifies structural disparities in programme availability, highlights the motivations and constraints that shape student movement and shows how mobility patterns influence workforce distribution.

The deliverable offers evidence that targeted interventions are needed to strengthen provision in underrepresented regions, reduce barriers to mobility and support a more balanced education to workforce pipeline. It also provides a foundation for developing recommendations that address regional inequalities and support more inclusive participation in the European space sector.

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## D3.3: Analysis report of Equality, Diversity and Inclusion Issues

### 1. *Context and gap addressed*

The European space sector is strategically important and continues to expand, but its workforce remains demographically narrow. Historically, the sector has been dominated by men from a limited set of social and cultural backgrounds, and progress toward greater equality, diversity and inclusion has been slow. Existing initiatives at European and national level address EDI principles, but evidence shows persistent gaps in representation, access and career progression, particularly for women and individuals from less advantaged backgrounds.

EDI-related evidence exists across multiple domains, including education statistics, workforce surveys, organisational practices and targeted studies focusing on gender, nationality, career stage or socio-economic background. These sources contribute valuable insights into participation and experience within the space sector, while often being generated for specific purposes or audiences. Within ASTRAIOS, data collected on education pathways, workforce demographics, mobility and skills demand provided an opportunity to consider EDI alongside structural features of the skills pipeline.

### 2. *Objective*

As detailed in WP3000, D3.3 aimed to examine equality, diversity and inclusion issues across the space skills pipeline by connecting evidence from education, workforce data, skills demand analysis and stakeholder surveys. The objective was to support a more holistic discussion of how EDI considerations relate to education pathways, recruitment, retention and progression within the European space sector, contributing to the project's overall synthesis and recommendations.

### 3. *Methodology*

The deliverable applies a mixed qualitative and quantitative approach.

- Surveys distributed across the ASTRAIOS partner network, targeting students, early-career professionals and established sector actors, to capture perceptions, experiences and priorities related to EDI.
- Analysis of workforce data, including demographic structure, age distribution and mobility patterns across EU Member States and the United Kingdom.
- Review of education provision, focusing on the distribution of space-related programmes and access to STEM pathways.
- Desk research drawing on institutional reports, academic literature and policy documents related to EDI in space and STEM sectors.

Quantitative data were analysed for trends and imbalances, while qualitative inputs were thematically analysed to identify recurring barriers and structural issues.

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## 4. *Key results*

| | |
|---|---|
| Workforce composition and representation | The European space workforce has grown steadily. Nevertheless, it remains heavily male-dominated. Women account for approximately one quarter of the workforce, with even lower representation in senior and decision-making roles. Progress toward parity has been incremental and uneven across countries and organisations. |
| Age structure and generational imbalance | The workforce shows signs of ageing, particularly in long-established Member States, with high proportions of employees approaching retirement. Newer Member States tend to have younger workforces, highlighting disparities in experience distribution and future replacement needs. |
| Education access and STEM pathways | Space-related education programmes are widely available in Europe. Still, they are geographically concentrated in a limited number of hubs. Access to STEM education remains uneven, with gender and socio-economic background influencing participation and performance, particularly in advanced mathematics and physics. |
| Skills gaps from an EDI perspective | The sector faces persistent shortages in technical skills, while non-technical skills are more readily available. Misalignment exists between university outputs, which emphasise Master's and PhD profiles, and industry demand, which often prioritises Bachelor-level engineers. These mismatches disproportionately affect early-career entrants and underrepresented groups. |
| Workplace culture and retention | Survey evidence highlights that workplace culture, work-life balance and informal practices strongly influence inclusion and retention. Discrimination, exclusion and harassment remain reported issues, particularly for women and young professionals. Flexible working arrangements and transparent career pathways are inconsistently applied across the sector. |
| Perceptions and expectations of the incoming workforce | Many students perceive entry into the space labour market as difficult, despite evidence of sustained demand. Mentorship, role models and clearer information on career pathways are identified as critical factors for improving confidence, inclusion and early-career integration. |

## 5. *Outcomes*

D3.3 provides a comprehensive analysis of Equality, Diversity and Inclusion challenges across the European space sector. It demonstrates that EDI issues are not confined to recruitment, but are shaped by education access, skills alignment, organisational culture and career progression mechanisms.

The deliverable shows that small imbalances at entry level accumulate over time, resulting in pronounced underrepresentation at senior levels. It highlights the need for coordinated action across education, industry and policy, combining structural reforms with targeted support measures such as transparent recruitment, mentoring, skills development and inclusive workplace practices.

By framing diversity as both a social responsibility and a strategic requirement for innovation and workforce sustainability, D3.3 provides an evidence base to support future policy measures, curriculum adaptation and human resources strategies across Europe's space ecosystem.

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## D3.4: Mentoring virtual programme established across Europe focusing on addressing EDI issues

### 1. *Context and gap addressed*

The European space sector is undergoing rapid transformation driven by increased interdisciplinarity, digitalisation and cross-border collaboration. These changes place greater emphasis on transferable skills, professional adaptability and inclusive workplace practices. Mid-career professionals entering or transitioning within the space sector often face structural barriers related to access to networks, informal knowledge, organisational culture and career guidance.

Mentoring is one of several practices that can contribute to inclusion, retention and progression within the space workforce, particularly when combined with broader organisational and cultural measures. At the same time, mentoring is typically embedded within local or thematic initiatives, and its role in addressing EDI considerations is shaped by programme design, participant profiles and organisational context. Within ASTRAIOS, earlier analyses of education pathways, workforce demographics, mobility patterns and EDI issues provided a basis for exploring how mentoring might be structured and experienced across different stages of the space skills pipeline.

### 2. *Objective*

As part of WP3000, D3.4 aimed to design, implement and reflect on a virtual mentoring programme involving participants from across Europe, with a particular focus on equality, diversity and inclusion considerations. The objective was to explore mentoring as a supportive practice within the space sector, generate insights into participant experiences and programme design, and contribute qualitative evidence to the project's broader analysis of education-to-workforce pathways, progression and inclusion.

### 3. *Methodology*

The mentoring programme was implemented as a pilot using a structured yet flexible design.

- Targeted recruitment of mentors and mentees through consortium networks, professional communities and open calls, with defined eligibility criteria to ensure diversity of profiles, experience levels and geographies.
- Use of entry surveys and onboarding questionnaires to capture expectations, prior mentoring experience and perceived challenges related to career transitions.
- Formation of mentor–mentee pairs, supported by guidance materials and self-scheduled individual meetings.
- Organisation of two collective virtual sessions featuring experienced professionals, enabling shared discussion, experience exchange and peer interaction.
- Exit surveys and qualitative feedback to compare expectations with outcomes and identify lessons learned.

Data collection prioritised anonymity and transparency to support trust, reduce bias and align with EDI principles.

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## 4. *Key results*

| | |
|---|---|
| Participation and cohort composition | Thirty-two participants were selected from thirty-eight applicants, forming mentor–mentee pairs across multiple European countries. Participants represented a mix of industry, academia and public institutions, with both mentors and mentees contributing to programme activities. |
| Mentoring activities | Participants completed up to three individual mentor–mentee meetings over a six-week period. Two collective sessions brought together mentors, mentees and invited speakers to discuss career transitions, challenges and opportunities in the space sector. |
| Demand for mentoring | Application patterns revealed higher demand for mentee roles than mentor roles, indicating strong interest in mentoring support even among relatively experienced professionals. Some participants agreed to take on mentor roles despite initially applying as mentees. |
| Perceived value | Feedback highlighted the value of direct experience sharing, informal knowledge transfer and human interaction beyond typical workplace settings. Participants emphasised the usefulness of mentoring during career transitions and the importance of structured yet low-burden programme design. |
| EDI relevance | The programme supported inclusion by lowering barriers to access mentoring, fostering cross-background interaction and creating a psychologically safe space for discussing career challenges. Collective sessions were identified as a particularly inclusive format with potential for wider outreach. |

## 5. *Outcomes*

D3.4 demonstrates that a virtual mentoring programme can effectively support mid-career transitions into the European space sector while contributing to EDI objectives. The pilot shows that mentoring can enhance access to informal knowledge, strengthen professional confidence and support smoother integration into the sector.

The deliverable identifies practical considerations for future mentoring initiatives, including the need for early mentor recruitment, manageable time commitments, clear guidance materials and open collective sessions to maximise inclusivity. By documenting implementation choices, participant experiences and lessons learned, D3.4 provides a replicable reference for organisations seeking to use mentoring as a tool for workforce development and inclusion in the European space ecosystem.

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# 4. Recommendations

## 4.1 Recommendations for policymakers

1. ***Strengthen financial support and targeted funding mechanisms to address economic barriers [D3.2, D2.8]***

Economic and regional inequalities limit participation in mobility and advanced study. Expanded financial mechanisms can help learners from disadvantaged regions access specialised training and reduce imbalances in who can take part in international programmes.

2. ***Improve coherence and coordination across European education, industry, and policy mechanisms [D1.1, D3.1, D2.2]***

Fragmentation across initiatives, programmes and institutional structures reduces efficiency and makes it harder for learners and organisations to navigate opportunities. Better coordination and communication/dissemination of such initiatives can reduce duplication, improve transparency and support more consistent development across Member States.

3. ***Prioritise digital and data intensive skills within strategic policy frameworks [D2.8, D3.1, D1.1]***

Workforce shortages in areas such as software engineering, artificial intelligence & machine learning, data processing, and cloud operations are among the most critical limiting factors for sector growth. Targeted policy support can help accelerate the development of training capacity in these areas in general, while wider advertising of opportunities and career prospects in the space sector can help draw in students and graduates from these fields.

4. ***Embed equality, diversity, and inclusion within space sector policy and institutional workflows [D3.2, D2.8, D2.3]***

Persistent demographic and regional imbalances diminish the available talent pool. Policies that promote inclusion, equitable participation and transparent recruitment can strengthen long term workforce resilience. Supporting existing initiatives (e.g., DIVERIS) and internationally recognised networks such as WIA-Europe and SGAC helps focus the effort and expertise and prevent spreading resources too thinly.

5. ***Create mechanisms to sustain and institutionalise outputs from EU-funded projects [D3.1]***

Many European initiatives generate high quality training materials, taxonomies, and tools. Long term mechanisms are needed to ensure these outputs become part of permanent structures rather than remaining isolated project results. Coordinating efforts to build a comprehensive dataset of resources resulting from EU-funded projects/initiatives would help capitalising on project outputs and save resources for future initiatives.

6. ***Ensure ESCO updates include missing space-sector knowledge concepts (e.g., spacecraft engineering, systems engineering) [D1.2]***

Explicit recommendations in D1.2 highlight that ESCO lacks key space-specific knowledge categories. Updating ESCO ensures accurate skill classification, supports curriculum development, and improves labour-market transparency.

## 4.2 Recommendations for educators and universities

7. ***Improve alignment between educational provision and evolving industry needs [D1.1, D3.1, D2.8]***

Rapid technological change requires curricula to adapt more quickly. Closer alignment with industry needs helps learners acquire relevant technical and interdisciplinary skills and reduces mismatches between graduate capabilities and workforce expectations. Mechanisms shall be put in place to regularly benchmark

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industry needs against academic curricula and learning methods. This could be facilitated through existing European initiatives such as the Large-Scale Skills Partnership and Space Careers Launchpad, but would require further investment from the European Commission.

8. ***Progress toward standardised curricula and clearer qualification recognition across Europe [D1.1, D3.1]***
Inconsistent curricula and limited cross border recognition create barriers to mobility and reduce transparency for employers. Greater standardisation supports smoother transitions and helps ensure comparable training quality.

9. ***Enhance accessibility through flexible pathways, modular provision and lifelong learning structures [D1.1, D3.1, D3.2]***
Clearer, more flexible routes into and through education help both learners and mid-career professionals navigate the sector. Modular formats and well-defined progression pathways support continuous skill development.

10. ***Strengthen soft skills training through structured curricular integration [D2.3, D3.1]***
Competencies such as communication, teamwork, leadership and adaptability are increasingly important across all parts of the space value chain. Integrating these skills into programmes prepares learners for multidisciplinary and international work environments.

11. ***Provide multilingual support, preparatory language training and intercultural integration resources [D3.2, D2.3]***
Language barriers reduce access to advanced programmes and limit mobility. Preparatory language courses and integration support help more learners participate in international training and study opportunities.

12. ***Increase visibility and consolidation of information on programmes, pathways and funding [D1.1, D3.2]***
A lack of clear information discourages participation and leads to unequal uptake across regions. Streamlined and accessible communication helps potential learners understand available opportunities and make informed decisions.

13. ***Strengthen institutional support for inclusive environments and equitable participation [D3.2, D2.3, D2.8]***
Inclusive learning environments and transparent processes help address structural barriers faced by underrepresented groups. Improved support systems enhance retention and progression throughout the education pipeline. One current and successful example of this is the UKSEDS network[8], which hosts a variety of opportunities in student competitions, funding, conferences, and mentoring programmes, and coordinates the participation of students in these through university-based branches. Though international branches of SEDS exist in the UK, Singapore, Turkey, etc., SEDS is not widely established in the EU.

14. ***Embed practical, experiential learning systematically within degree programmes [D3.1]***
Hands-on learning (projects, laboratories, real-world challenges) reduces transition gaps between education and employment and responds to explicit industry requests.

[8] More information on UKSEDS can be found online.

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15. ***Promote interdisciplinary teamwork and project-management training within technical degrees [D3.1]***
Space sector work is inherently interdisciplinary. Early exposure to collaborative, cross-domain projects improves analytical thinking, collaboration skills and team competence.

## 4.3 Recommendations for the space industry sector

16. ***Expand structured upskilling, reskilling and lifelong learning opportunities [D1.1, D3.1, D2.8]***
Skills requirements are changing quickly and vary across organisations. Strengthening access to continuous professional development helps employees keep pace with technological advances and supports organisational competitiveness.

17. ***Participate in academia industry partnerships that support curriculum relevance and practical experience [D3.1, D2.2]***
Close collaboration with educational institutions ensures that training content reflects real workforce needs. Internships, vocational education and apprenticeships, and co-developed modules provide valuable applied experience and improve workforce readiness.

18. ***Foster workplace cultures that support diversity, retention and equitable progression [D2.3, D2.8, D3.2]***
Supportive workplace cultures contribute to better retention and more sustainable workforce development. Transparent progression pathways and inclusive practices can strengthen organisational stability and attract a wider range of talent.

19. ***Contribute to coordinated funding and mobility support mechanisms [D3.2, D2.8]***
Industry participation in scholarship and mobility schemes helps widen access to learning and training, particularly in specialised areas. This strengthens the future talent pool and supports sector wide capacity building. Industrial PhDs, which are an example of such schemes, prove already successful in some European countries.

20. ***Adopt structured approaches to evaluating and developing soft skills in the workplace [D2.3]***
Standardising soft-skill evaluation enhances fairness, transparency and professional development consistency by transforming subjective experiences into shared, observable, and development-oriented practices. This could be achieved by establishing a framework to systematically evaluate and develop these skills through the career progression path: integrating soft skills into performance appraisal models, embedding soft skills development into operative functions, leadership accountability, and building a continuous soft skills development pathway .

21. ***Adapt recruitment and talent-management strategies for hybrid/remote work environments [D2.3]***
Remote operations require new competencies and recruitment criteria; updating HR practices ensures hiring aligns with modern work realities.

## 4.4 Recommendations for individuals seeking to enter the space sector

22. ***Strengthen digital, data and software skills to meet core labour market demands [D2.8, D3.1]***
Digital and data driven skills are among the most sought-after capabilities in the sector. Strengthening these areas significantly increases employability across upstream, midstream and downstream roles.

23. ***Build interdisciplinary knowledge that links engineering, data science and application domains [D1.1, D3.1]***
Emerging roles increasingly require a mix of technical, analytical and domain specific skills. Developing interdisciplinary competence helps individuals adapt to evolving job profiles.

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24. ***Engage in mobility programmes, internships, apprenticeships and collaborative projects [D3.2]***
Practical experience reinforces both technical expertise and transversal skills. Participating in applied learning activities supports smoother transitions into the workforce.

25. ***Strengthen soft skills to support work in multicultural and interdisciplinary contexts [D2.3, D3.1]***
Communication, collaboration and adaptability are fundamental to success in international and multidisciplinary teams. Developing these skills improves readiness for complex project environments.

26. ***Improve language capabilities to access advanced programmes and mobility opportunities [D3.2]***
Language proficiency is often necessary for participation in international programmes and collaborative projects. Strengthening language skills widens access to training and mobility.

27. ***Participate in professional networks and mentorship initiatives [D3.1, D3.2]***
Networks and mentorship communities provide guidance, visibility and support for early and mid-career entrants. Engagement with these groups helps individuals navigate the sector more effectively.

28. ***Actively seek information on pathways, training routes and funding opportunities [D1.1, D3.2]***
A proactive approach to understanding available opportunities helps individuals identify the most suitable routes into the sector and overcome informational barriers.

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## 5. Referenced Deliverables

[D1.1] M. Belgiu, Y. Al Asmar, R. Vargas Maretto, H. La and S. Ronzhin, ASTRAIOS Deliverable D1.1: Structured Data Set of HEIs and Offered Space-Relevant Curricula/Courses, 2023.

[D1.2] H. Thiemann and J. Dudley, ASTRAIOS Deliverable D1.2: Developing a European Taxonomy of Space Knowledge (EU-TaSK), 2023.

[D1.3] H. Thiemann and J. Dudley, ASTRAIOS Deliverable D1.3: EU Space Sector Demographics Report and Database, 2024.

[D2.1] M. Kolehmainen, E. Detsis, J.-D. Bodénan and R. Pradal, ASTRAIOS Deliverable D2.1: Overview of the Trends and Challenges for the European Space Sector, 2023.

[D2.2] D. Bournou, R. Pavone, K. Vanderhauwaert and H. Bracquené, ASTRAIOS Deliverable D2.2: Applications, Services and Supporting Technologies, 2024.

[D2.3] D. Ignjatovic and J. Moser, ASTRAIOS Deliverable D2.3: Space Sector Soft Skills, 2023.

[D2.4] A. De Almeida, ASTRAIOS D2.4: Profiles of success stories on EO and GNSS, 2025.

[D2.5] A. De Almeida, ASTRAIOS Deliverable D2.5: European Bootcamp to bring European students/entrepreneurstogether and be trained in transferable training skills, 2025.

[D2.6] A. De Almeida, ASTRAIOS D2.6: MOOC on soft skills and new way of working, 2025.

[D2.7] C. Ramos and I. Balenciaga, ASTRAIOS D2.7: Environmental, Social and Governance Report in the Space Entrepreneurship Ecosystem: Trends, Challenges and Opportunities, 2025.

[D2.8] W. Lahaye, H. Thiemann, R. Pradal and M. Tabsissi, ASTRAIOS D2.8: Workforce demand evolution and distribution, 2025.

[D3.1] E. Zabihian, M. N. Kardassi, C. Maddock, H. Thiemann and S. Kerkezian, ASTRAIOS Deliverable D3.1: Analysis report of skills demand and capabilities across sector, 2025.

[D3.2] S. Kerkezian, E. Zabihian and H. Thiemann, ASTRAIOS D3.2: Analysis report of geographical gaps & student mobility characteristics, 2024.

[D3.3] G. Gaillard, ASTRAIOS D3.3: Analysis report of Equality, Diversity and Inclusion Issues, 2025.

[D3.4] G. Gaillard, ASTRAIOS D3.4: Mentoring virtual programme established across Europe focusing on addressing EDI issues, 2025.

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# 6. References

[1] Council of the European Union, *Council Recommendation on the European Qualifications Framework for Lifelong Learning,* 2017.

[2] Cedefop, Terminology of European education and training policy: A selection of 430 key terms, Publications Office of the European Union, 2014.

[3] European Commission, "Erasmus+ Programme Guide," 2024.

[4] European Space Policy Institute, *Space Education in Europe,* 2022.

[5] European Commission, *The ESCO Classification: European Skills, Competences, Qualifications and Occupations,* 2024.

[6] H. B. Thiemann, J. Dudley, W. Lecky and E. Dallas, *Space Sector Skills Survey 2023,* Space Skills Alliance, 2023.

[7] Cedefop, "Skills Forecast Methodological Framework," 2020.

[8] Cedefop, *Skills intelligence,* 2022.

[9] Cedefop, "Insights into skill shortages and skill mismatch," 2018.

[10] EO4GEO Consortium, *EO4GEO Body of Knowledge (BoK),* 2021.

[11] EO4GEO Consortium, *Sector Skills Strategy for Earth Observation and Geoinformation,* 2022.

[12] OECD, "The Space Economy in Figures: How Space Contributes to the Global Economy," OECD Publishing, Paris, 2019.

[13] OECD, "OECD Handbook on Measuring the Space Economy," OECD Publishing, Paris, 2012.

[14] C. Evroux, "EU space policy: Boosting EU competitiveness and accelerating the twin ecological and digital transition," European Parliamentary Research Service, Brussels, 2022.

[15] H. B. Thiemann and J. Dudley, *Demographics of the UK Space Sector,* Space Skills Alliance, 2021.

[16] UNOOSA, *Space4Women: Landmark Study on Gender Equality in the Space Sector,* 2021.

[17] Women in Aerospace Europe, *Skills Gap in the Aerospace Sector: Causes, definitions, analysis, and responses,* 2021.

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[18] *Oxford English Dictionary,* Oxford: Oxford University Press, 2025.

[19] STARS*EU Project Consortium, *STARS*EU Space Career Portal,* 2024.

[20] European Space Agency, *ESA Graduate Trainee Programme - Overview,* 2023.

[21] European Space Agency, *ESA Education: Programmes and Resources,* 2023.

[22] EU Charter of Fundamental Rights, "Article 21 - Non-discrimination," *Official Journal of the European Union C 303/17,* 14 12 2007.

[23] J. Hart, M. Noack, C. Plaimauer and J. Bjørnåvold, "Towards a structured and consistent terminology on transversal skills and competences," European Commission, Cedefop, 2021.

[24] M. N. Kardassi and C. Maddock, "State of Skills Gaps within the Space Sector in Europe," University of Strathclyde, Glasgow, 2025.

[25] D. Rocks and P. Moore, "Beyond the Horizon: Building Ireland's Space Workforce," Department of Further and HIgher Education, Research, Innovation and Science, Dublin, 2025.

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This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement **No. 101082636**

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