D1.1

Structured data set of HEIs and other institutions/organizations and offered space-relevant curricula/courses

Document Author(s)	Mariana Belgiu, Yolla Al Asmar, Raian Vargas Maretto, Hanh La, Stanislav Ronzhin (Twente)
Document Contributor(s)	Mariana Belgiu, Yolla Al Asmar, Raian Vargas Maretto, Hanh La, Stanislav Ronzhin (Twente)

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Abstract

Competitiveness and innovation of the EU space sector depend on high educational standards and the availability of skilled professionals in the field, as well as the possibility for these professionals to enhance and update their skills through their careers so that they can adapt to changing circumstances. This report describes the analysis of the space-related educational programs and their courses at the Bachelor, MSc, PhD, and continuing education (CE) levels. We selected and analyzed the courses and educational standards of 132 Degree Programs (DPs) at Bachelor (25 DPs) and Master (107 DPs) levels, 19 PhD programs, and 60 CE courses. Therefore, the findings presented in this report reflect the characteristics of the gathered DPs and courses. Thematic diversity, space sectors, and geographic coverage were the main criteria used to select the DPs and courses. Gathered DPs have been mapped across 28 knowledge domains (KDs) and 105 knowledge areas (KAs) identified in this report and across the different segments of the value chain of space activities relevant to the three space sectors: upstream, midstream, and downstream. The diversity of KDs and KAs highlights the interdisciplinary nature of the space sector education programs that cover a wide range of scientific knowledge, and technological skills. Most of the analyzed Bachelor DPs are related to the upstream sector, whereas the Master and PhD DPs are equally related to the downstream and upstream sectors. Some of the gathered DPs focus on understanding Earth's environment, atmospheric monitoring, and climate change using space-related technologies. Yet, the lower representation of these KDs suggests a potential need for an increased emphasis on these areas in the context of space-related educational programs. Similarly, the low occurrences of space safety and space traffic management KAs suggest that space systems engineering KD receives less attention in the gathered space education at the Master level. Some of the analyzed DPs offer a diverse range of elective courses to develop transversal skills (leadership, entrepreneurship, communication, or presentation skills) and include internships either as compulsory or optional activities. The analyzed PhD programs share a common emphasis on developing not only discipline-related skills but also transversal skills such as effective communication, teamwork, and project management skills.

The analyzed DPs and courses are shared in a structured and curated web catalogue, that allows users to search, and retrieve collected DPs and courses based on country, institution, language, space sector, KAs, KDs or European Qualifications Framework (EQF) level. We concluded that the analysis of the educational capabilities in the space sector should be conducted regularly so that we can assess the changes in the educational offerings and standards over time. The geographic coverage of the analyzed data should also be extended beyond EU-27 +UK.

Keywords: knowledge areas, knowledge domains, downstream space sector, upstream space sector, midstream space sector, educational standards, continuing education, transversal skills

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Table 1. Glossary

Name	Description
Continuing Education	Used as synonym of Life Long Learning in this report. According to EUROSTAT, Lifelong learning encompasses all learning activities undertaken throughout life with the aim of improving knowledge, skills and competences, within personal, civic, social or employment-related perspectives. The intention or aim to learn is the critical point that distinguishes these activities from non-learning activities, such as cultural or sporting activities.
Degree Program	Curriculum or course of study in a discipline or field that leads to a degree.
Downstream space sector	The OECD defines the downstream as follows: "downstream space activities comprise the provision of products and services that rely on satellite signals or data, aimed at consumer and business markets. They include primarily satellite communications and precision, navigation and timing applications, but also earth observation products and services, which have greatly benefited from advances in artificial intelligence and cloud computing."
European Qualification Framework (EQF)	Facilitates the recognition of qualifications acquired in different European countries, promoting mobility and lifelong learning opportunities across the continent. It consists of eight levels that are based on learning outcomes defined in terms of knowledge, skills, responsibility, and autonomy. These levels range from basic qualifications (Level 1) to the highest academic and professional qualifications (Level 8). Bachelor = EQF 6; Master = EQF 7 and PhD = EQF 8.
Joint Program	International programs jointly designed and delivered by a group of higher education institutions.
Knowledge Areas	The main branches or categories under the upper hierarchy, each subclass represents more detailed or specialized areas within the broader domain. These are roughly equivalent to courses within a degree. These are also known as KA.
Knowledge Domains	The top level or the main categories in the two-level hierarchy. Each class represent the broadest classification of a major divisions of knowledge. They are roughly equivalent to degree subjects. These are also known as KD.
Midstream space sector	According to OECD "an increasing number of organizations are starting to use the "mid-stream" concept (between upstream and downstream) to categorize space and ground system operations and describe activities along the value chain. These crucial activities constitute the link between satellites and terrestrial

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	infrastructures. They may be categorized in either upstream or downstream activities depending on methodological choices."
PhD program	Postgraduate academic degree
Study program	A combination of core, elective and general education courses as specified in the syllabus required to complete a specific degree
Theme	A focus topic or subject with common characteristics
Transversal skills	European Classification of Skills, Competences, Qualifications and Occupations (ESCO) definition: "Transversal skills are 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"
Upstream space sector	The OECD defines the upstream as "any space program requires strong scientific and technological foundations ranging from basic research to full production of space and ground systems."

Table 2. Abbreviations

Abbreviations	Explanations
BEng	Bachelor of Engineering
BoK	Body of Knowledge
DP(s)	Degree Program(s)
EASN	European Aeronautics Science Network
ECTS	European Credit Transfer and Accumulation System (ECTS)
EQF	European Qualification Framework
ESA	European Space Agency
ESCO	European Skills, Competencies, Qualifications, and Occupations Classification
ESOC	European Space Operations Centre
HEIs	Higher Education Institution
KAs	Knowledge areas
KDs	Knowledge domains
MEng	Master of Engineering
MSCA	Marie Skłodowska-Curie Actions
STEAM&T	Science, Technology, Engineering, Arts, Mathematics & Transversal
UAV	Unmanned Aerial Vehicle

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1. INTRODUCTION

1.1. General Information

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

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

Competitiveness and innovation of the EU space sector depend on high educational standards and the availability of skilled professionals in the field, as well as the possibility for these professionals to enhance and update their skills through their careers to adapt to changing circumstances. This is of special interest to the European R&I community, where the quality of the results and the impact of EU-funded research is a requirement for the future space sector. This report described the outcomes of the analysis of different educational programs at Bachelor, MSc, PhD, and continuing education levels in the space sector across the EU-27+UK. We identified and analyzed 3591 courses offered by 132 Degree Programs (DPs) at Bachelor (25 DPs) and Master (107 DPs) levels, 19 PhD programs and 60 continuing education (CE) courses. The identified programs, learning objectives and course descriptions have been mapped across the different segments of the value chain of space activities (upstream, midstream, and downstream) of the EU-27+UK and across space relevant knowledge domains (KDs) and knowledge areas (KAs) identified by the ASTRAIOS team. We created a structured and curated online catalogue, that allows users to search, and retrieve the education offers in the space-related sectors based on country, institution, language, space sector or European Qualifications Framework (EQF) level.

This report describes the outcomes of the analysis of relevant educational programs and their courses at the Bachelor, MSc, PhD and CE levels. The following activities are summarized:

- Designing and implementing the ASTRAIOS database and database schema to structure and organize information about the identified space sector's relevant DPs at the Bachelor, Master and PhD levels PhD, and CE courses.

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- Identification of the relevant space sector-related educational programs and courses using an online survey and capitalizing on the expertise and network of the ASTRAIOS team.
- Mapping the identified programs and courses across the different segments of the value chain of space activities.
- Mapping the gathered DPs and courses to space relevant KDs and KAs considered in ASTRAIOS.
- Structuring collected information on educational courses and programs into an online catalogue developed using LinkedData Technology.

1.2. Structure of the document

Table 3 shows the structure of the document in details.

Table 3. Structure of the document

Chapter	Title	Description
1	Introduction	General introduction of the objectives of this deliverable and summary of the relevant previous projects.
2	ASTRAIOS Database	Overview of the database used to store the collected information.
3	Knowledge domains and knowledge areas	Presentation of the knowledge domains and areas considered to categorize the degree programs and courses.
4	Data collection methods	Presentation of the methods used to collect information about DPs, CE courses and PhD programs.
5	Web Catalogue	Overview of the Linked Data technologies used to develop the searchable catalogue and the indexed information.
6	Analysis of the Bachelor and Master programs	Analysis of the collected courses offered by the Bachelor and Master programs included in our analysis.
7	Analysis of the PhD programs	Analysis of the PhD programs offered by several universities in EU+UK and those offered in the framework of MSCA doctoral networks.
8	Analysis of CE courses	Analyzing the identified CE courses.
9	Conclusions and recommendations	Key conclusions.
10	References	References.

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11	Appendix	Appendix.

1.3. Previous relevant projects

STARS EU provides support to DG DEFIS regarding the education and skills for space within the European Union, facilitates the creation and dissemination of scientific knowledge and analyses projects funded by the EU in the field of space. STARS*EU conducted an analysis of 48 Bachelor and Master programs and 16 PhD programs, mainly focusing on the upstream sector. Collected information has been structured using a three-level taxonomy called Science, Technology, Engineering, Arts, Mathematics & Transversal (STEAM&T). The taxonomy developed by STARSEU has been served as the starting point for identifying the knowledge domains (KDs) and knowledge areas (KAs)used by the ASTRAIOS team to categorize DPs and courses (see section 3 of this document).

EO4GEO was an Erasmus Skills Alliance project that comprised 25 partners from 13 EU countries. Its objective was to bridge the skills gap between the supply and demand for education and training in the space geoinformation sector. It promoted the adoption and integration of space/geospatial data and services across a wide range of application domains. EO4GEO developed a Body of Knowledge (BoK) specifically focused on the downstream space geoinformation sector. It assessed the availability of space/geospatial education and training through online surveys, website analysis, personal contacts, and consultations with project partners. It identified the demand for skills, competences, and knowledge in the space geoinformation domain by conducting surveys with both employers and employees and developed training materials to address competency gaps in the downstream space sector. One of the activities of this project was to develop an ontology for the Earth Observation and Geographic Information domains, referred to as Body of Knowledge (BoK) for EO/GI. BoK capitalized on the existing Geographic Information Science and Technology Body of Knowledge (GI S&T BoK), developed by the GI-N2K project based on the American University Consortium for Geographic Information Science. EO4GEO BoK was also used by the ASTRAIOS team to identify KDs and KAs relevant to the downstream sector including the Copernicus thematic areas: atmosphere, marine, land, climate, emergency and security. Furthermore, we included two of the courses developed and shared by EO4GEO in our database: Landslide affecting Cultural Heritage sites: Roman Thermae of Baia and CO2 budgets for municipalities. An introduction.

UNIVERSEH is an alliance of five HEIs (now 7 in the UNIVERSEH 2.0 newly approved project) that together with their 59 associates, student and staff communities aimed to develop a new way of collaborating in the space

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sector. The main objectives are: (1) enhancing mobility and multilingualism by organizing short-term mobility, creating new partnerships, and offering language courses; (2) developing new joint interdisciplinary and cross-sectoral curricula based on current and future needs; (3) developing new pedagogical models such as personal learning networks, virtual; (4) becoming an entrepreneurial university; and (5) producing a EuroCharter on Equity, Inclusion, and Diversity.

The **Copernicus Academy** is a network designed to promote Copernicus, the European Union's Earth observation program, through academic and research institutions. It focuses on education, training, and innovation in utilizing EO data. The Academy connects universities, research centers, and business schools to enable the development of Copernicus-related skills and research. It aims to drive knowledge exchange, enhance collaboration, and stimulate the adoption of Earth observation technologies for environmental and societal applications. Eighteen members of the Copernicus Academy have been included in the ASTRAIOS.

CopHUB.AC is a Horizon 2020 project aimed at establishing long-term Copernicus hubs to support the Copernicus Academy, enabling knowledge exchange, innovation, and outreach. It consists of several nodes, such as the Knowledge Landscape, Thematic Working Groups, and an innovation pipeline to link academic R&D with business. The project offers resources like a Citizen App for Copernicus information, an Innovation Monitor dashboard, and the CopHub.AC Gateway for data collection. Its goal is to stimulate Europe-wide adoption of space technology and geospatial information. Similarly, **Cordinet** was a Horizon 2020 project that aimed to support and expand the Copernicus Academy and Copernicus Relays, facilitating networking and knowledge exchange. The project intended to strengthen the Copernicus user community by providing platforms for collaboration, training, and information sharing. It sought to bridge gaps between academia, industry, and other stakeholders, promoting Copernicus applications and services across Europe. Through Cordinet, Copernicus users could access resources and connections to maximize the potential of Earth observation technologies. The project has ended, but its legacy continues through the expanded Copernicus networks.

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2. ASTRAIOS DATABASE

2.1. General Information

We designed a relational database where the whole information collected from the main space-oriented DPs and courses is stored in an organized structure. This structure allows the development of a curated online searchable catalogue. Furthermore, it serves as a basis for the execution of the upcoming tasks and analysis tasks of the project. Storing and organizing this catalogue in a relational database brings the advantages of structuring and storing the data in an optimized and logical way, but also allows to perform advanced queries and searches. This allows our team to efficiently perform the proposed analysis of the current status of the education in the Space Sector in EU-27+UK.

For this purpose, a PostgreSQL database has been developed with the structure depicted in Figure 1. This has been done in an iterative process, with improvements and validations on every cycle, which is important to keep the database in the best structure possible for the analysis purpose. The database is running on a server hosted at the University of Twente and linked to the web catalogue developed for the project, available online through astraiosdb.utwente.nl. This catalogue is described in detail in chapter 5 of this document.

2.2. Database schema

The database schema was designed to be implemented in PostgreSQL and to include all the information related to the analyzed DPs (Bachelor's and Master's), PhD and CE courses. As depicted in Figure 1, the database consists of seven main tables:

- The table "institution" contains information related to the Higher Education Institutions (HEI).
- The table "faculty" contains all the information related to the faculties or departments of the HEIs responsible for running the DPs documented in this project.
- The table "degree_program" contains all the relevant information about the DPs documented in this project and their associated KDs (stored indirectly through two auxiliary tables, described below).
- The table "course" contains all the relevant information about the courses and their associated KDs and KAs (stored indirectly through two auxiliary tables).
- The table "phd_programs" contains all the relevant information about the PhD programs and projects offering PhD positions.

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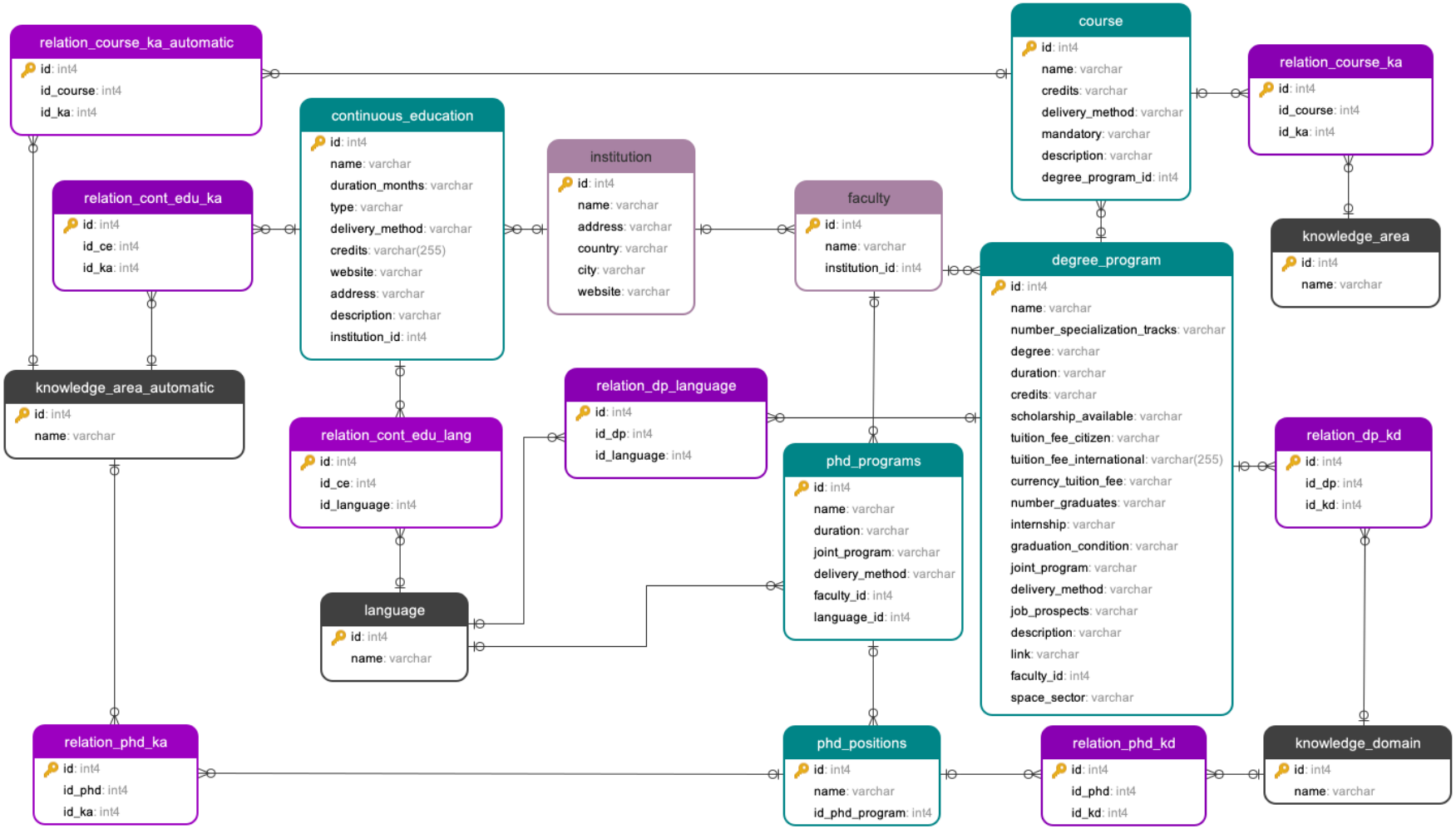

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Figure 1. Database schema used to store information on the analysed degree programs.

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- The table “phd_positions” contains all the relevant information about the PhD positions documented in this project, as well as their associated KDs and KAs (stored through two auxiliary tables, described below),
- The table “continuous_education” contains all the relevant information about the CE courses documented in this project, as well as their associated KAs (stored through two auxiliary tables, described below).

Since the KDs, KAs and languages are shared by many entries in several tables (many-to-many relationships), auxiliary tables were created to store this information, as well as their relationship with the courses, curricula, PhDs, and CE programs, which will be described later.

Considering this structure, each institution can have several faculties/departments, which can have several DPs (e.g., bachelor's and master's programs), several PhD programs and/or several CE courses. Each DP, however, can be related to one faculty and, in the case of joint programs, this is indicated by a Boolean (true/false) attribute in the description of the DP. Each DP will be then related to several courses. Therefore, to ensure efficiency and to avoid redundancies and inconsistencies, the database was designed with a hierarchical relation (one-to-many) among most of these tables.

Furthermore, to avoid duplicating the values of KDs, KAs and languages for every related item (redundancy), auxiliary tables were created for those. Since these items can be related simultaneously to many different programs or courses, and each program or course can be related to more than one of them, many-to-many relationships were designed for it. These many-to-many relationships were represented in the database through auxiliary tables. In addition to that, as described in the next chapters, we performed two different analysis of knowledge areas, one through automatically assigning the knowledge areas to the corresponding courses, and by assigning them manually. For this reason, additional tables were created to represent the automatically assigned KAs, and their relations with courses, PhDs and CE. These tables are described below:

- The table “knowledge_domain” contains all the KDs from the typology considered in this project,
- The table “knowledge_area” contains all the KAs from the typology considered in this project, in the way they were assigned manually to the courses,
- The table “knowledge_area_automatic” contains all the KAs from the typology considered by the project, in the way they were assigned automatically to the courses,
- The table “language” contains all the languages of the analyzed countries,

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- The table “relation_dp_kd” represents the relationship between DPs and knowledge domains, describing all the knowledge domains related to each DP (many-to-many relationship),
- The table “relation_phd_kd” represents the relationship between the PhD positions and knowledge domains, describing all the knowledge domains related to each DP,
- The table “relation_course_ka” represents the relationship between courses and knowledge areas from the manually assignment analysis,
- The table “relation_course_ka_automatic” represents the relationship between courses and knowledge areas from the automatic assignment analysis,
- The table “relation_cont_edu_ka” represents the relationship between the CE courses and the knowledge areas,
- The table “relation_phd_ka” represents the relationship between the PhD positions and the knowledge areas,
- The table “relation_dp_language” represents the relationship between the DPs and the languages,
- The table “relation_cont_edu_lang” represents the relationship between the CE courses and languages,
- Since all the PhD positions analyzed by the project are conducted in one single language, the relationship between the PhD positions and languages is a one-to-many relationship, and consequently did not need an extra table to be represented.

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3. KNOWLEDGE DOMAINS AND KNOWLEDGE AREAS

Space relevant Knowledge Domains (KDs) and Knowledge Areas (KAs) have been considered to structure thematically the information about the identified DPs (i.e. study programs), associated courses, and CE analyzed in the project. The KDs/KAs categories have been identified using a top-down and bottom-up approach.

3.1. Top-down approach

Several steps have been involved in the development of the ASTRAIOS KAs and KDs, beginning with examining past projects, which served as a valuable base for establishing the taxonomy. First, we investigated the ontologies (taxonomies) developed by the relevant past and ongoing projects such as STARSEU and EO4GEO. started the development of the KDs/KAs by considering the categories included in the STEAM&T developed by STARSEU that organized the KAs and KDs as a three-level hierarchy:

1. STEAM&T categories;
2. space-related knowledge domains;
3. space-related specific knowledge areas.

Second, the KDs/KAs developed by STARSEU were extended in consultation with ASTRAIOS partners with additional categories relevant for the space sector. Third, we investigated ESCO taxonomy (European Skills, Competencies, Qualifications, and Occupations). ESCO consists of three main pillars: Occupations, Skills, Competences, and Qualifications.

Our specific focus then turns to the knowledge level where we used relevant KDs and KAs. Forth, we included downstream-related areas of knowledge defined in the EO4GEO Body of Knowledge (BoK) and the Copernicus thematic areas: atmosphere, marine, land, climate, emergency, and security. The KDs and KAs used by ASTRAIOS from STARSEU, ESCO and EO4GEO are identified in table 5.

The resulting KDs/KAs were organized in a two-level hierarchy (see Table 4) and shared with the ASTRAIOS team to assess the relevance and completeness of the included categories.

Table 4. Number of categories included in the two-level ASTRAIOS's KDs and KAs (primary release)

Level	Name	Categories numbers	Example
Level 1	Knowledge Domains	28	Satellite engineering
Level 2	Knowledge Areas	83	Satellite platforms and payloads

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3.2. Bottom-up approach

The first version of the ASTRAIOS KDs and KAs presented above has been extended with additional categories identified as being relevant for the space sector during the analysis of the space-related DPs and courses. The final version of the ASTRAIOS KDs and KAs is composed of 28 KDs and 106 KAs. Besides, 11 Transversal Skills KD have been defined. Table 5 shows the KDs/KAs added using the bottom-up approach (highlighted in blue), the KD and KAs that were renamed (highlighted in green), and KDs and KAs that were aggregated during our ASTRAIOS KAs and KDs development iterative process (highlighted in Red). An example of the ASTRAIOS KDs and KAs is available in Figure 2. More information about the final ASTRAIOS KDs and KAs including the description by KA and the main relevant keywords is available in appendix A. The KDs and KAs used by ASTRAIOS from STARSEU, ESCO and EO4GEO are written in magenta,red, and orange respectively.

Table 5. ASTRAIOS KDs and KAs developed using top-down and bottom-up approaches distinguished by color-coded scheme. The KDs and KAs used by ASTRAIOS from STARSEU, ESCO and EO4GEO are written in magenta, red, and orange respectively

Knowledge Domains/DP	Knowledge Areas/Courses	Removed KD/ KA	Aggregated and added KD/KA
Chemistry	Astrochemistry		
	Cosmochemistry		
	Materials Chemistry		
	Physical chemistry		
	Other chemistry KAs		
Agriculture science	Agricultural mapping and monitoring		
Oceanography	Chemical oceanography		
Atmospheric Science	Atmospheric Monitoring		
Geology	Planetary Geology		
	other geology KAs		
Climate Science	Climate change		
Geography	Physical geography		
	Human Geography		
Hydrology	Water management		
Marine Science	Marine management		
Geographic Information Science	Cartography and visualization		
	Geographic information system		
	Geospatial analytics and modelling	Geo-computation and Geostatistics	Geospatial analytics and modelling
	Web GIS		
	Geospatial data architecture and management		
Physics	Classical mechanics		
	Thermodynamics		
	Other physics KAs		

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	Quantum physics and technology		
	Plasma physics		
	Electromagnetism		
	Nuclear physics		
	Optics		
	Nanoscience		
	Nanotechnology		
	Particle physics		
Astronomy	Planetary science		
	Instrumentation- telescopes, detectors and techniques		
	Astrophysics		
	Stellar physics		
	Cosmology		
	Large databases in astronomy: archiving, handling, and analysis		
	other astronomy KAs		
Biology	Biotechnology		
	Other biology KAs		
	Astrobiology		
Remote Sensing	Remote sensing		
	Sensors and instruments	UAVs	Sensors and instruments
	Image processing and analysis		
Mathematics	Algebra		
	Dynamical systems		
	Logic and set theory		
	Mathematical Optimisation		
	other statistics (rather than geostatistics) KAs		
	Geometry		
	Applied mathematics	Mathematics of data science, Probability, Control theory	applied mathematics
	Calculus		
Environmental sciences	environmental engineering and sustainability		
	Ecology		
	Land management		
	Biodiversity and conservation		
	Disaster management		
	Geodesy		
	Other environmental sciences KAs		
Electrical engineering	Telemetry tracking and control transponders		
	Signal processing		
	Avionics		

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	Electronics		
		Security Engineering	Security and privacy
Chemical engineering	Materials Engineering		
Industrial engineering	Manufacturing engineering		
Metrology	Metrology and calibration		
Satellite Engineering	Satellite platforms and payloads, space mission		
	Satellite sensor design, cubeSat design	CubeSat design	Satellite sensor design, cubeSat design
	Satellite antenna design		
	satellite navigation and positioning		
Mechanical engineering	Automation and robotics		
`Space System Engineering	mechatronics		
	Guidance, Navigation and control for Space systems (GNCSS)		
	Space safety: Space debris , planetary defence		
	Space sustainability		
	Space architecture		
	Space traffic management		
	Spacecraft engineering		
	Space mining		
Aerospace engineering	Air safety and security		
	Air transport control		
	Other aerospace engineering KAs		
	Astrodynamics		
	Aerodynamic		
	Robotic spacecraft		
	Astronautics		
	Aeronautics		
Computer Science	**Artificial intelligence**		
	Software development		
	Algorithms, data structures, complexity, and computability		
	Computer systems, architectures, network		
	Other data management (rather than geospatial data architecture and management) KAs		
	Data science, data analysis, data mining		
	Information Theory		
	Security and privacy		
	Software engineering		
	Computer graphics, computer simulation, virtual reality		
Economics	Economics	Business and marketing	Economics

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	Space insurance		
	Space economy		
	Finance, business and management	Space business	finance, business and management
Law	Policy and law	Space Policy and Law	policy and law
	Space and ethics		
Health and Medicine	Health		
	Space medicine		
(Transferrable) Skills	qualitative, quantitative research skills		
	programming skills		
	academic writing		
	language		
	problem-solving		
	written / oral communication		
	teamwork		
	work based experience		
	project management		
	entrepreneurship		
	conflict mediation		

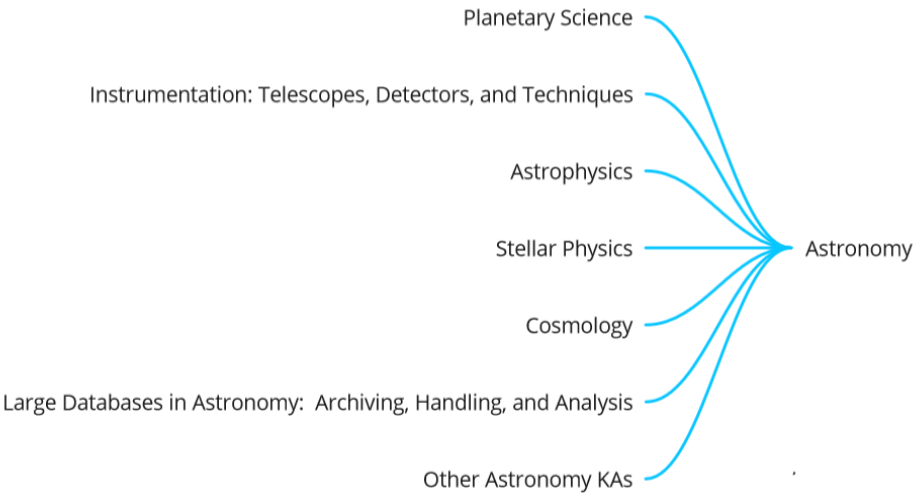

Figure 2. Visualization of the Astronomy Knowledge Domain and associated Knowledge Areas

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4. METHODS USED FOR DATA COLLECTION AND ANALYSIS OF DEGREE PROGRAMS AND COURSES

ASTRAIOS team used several methods to collect information on the available DPs and courses:

- Desk-based research: manual collection of information about DPs and courses following the database schema defined in Section 2. This activity has been carried out by the ASTRAIOS team. In addition, we have also organized a data-a-thon with the MSc students of the Faculty of Geo-Information Science and Earth Observation (ITC) to collect required data
- Survey designed to collect information on existing DPs and courses in the space sector
- Automated solution: web-crawler designed to automatically collect online information about existing DPs and courses and text mining used to automatically assign courses to the KAs defined in section 3.

A detailed presentation of the methods follows below.

4.1. General information

The identified Bachelor, MSc, PhDs DPs and CE were described according to the developed ASTRAIOS database schema using two approaches: desk-based research and automated solutions. The following criteria have been used for the Bachelor and Master DPs selection:

- **Criterion 1 - Geographic coverage diversity**: the distribution across EU-27+ UK followed the number of DPs per country as outlined in the Space Education in Europe (ESPI) report.
- **Criterion 2 - Distribution across the space sectors**: we targeted selecting approximately 60% DPs from the downstream sector and 40% programs in the remaining sectors. The downstream sector consists of Earth Observation, Geomatics/Geoinformatics, GNSS, as well as other DPs related to the six Copernicus services (atmosphere, marine, land, climate change, security, emergency) where EO/Geoinformatics and other space-related technologies are taught.
- **Criterion 3 - Distribution across Bachelor and Master degree:** both degree levels should be represented in the analyzed DPs sample set.
- **Criterion 4 - Thematic diversity:** we wanted to make sure that multi-disciplinary space-related educational programs such as those related to Geoinformatics, space law, space medicine etc. are also included.

The Bachelor and Master DPs included in our analysis were identified by the ASTRAIOS WP1000 partners and using an online survey. The WP1000 partners have been provided with this online form (available also as a pdf in appendix B) to collect the following information about the Bachelor and Master programs:

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- Information about institutions/ Higher Education Institutions (HEIs): name, country, physical address, and website.
- Information about the DPs: name, Bachelor/Master level, space sector, website, and additional reasons for including a specific DP.

An Excel sheet form has been prepared and shared with the ASTRAIOS partners to collect information about the available PhD programs and CE courses in the project. The gathered CE courses (including winter and summer school) offer certificates or statements of completion and were selected using the following criteria:

- **Criterion 1**: inclusion of winter and summer school.
- **Criterion 2:** diverse geographic coverage.
- **Criterion 3:** distribution across space sectors (60% downstream, 40% upstream and midstream).
- **Criterion 4**: thematic diversity

For the CE courses, the following information is collected: Institute name, course name, course URL, main Language and Language 2 (if it exists), Delivery method (online/hybrid/presential), Physical Address (i.e., Street name + Number, Postcode, City) if applicable, tuition fees, is it a summer school (Summer school/Winter school/ both / none), Description (including the learning outcomes) and KAs to be assigned according to the predefined ASTRAIOS KAs.

To analyze the ongoing PhD programs and PhD research projects the following strategy was followed:

- Identifying universities from the database created in the framework of the ASTRAIOS project that are offering PhD studies in the space sector.
- Identifying the Marie Skłodowska-Curie doctoral networks available in the space sector and listed on the https://cordis.europa.eu database.
- Identifying the faculty (or key beneficiaries of the MSCA networks) offering the PhD programs.
- Identifying the courses offered by the analyzed PhD programs (where this information was available).
- Including the advertised PhD positions and ongoing PhD projects listed on the website of the institutions/organizations and those offered in the framework of the ongoing MSCA doctoral networks (total of 251 positions).
- Mapping the identified PhD positions to the ASTRAIOS KDs/KAs. Some of the positions were mapped to more than two KDs and KAs.

4.2. Desk-based research

Bachelor and Master DPs were documented by Twente and WP1000 partners. In addition, Twente team organized a **data-a-thon competition** with the Master students of the Faculty of Geo-Information Science and

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Earth Observation (ITC) (see more information in 4.2.1). For the DPs documentation activities, we prepared an online Google form that consists of three sheets with the following fields:

- **Institution/ Faculty sheet**: Institute name, name of the faculty offering the DP.
- **Degree program sheet:** Degree Program Name, Degree Level (Bachelor/Master), Duration (Years), Credits (EC), Number of specialization/tracks, Main Language and Language 2 (if exists), Scholarship available(True/ False), Internship required (Mandatory/Recommended/None), Graduation condition (Thesis, Final Exam of content of DP, Both, None), Joint program (True/False), Delivery mode (online/hybrid/presential), Job prospects, Description (including the learning outcomes) and Knowledge Domains (KD) that can be selected from the predefined ASTRAIOS KDs and KAs, and the option to add additional KDs (i.e. missing KDs of the defined ASTRAIOS KDs list).
- **Courses sheet:** Course name, credits, Delivery method (online/hybrid/presential), Mandatory (True/False), Description (including the learning outcomes), and Knowledge Areas to be assigned according to the predefined Kas list, and the option to add other KAs (missing KAs of the defined list).

Twente and WP1000 partners documented **89** DPs and the students active in the data-a-thon documented **39** DPs. Additional **12** DPs have been documented using a survey as described below in section 6.5. The complete list of the Master and the Bachelor DPs, including the name, degree and the type of the space sector that was analyzed and added to the database can be found **in appendix C.**

4.2.1. Data-a-thon

A data-a-thon competition was organized together with the Master students of ITC. The timeline of the competition is presented in Figure 3.

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Figure 3 Data-a-thon timeline

The competition started on the 21st of June 2023 with 10 participants (out of 17 originally showing interest in participation). Twente team organized a half-day event on the 21 of June to introduce the overall goal of the ASTRAIOS project, the rules and regulations of the data-a-thon and to demonstrate how to collect required information. After this event, online support was provided to the participants and a Q&A session was organized to help participants address their questions and doubts. The competition closed on 23 July. Twente team evaluated the submitted documented DPs and the three winners were announced. The participants documented 39 DPs and 929 courses in total. Please find a picture of the winners and the UT ASTRAIOS Team in appendix F.

The main challenges encountered during desk-based research are summarized below:

- Translating available online information into English using Google Chrome might have led to inconsistencies in the name of the courses.
- English version of websites is not completely available in English: some websites have English versions, but very often only the titles are available in English, whereas the rest of the information is available in the local language.
- Course titles are included on the website without any specific information on course content.

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- Some course descriptions did not include information about the ECTS.
- The course description and learning outcomes of several documented DPs are missing. Yet, we included them in our database because the DPs are from underrepresented countries in the space sector such as Romania.
- Mapping the DPs and courses to the KDs/KAs is a subjective and time-consuming task.
- The same DP can be assigned to several KDs based on the available descriptions and the level of understanding of the program by the ASTRAIOS team members.
- Not all the courses of the same DPs were offered in the same language, but they can be mixed of two languages.

4.2.2. Survey

An online survey was also prepared to collect information about DPs at Bachelor, Master and PhD levels covering upstream, midstream, and downstream space sectors across EU-27+UK. The online survey has been prepared to expand the geographic coverage and diversity of the collected information and to gather supplementary information, including study program guides that might not be accessible on academic institution websites. Moreover, it captured insights into the transversal skills acquired through the identified DPs. The survey questions included close, multiple choice and short answers questions. They were designed to be clear (showing examples for some of them) and direct, with a predefined list of answers (when possible) to receive more concrete/concise answers. The participants could also upload files or specify additional relevant websites. Only four questions were mandatory, namely those that aimed at collecting information about the names and DPs levels. The survey was designed to maintain the anonymity of participants, ensuring that no personal data was collected.

The online survey is divided into four main sections:

- Section 1: Details of the respondent and institution consisting of 4 questions.
- Section 2: Information about the available DPS consisting of 14 questions.
- Section 3: Courses with 1 question.
- Section 4: Additional information and submission consisting of 1 question.

The survey was built and later distributed on the EUSurvey. The EUSurvey is a web application created and managed by the Directorate General for Informatics of the European Commission, herewith known as "DIGIT" (https://ec.europa.eu/eusurvey/home/tos). The complete survey with all sets of questions can be found in the appendix D. The survey was shared on the ASTRAIOS Social Media channels and distributed to EASN members

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(739 email addresses). Besides, we extended the time to submit the survey to the 20th of September to increase the number of respondents.

4.3. Automated solutions for data collection and analysis

4.3.1. WebCrawler

To populate the database with information about the DPs and courses, an automatic solution based on web crawling was also tested (in addition to the desk-based research presented above). Several challenges have been encountered during the development of this solution. Firstly, the DPs websites are developed in various programming languages (e.g., HTML, JavaScript, etc.) with diverse forms (static or dynamic), structures, and styles. Some websites shared information about DPs and courses using PDFs and were updated quite regularly with different urls, which required extra work for our team to find the new urls. The automatically web extracted text often includes irrelevant data such as multimedia elements, advertisements, site navigation, and comments. Information extraction from the DP websites in EU27+ sometimes required processing a large amount of non-English text in the forms of raw plain text, text in tables on the website, and text in PDFs. However, the inclusion of a (free) Google API translator in the webcrawler is not time efficient. Moreover, translating tables while preserving their original structure is challenging. The preserved structures of the tables were later helpful in populating curriculum data in different columns. Lastly, the required DP and course information (e.g. tuition fees) was not always available on the websites, making it impossible to collect it using automated methods. In order to tackle the above challenges, we adapted our web crawler to different types of information to be collected:

- To collect general information about DPs, we extracted all the raw text from static and dynamic webpages (228 links), regardless of whether they included PDFs, using Beautiful Soup (for parsing content of static webpages), Selenium (for scraping dynamic webpages), a combination of Axio and Cheerio in Node.js to extract web content with tables. We integrated a Google API translator to translate non-English webpages (53 links).
- To collect general information about DPs, we extracted all the raw text from static and dynamic websites using Beautiful Soup (for parsing content of static webpages), Selenium (for scraping dynamic webpages), a combination of Axio and Cheerio in Node.js to extract web content with tables. We integrated a Google API translator to translate non-English webpages.

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- To collect detailed information about courses within DPs, we extracted the tables from curricula webpages with PDFs. To preserve the structure of tables in PDFs, we used the Web Google Translate (instead of Google API translator) to translate 10 PDFs with tables to English per document.

The desired output of our webcrawler consists of tables with English text, which can be further distributed to our database structure. The running time of the whole (integrated) webcrawler is approximately 2 hours (124 minutes to be precise), in which the Google API Translator spent 96 minutes to translate 53 non-English webpages. The extraction of raw text from 228 English webpages only took 4.7 minutes.

4.3.2. Populating ASTRAIOS database using the automated solutions.

After extracting the raw text and tables from the DPs websites, we employed two methods to automatically populate the database.

Keyword approach to populate the raw text

In our keyword approach, we employed specific keywords from the names of our corresponding data fields—such as 'description,' 'credits,' 'duration,' 'job prospect,' 'internship' etc. —to design an algorithm to identify and extract paragraphs that include these terms. Our approach assumed that all information pertinent to a single data field will be encapsulated within one paragraph. Using this approach, we successfully extracted the paragraphs associated with ‘degree’, ‘credits’ (ECTS), ‘duration’ (years, months) and ‘joint_program’.

Mixed approach for restructuring the tables

In this method, we automatically extracted tables from PDFs and merged them into a single extensive CSV file, where the first column contains the URL of the DP. We then manually standardized the column names in our CSV file and categorized the tables based on their similar columns. Most of these tables included fields like course names, credits, and course descriptions. We eliminated less important columns such as instructor names, languages, course codes, and abbreviations, resulting in a streamlined CSV file listing course names, credits, and descriptions. Subsequently, we imported this data into our database.

Finally, our automated solution worked best to extract curriculum data of 22 DPs from 30 webpages with PDFs. The remaining DPs were populated semi-manually or manually.

4.3.3. Mapping courses to KAs automatically

After identifying the KAs using top-down and bottom-up approaches as described in section 3, we developed and also tested an automated solution to map the courses to KAs based on their names (titles). For the algorithm to effectively parse the diverse vocabularies found in course names/titles, we enriched each KA with a subsidiary list of keywords. These keywords encompass various elements such as the name of the KA, its

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synonyms, related terms, and any relevant abbreviations. Our algorithm operates by searching for these keywords within each course name. Upon finding a match, the algorithm maps the course to the corresponding KA. When no keywords are detected, the course is classified under a general 'Others' KA category. This process is iterative. We continually updated our lists of keywords and KAs based on new terms encountered in course names, thereby refining the algorithm's performance over time.

We also conducted a qualitative assessment of the identified KAs using these automated solutions. This involved three rounds of random checks of 10 KAs, resulting in a final accuracy rate of 95%. For the courses that were mapped to incorrect KAs, we reviewed the course names and descriptions before reassigning them to the correct KA category. In our effort to improve the accuracy of the algorithm, we carefully examined and selected new terms to ensure minimal overlap with existing terms.

We maintained single-word terms when they were crucial and unique to a specific KA. For multi-word terms, we retained them when a word within the term was not exclusively tied to a particular KA. For instance, the term 'satellite' is not unique to any KA. Therefore, we included multi-word terms like 'satellite platform', 'satellite sensor design', and 'satellite antenna design' in different KAs within the KD 'Satellite Engineering'.

4.3.4. Text-mining and analyzing keywords in course descriptions

To get additional insights from the course descriptions that have not been captured by our KA identification algorithm, we implemented a text-mining procedure on course descriptions and visualized the most frequent keywords (bigrams) occurring in the corpus of course descriptions by a Word cloud.

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5. ASTRAIOS ONLINE CATALOGUE

5.1. ASTRAIOS data on the WEB

The current practice of publishing educational program information via university websites and data portals exhibits scalability limitations. Technically, the use of keywords and themes for the description of data semantics cannot keep up with the growing number and topical diversity of published datasets. At the same time, the publish-find-bind model of data dissemination decouples data discovery from data access which makes it increasingly difficult to find data that can be (re)used in combination with other data for the sake of analysis and creating added value web applications. However, application developers and researchers increasingly need to see all the data not only from one provider but also from several providers as a whole in runtime. In this context, in contrast to the traditional approach, Linked Data (LD) as a technique for publishing structured semantically rich data on the Web does not create data silos. Being based on well-known Web technologies (such as HTTP), interoperable semantic standards and graph data model, LD makes it possible to perform data discovery, access, and integration in one step. Apart from that, LD creates a Web-scale semantic infrastructure that enables interoperability not only between separate databases but also between organizations. For these reasons, Linked Data is used as the main technology for publishing ASTRAIOS data.

5.1.1. ASTRAIOS Linked Data

The data collected by the project and stored in a Postgres relational database (see Section 2.1) was structured using the Resource Description Framework. It allowed instances (e.g., Courses, Degree Programs) and concepts (e.g., Knowledge Domain and Knowledge Areas), represented by nodes, to be related to one another by relationships, represented by arcs between the nodes. In RDF, a data element is described as a set of statements called triples or facts. A triple resembles the basic structure of a sentence consisting of three parts, namely (1) a subject, (2) a predicate and (3) an object. These three parts can be expressed using HTTP Universal Resource Identifiers (URIs), but objects can also be literal values (e.g., integer numbers). In general, a subject defines a data element (an instance or a concept), a predicate shows what kind of relation exists between the subject and the object, while an object is another data element that has a relation with the subject. Through URIs these data elements (nodes and arcs) become globally accessible by means of the SPARQL query language.

5.1.2. Design decisions

Creation of publishable LD from a relational data source required several design decisions to be made about ontologies for data mapping and strategy for minting data URIs.

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Ontologies

There are several ontologies designed for capturing DPs information. Table 6 provides information on the ontologies used to represent classes of objects and their properties. The Academic Institution Internal Structure Ontology (AIISO) provided semantic primitive for representing the internal organizational structure of an academic institution such as institutions, colleges, faculties, departments, DPS and courses. This is a powerful but basic ontology. For representing detailed information related to these classes, the GeoCourseHub ontology was used. This ontology was created at the Faculty of Geo-Information Science and Earth observation of the Twente University for capturing granular descriptions of course content. For more generic and domain neutral information the Schema.org ontology was used. Last but not least, in order to annotate courses and DPs, Knowledge Areas and Knowledge Domains were described and linked to the related classes using Simple Knowledge Organization System (SKOS) ontology. The resulted conceptual schema is one of the project artefacts that provides a particular value because it can be reused in a broader application context, e.g., for capturing the content of data in space sector.

Table 6. Ontologies used for capturing ASTRAIOS data semantic

Ontology name	URI	Prefix
The Academic Institution Internal Structure Ontology (AIISO)	http://purl.org/vocab/aiiso/schema#	aiiso
Schema.org	https://schema.org/	schema
GeoCourseHub ontology	https://gch.utwente.nl/ontology#	gch
Simple Knowledge Organization System (SKOS)	http://www.w3.org/2004/02/skos/core#	SKOS

URI strategy

The design of URI patterns for the ASTRAIOS Catalogue follows the best practices and standards established by the World Wide Web Consortium (W3C). In general, URIs of the catalogue have three patterns. The first pattern is the URIs of the home page and other static pages (see Table 7). The second pattern is used for the browser API as shown in Table 8. Table 9 provides the third URI pattern that is used for data items (resources). Example class URI patterns are provided in Table 10.

Table 7. ASTRAIOS Catalogue domain URI pattern

Description	URI pattern
ASTRAIOS Catalogue domain name	https://astraiosdb.utwente.nl/
Pattern for the static pages	https:/astraiosdb.utwente.n/{page_name}

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Table 8. Browser URIs

Description	URI pattern
Data set browser	http://astraiosdb.utwente.nl/browse/{dataset_name}
Resource page	http://astraiosdb.utwente.nl/dataset/{ dataset_name }/resource/{resource_URI}

Table 9. Data resources URIs pattern

Description	URI pattern
Base URI for data instances	https://astraiosdb.utwente.nl/data/
Pattern for data instances	https:// astraiosdb.utwente.nl/data/{class_name}/{database id}

Table 10. Examples of class URI patterns

Description	URI pattern
Institution	http://astraiosdb.utwente.nl/data/institution/{id}
Faculty	http://astraiosdb.utwente.nl/data/faculty/{id}
Degree program	http://astraiosdb.utwente.nl/data/degree_program/{id}
Course	http://astraiosdb.utwente.nl/data/course/{id}
Knowledge Area	http://astraiosdb.utwente.nl/data/knowledge_area/{id}
Knowledge Domain	http://astraiosdb.utwente.nl/data/knowledge_domain/{id}
Language	http://astraiosdb.utwente.nl/data/language/{id}

Data Conversion and Storage

Conversion of the PostgreSQL data into Linked Data (RDF) was done using the OpenRefine toolkit. The PostgreSQL data was accessed and extracted using SQL and then, mapped to the ontological terms by the means of the RDF extension mapping interface. After the conversion the resulted triples were loaded into the triple store of the Linked Data Platform Netherlands (https://data.pldn.nl/).

Application architecture

The system architecture of the ASTRAIOS Catalogue application followed the three-tire paradigm of the application design. These tires are the presentation layer (frontend), data services (APIs) and data persistence layer (Data). The architecture is depicted in Figure 4. The use of the Linked Data standards allows these components to be loosely coupled, which in turn, enables reusability of the system components. In particular,

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this is relevant for the provision of the application agnostic data interfaces and consumption of data by a wide range of SPARQL compliant front-end components. All of these increase the flexibility of the system and enables reusability of the data in different contexts.

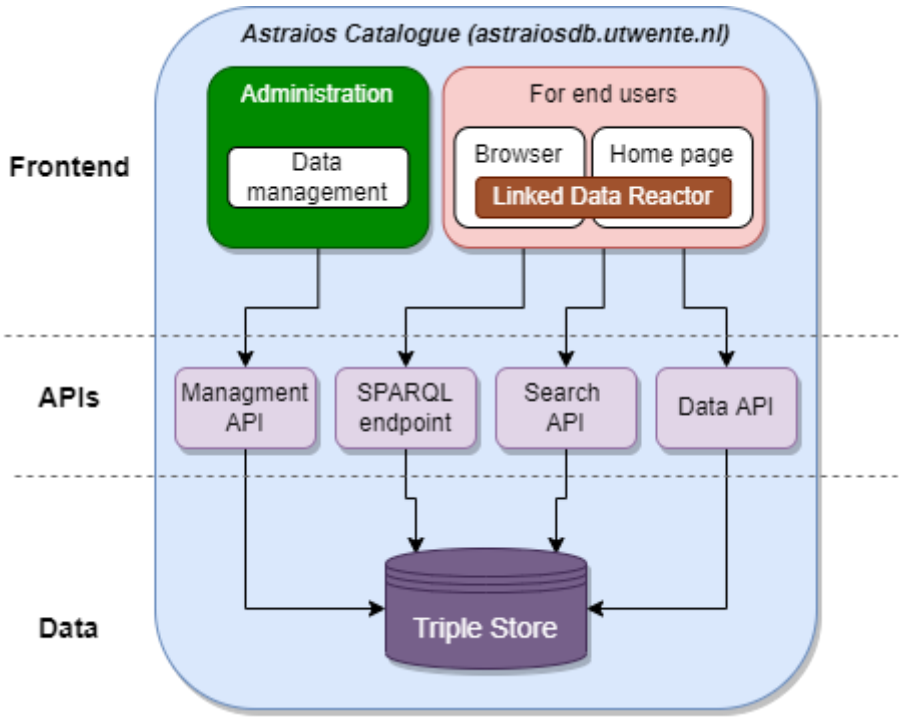

Figure 4. System architecture of the online ASTRAIOS Catalogue

5.2. Search and find documented degree programs

The ASTRAIOS Catalogue consists of several user interfaces as follows:

- Home page and static pages with information about the ASTRAIOS Catalogue and tools.
- Browser, a faceted search interface where the information on courses and degree programs can be explored.
- Home page.

The home page of the catalogue is depicted in Figure 5. It provides access to four faceted browsers as follows:

- Degree programs
- Degree program courses
- PhD opportunities
- Continuing education courses

On the top of the page, a navigation bar is located allowing users to access the page about the project, how-to pages that explain the catalogue functionalities, and the data API documentation page.

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Figure 5. Screen capture of the home page of the ASTRAIOS DB web portal.

5.2.1. ASTRAIOS Catalogue browser

AstraiosDB Browser is a faceted data-driven browser. It allows users to explore courses and DPS documented by the ASTRAIOS project. As presented in Figure 6, the left pane, the facet selector, allows users to select a property (or multiple properties) of interest. For example, one can select Country' and view all the countries where the available DPs take place in the facet value selector pane in the middle of the screen. The way how the values in the facet value selector are visualized can be changed using facet value selector modifier. The browser provides a range of possible visualizations including a check list, a tag list, a bar chart, a pie chart, a tree map, and a tag cloud. All these visualizations can be used for specifying facet values. By selecting the properties and specifying the values users can immediately see the results in the result pane in the right part of the screen. Users can learn more about the results by clicking on them.

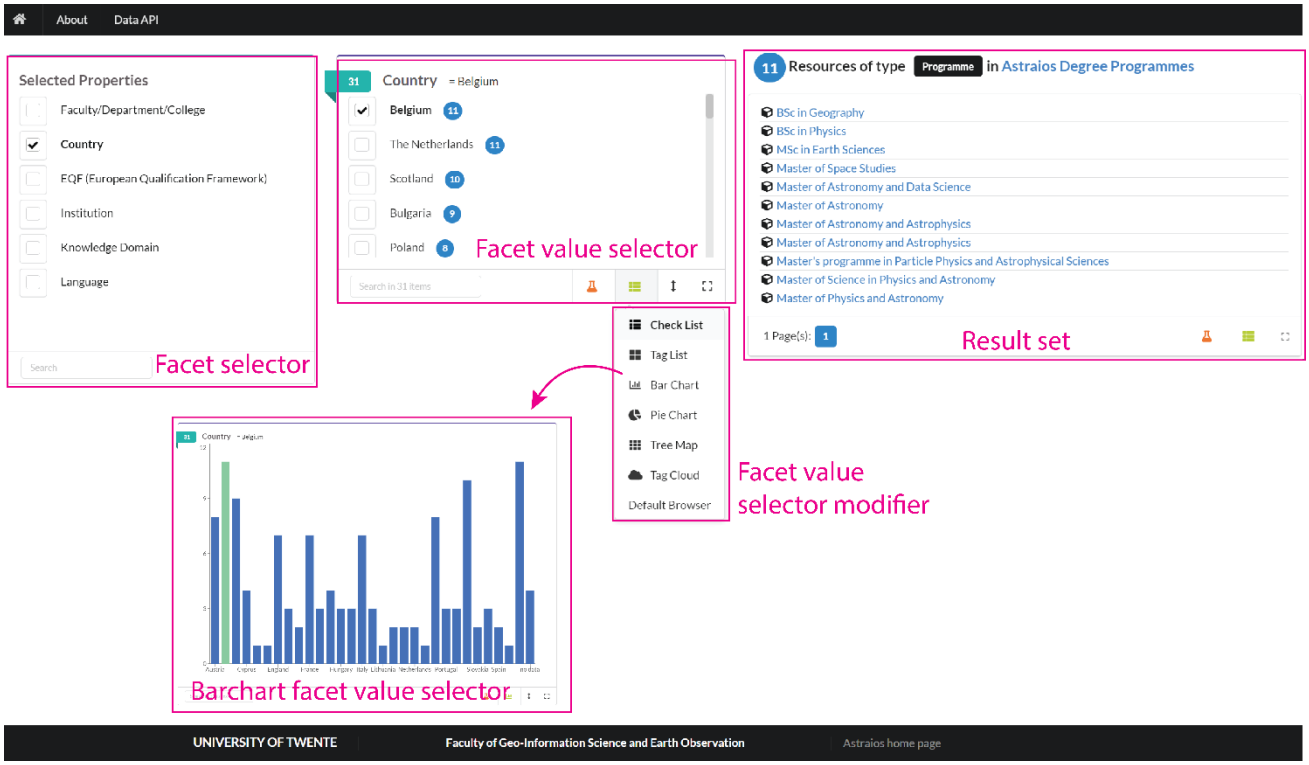

Figure 6. Screen capture of the ASTRAIOS DB browser user interface

5.2.2. Data interfaces: API ecosystem

The ASTRAIOS Catalogue provides several ways to access its data programmatically. This can be done via:

- Data API

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- Elastic Search API
- SPARQL endpoint

The ASTRAIOS Catalogue API provides access to the information on DPs and their courses. The description of the API functionality can be found following the link on the navigation bar at the top-right of the main page as shown in Figure 7. The API is documented using SWAGGER specification standard.

Figure 7. Screen capture showing the location of the link to the API documentation.

The ElasticSearch search full text API is available at:

- https://api.data.pldn.nl/datasets/Astraios/AstraiosData/services/elastic/_search

AstraiosDB uses Linked Data as the main data format. SPARQL is a query language for Linked Data. The SPARQL endpoint can be access at:

- https://api.data.pldn.nl/datasets/Astraios/AstraiosData/services/AstraiosData/sparql

An example query that retrieves first ten of the DPs and their name from the catalogue is presented in Figure 8. In this example, a standard web-based query editor YasGUI is used which showcase the possibility of querying ASTRAIOS data from a variety of software tools.

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Query

https://api.data.pldn.nl/datasets/Astraios/AstraiosData/services/AstraiosData/sparql

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
Prefix aiiso: <http://purl.org/vocab/aiiso/schema#>

SELECT Distinct ?sub ?label WHERE {
  ?sub a aiiso:Programme;
  rdfs:label ?label
} LIMIT 10
```

Table | Response | Gallery | Chart | Geo | Geo-3D | Geo events | Markup | Network | Pivot | Timeline

10 results in 0.084 seconds — Simple view ☐ Ellipse ☑ Filter query results — Page size: 50

	sub	label
1	<http://astraiosdb.utwente.nl/data/degree_programme/0>	"Applied Geoinformatics"@en
2	<http://astraiosdb.utwente.nl/data/degree_programme/1>	"Cartography and Geoinformation"@en
3	<http://astraiosdb.utwente.nl/data/degree_programme/10>	"Geographic Information Systems"@en
4	<http://astraiosdb.utwente.nl/data/degree_programme/100>	"Astronomy"@en
5	<http://astraiosdb.utwente.nl/data/degree_programme/101>	"Astrophysics and Cosmology"@en
6	<http://astraiosdb.utwente.nl/data/degree_programme/102>	"BSc in Geography"@en
7	<http://astraiosdb.utwente.nl/data/degree_programme/103>	"BSc in Physics"@en
8	<http://astraiosdb.utwente.nl/data/degree_programme/104>	"MSc in Earth Sciences"@en
9	<http://astraiosdb.utwente.nl/data/degree_programme/105>	"Aerospace Engineering"@en
10	<http://astraiosdb.utwente.nl/data/degree_programme/106>	"Astrophysics and Space Science"@en

Showing 1 to 10 of 10 entries — < 1 >

Figure 8. Screen capture of an example query issued from the standard Web-based SPARQL query editor

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6. ANALYSIS OF THE BACHELOR AND MASTER DEGREE PROGRAMS

6.1. Analysis of the degree programs per country, language, space sector and degree level

This section presents a summary of the distribution of the analyzed DPs across space sectors, KDs/KAs and additional information captured according to the ASTRAIOS database schema described in section 2. The findings presented in this section are representative to the characteristics of the DPs included in our analysis.

The distribution of the analyzed DPs per country and language is represented in Figure 9 and Figure 10, respectively. Most of the analyzed DPs are available in UK, the Netherlands and France. More than 60% of the DPs are taught in English with a few DPs offered in other languages such as French, German or Greek for the Master DPs and Polish, German, Bulgarian or Portuguese for the Bachelor DPs.

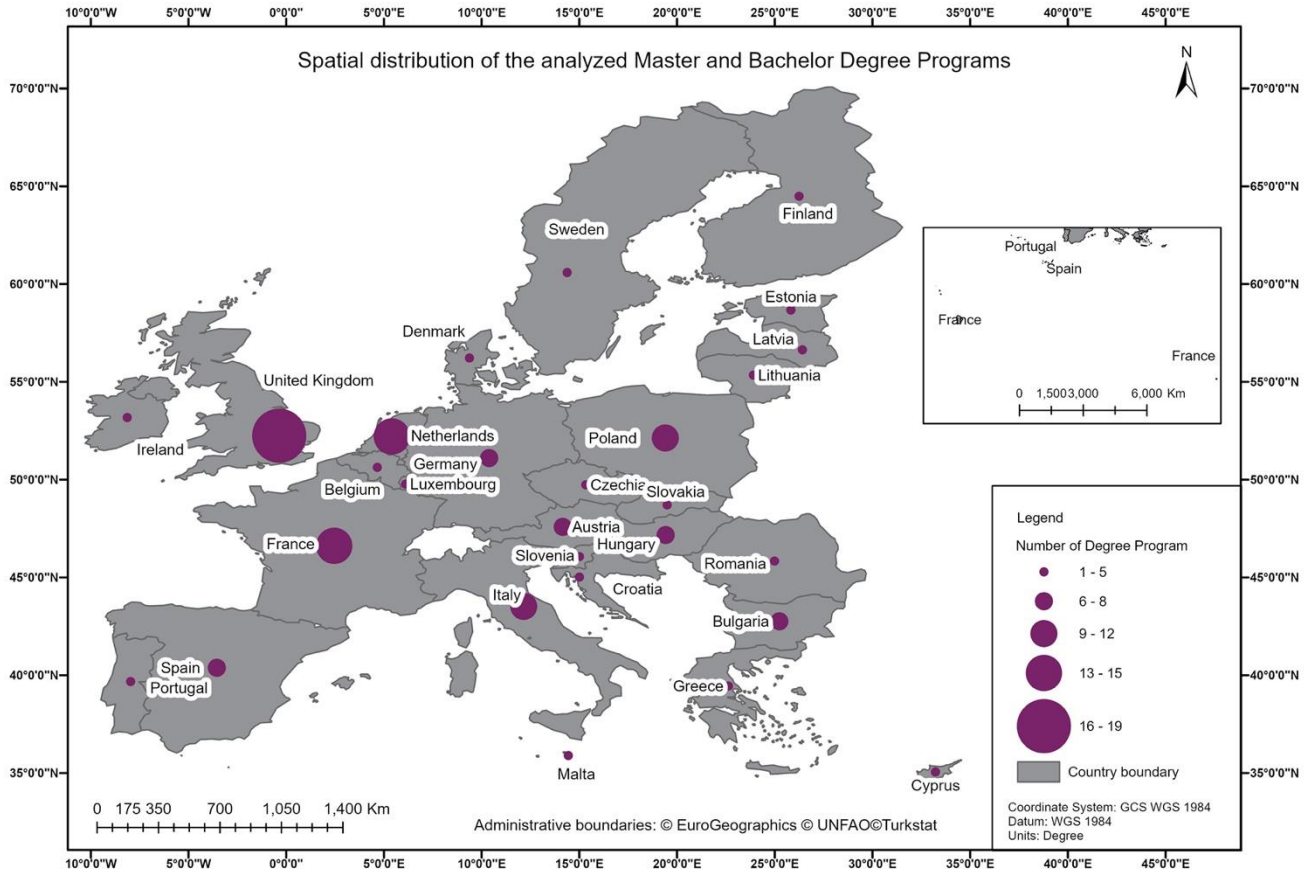

Figure 9. Spatial distribution of the analyzed degree programs

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Tuition fees vary among the gathered DPs. Typically, the tuition fees paid by international students (non-EU) are higher. These disparities arise due to various factors including national and EU policies, available student subsidies etc.

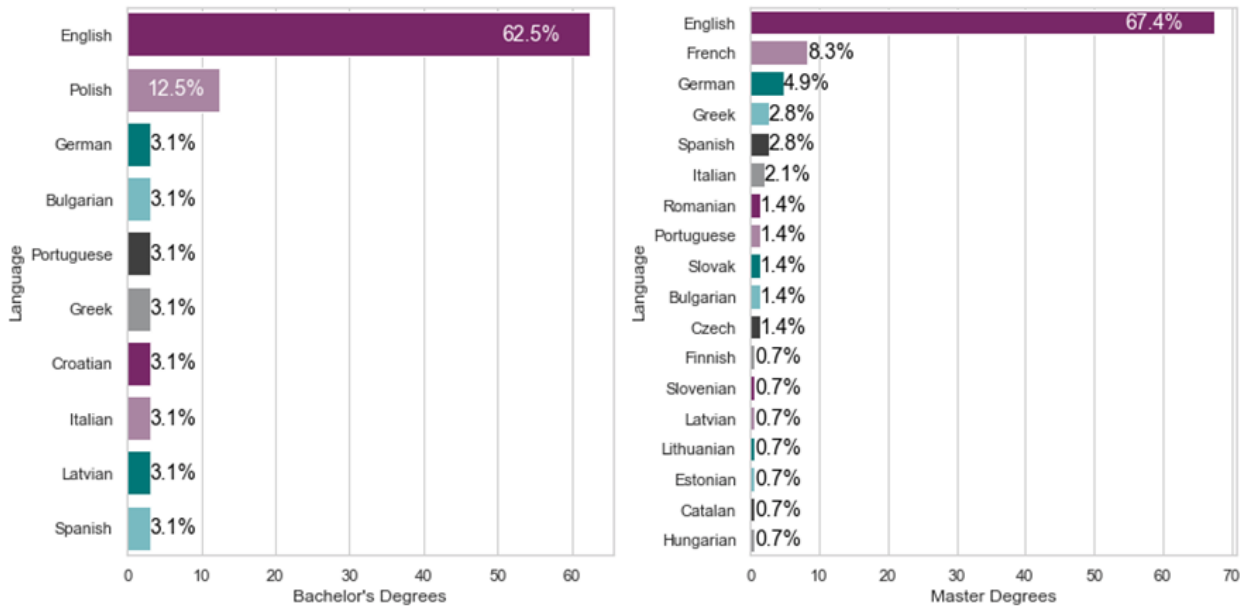

Figure 10. The language of instruction in the evaluated Bachelor and Master programs

Master degree level represents more than 80% of the analyzed programs (Figure 11). We analyzed the DPs relevant for the three space sectors: upstream, midstream and downstream (Figure 12). The upstream sector covers the space platforms, payloads, transportation, and group equipment. The midstream covers the ground segment, operations, data management, and distribution, whereas the downstream sector includes the user segment, data provision and services, applications, and services. Most of the Bachelor DPs are related to the upstream sector, whereas the Master DPs cover almost equally downstream and upstream sector (Figure 13).

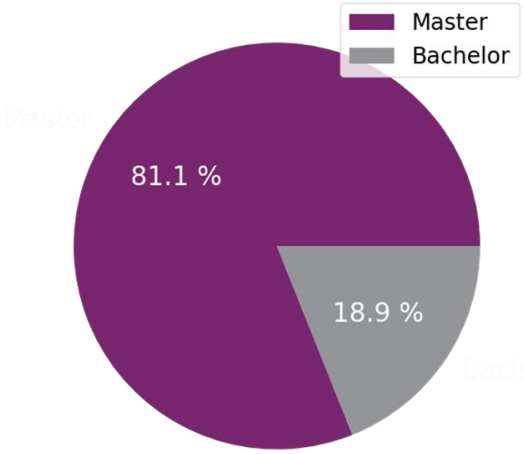

Figure 11. Percentage of Master and Bachelor degree programs analyzed in ASTRAIOS

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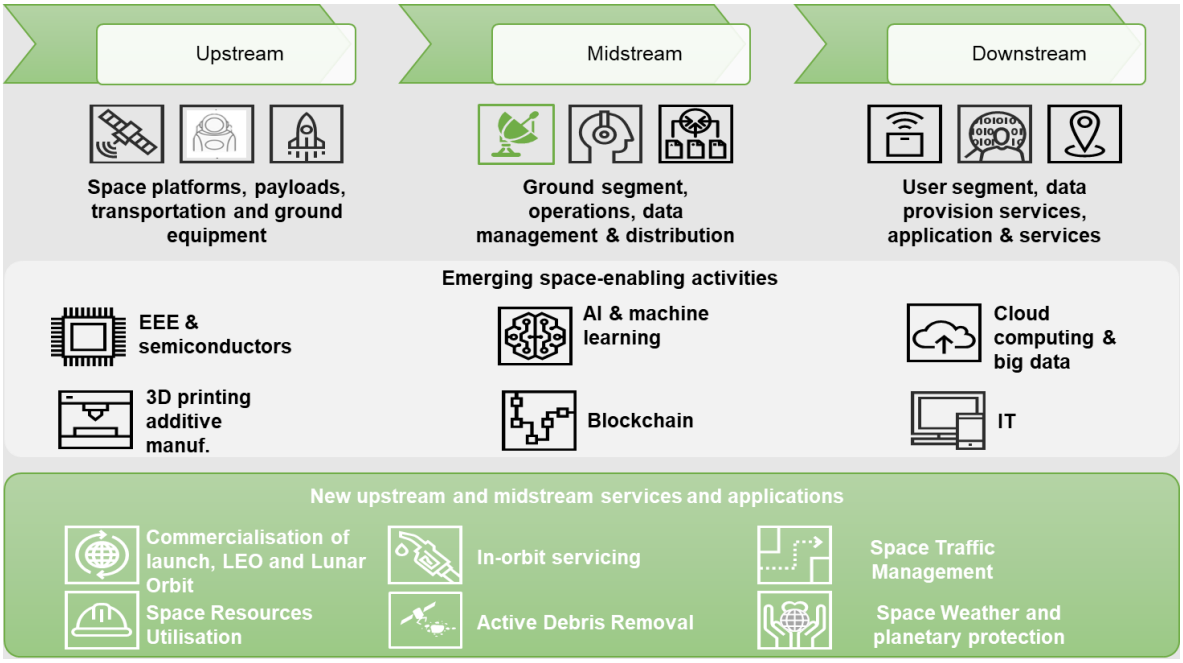

Figure 12. Representation of the upstream, midstream and downstream space sectors (Source: Space, PwC, 2023)

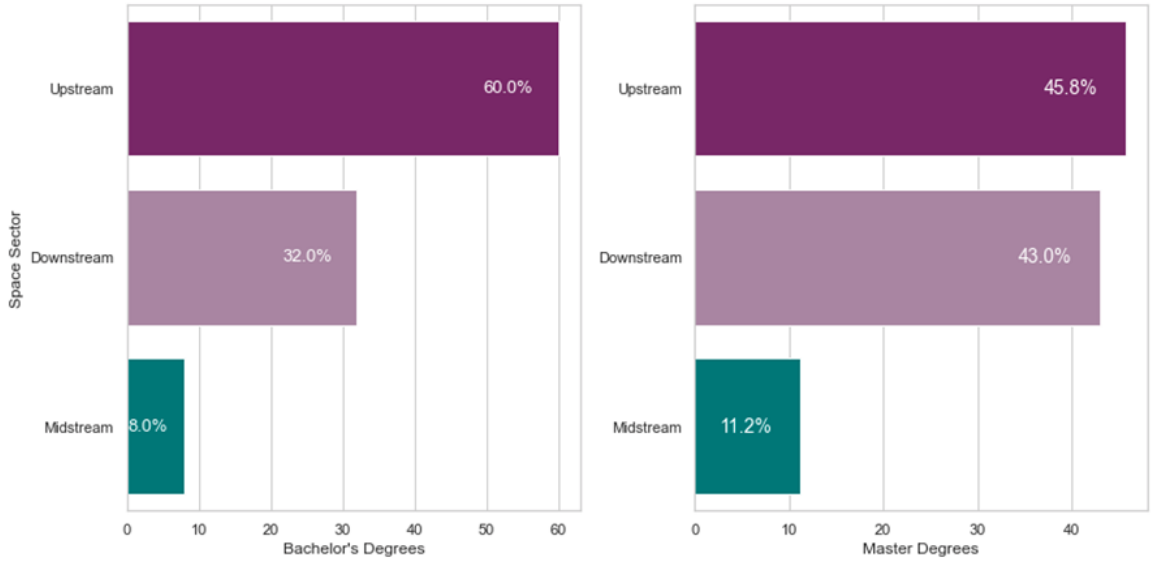

Figure 13. Distribution of the degree programs across upstream, downstream and midstream space sectors

40% of the analyzed Bachelor DPs are lacking internship from their curricula and almost 30% recommend students to have an internship during their studies (Figure 14). More than 30% of the Master programs include internship activities in their curricula and more than 20% recommend an internship. These results reveal a higher emphasis on practical experience and professional exposure at the Master level compared to the

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Bachelor level of the analyzed DPs.

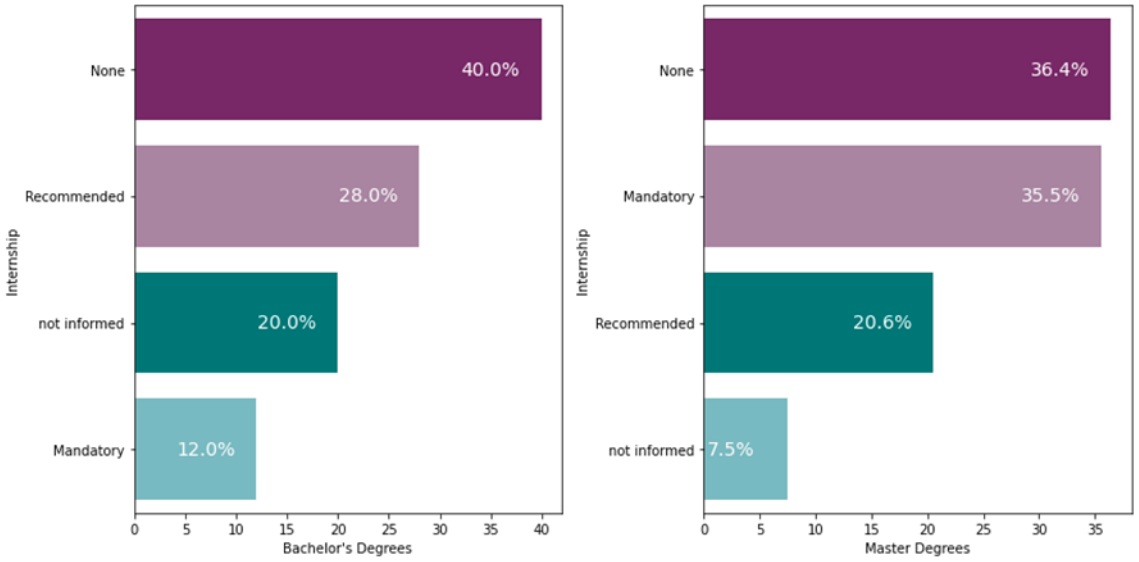

Figure 14. Frequency of the Bachelor and Master programs that included internship in the curricula

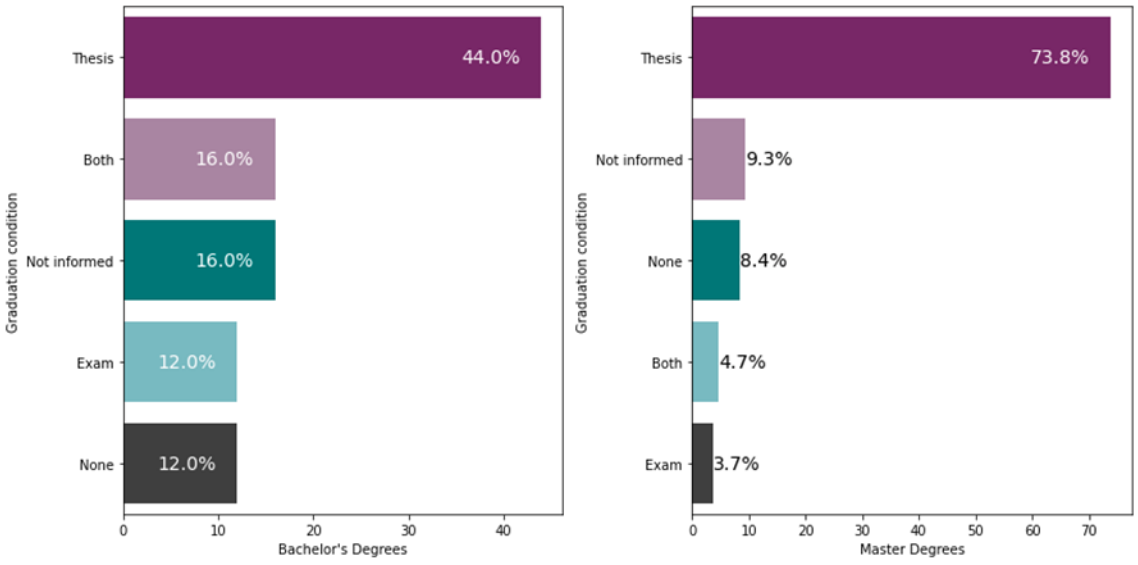

Figure 15. Graduation condition of the analyzed degree programs

The majority of the gathered Master and Bachelor DPs involve a research project that will lead to a thesis at the end of the study program (Figure 15). The inclusion of a research project leading to a thesis in space-related Bachelor and Master programs offer numerous benefits, including practical application of knowledge, development of critical skills, fostering innovation, preparing for potential further academic pursuits or

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research careers. Most of the analyzed Bachelor and Master students are not joint programs (92.0% and 81.3% respectively) (Figure 16).

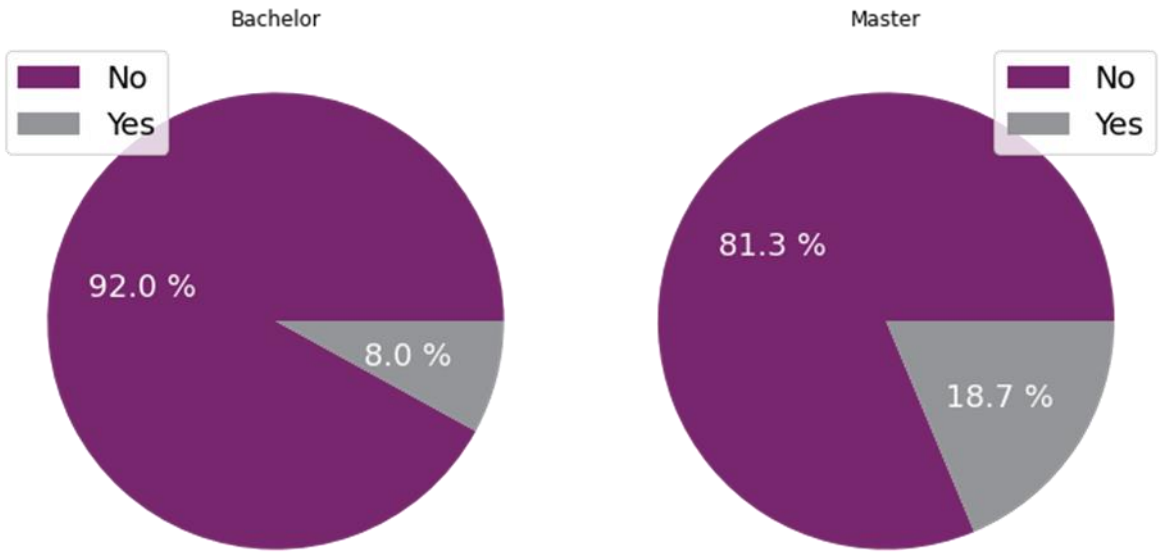

Figure 16. Availability of the joint programs

Many of the analyzed programs offered scholarships (36.0% of the Bachelor and 53.3% Master DPs) (Figure 17). The availability of scholarships in most space-related programs improves accessibility and affordability of the DP, attracts talent, fosters innovation, and might support diversity by reducing financial barriers.

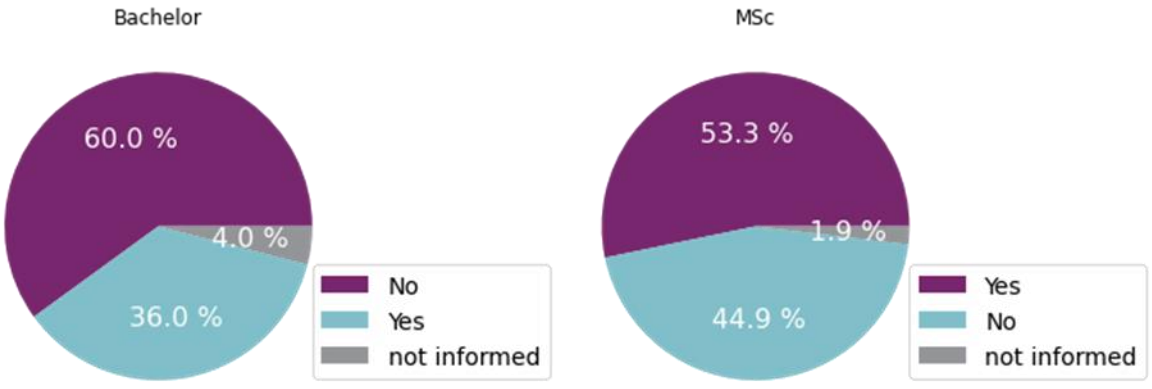

Figure 17. Availability of scholarship for both Bachelor and Master degree programs

6.2. Knowledge Domains of the analyzed Bachelor and Master degree programs

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Table 11 and Figure 18 show the frequencies and the percentages of the KDs in the Bachelor DPs, and Table 12 and Figure 19 how the frequency and the percentages of the KDs in the Master DPs, respectively. The analyzed DPs are mapped to the relevant KDs during the desk-based research activities. Each DP is assigned to at least one KD based on its relevance to the degree.

6.2.1. Knowledge Domains of the evaluated Bachelor Degree programs

We found that 67.9% (19 KDs) of the total number of KDs are representative to the analyzed DPs. 23.1% (9 KDs) are not linked to any DPs. The unassigned KDs included Agriculture Science, Health and Medicine, Economics, Hydrology, Industrial Engineering, Geology, Marine Science, Oceanography and Metrology. The missing KDs suggest no direct connections between the KDs and the DPs included in our sample set. However, the associated KAs following the defined list are still presented in some courses. Thus, these KDs are not excluded but contextualized within the framework of courses. Figure 18 shows that the predominant KD is Aerospace engineering (14.5 %).

We observe a high frequency of DPs related to physics (10.9%), astronomy (10.9%) and mathematics (7.3%). These three highly associated KDs often occur together or in pairs in some DPs, e.g., Bachelor's in physics with Astronomy and Space Science. Physics and mathematics are important for astronomy and aerospace engineering, as they provide the fundamental principles for understanding, designing, and developing these fields.

Other frequent KDs are Geographic Information Science and Remote Sensing (with a total contribution of 12.8 %). The high frequency of these two domains emphasizes the strong focus on the space downstream sector and geospatial technology, science, and earth observations of the analyzed DPs. Other highly frequent KDs are environmental sciences and geography (12.8 %). Both KDs co-occur often in some DPs, such as BSc (Hons) in Environmental Geography. The two KDs refer to disciplines that focused on studying the interactions between the Earth's physical features, environment and society. Computer science also has a high frequency. The co-occurrence of computer science with other KDs in some DPs shows the importance of computation techniques and data processing within the analyzed DPs such as the Telecommunication Systems Engineering BSc degree. The lower frequencies of some KDs, such as Satellite Engineering and Space System engineering, show a minor focus of the gathered DPs on those domains.

Table 11. Frequency of the KDs in the bachelor DPs

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Knowledge domain	Frequency
Aerospace engineering	8
Physics	6
Astronomy	6
Geographic Information Science	4
Environmental sciences	4
Mathematics	4
Computer Science	4
Remote Sensing	3
Geography	3
Electrical engineering	2
Space System engineering	2
Biology	2
Mechanical engineering	1
Climate Science	1
Law	1
Chemistry	1
Atmospheric Science	1
Chemical engineering	1
Satellite Engineering	1

6.2.2. Knowledge Domains of the evaluated Master Degree programs

We observe that 85.7% of the total number of KDs (28 KDs) are representative for the analyzed DPs, whereas 14.3 (4 KDs) are not assigned to any DPs. The missing KDs are Metrology, Oceanography Health and Medicine and agricultural science. However, the associated KAs following the defined list are still presented in some courses; thus, the themes are not excluded completely but contextualized within the framework of courses.

Figure 19 shows that a high percentage of the analyzed DPs were mapped to remote sensing and geographic information science KDs (10.6% and 9.6 %, respectively). This implies an emphasis on the space downstream sector. It also indicated a strong focus on geospatial technology, science, and Earth Observations. Furthermore, we observed that remote sensing and geographic information science KDs are related not only to the DPs with a main focus on the geoinformatics and remote sensing, but also to those DPs that focus on environmental sciences, geology and climate science. This indicates the utilization of geo-information science and remote sensing methods and technologies for addressing challenges related to the Earth's surface, environmental monitoring and sustainability, and climate change.

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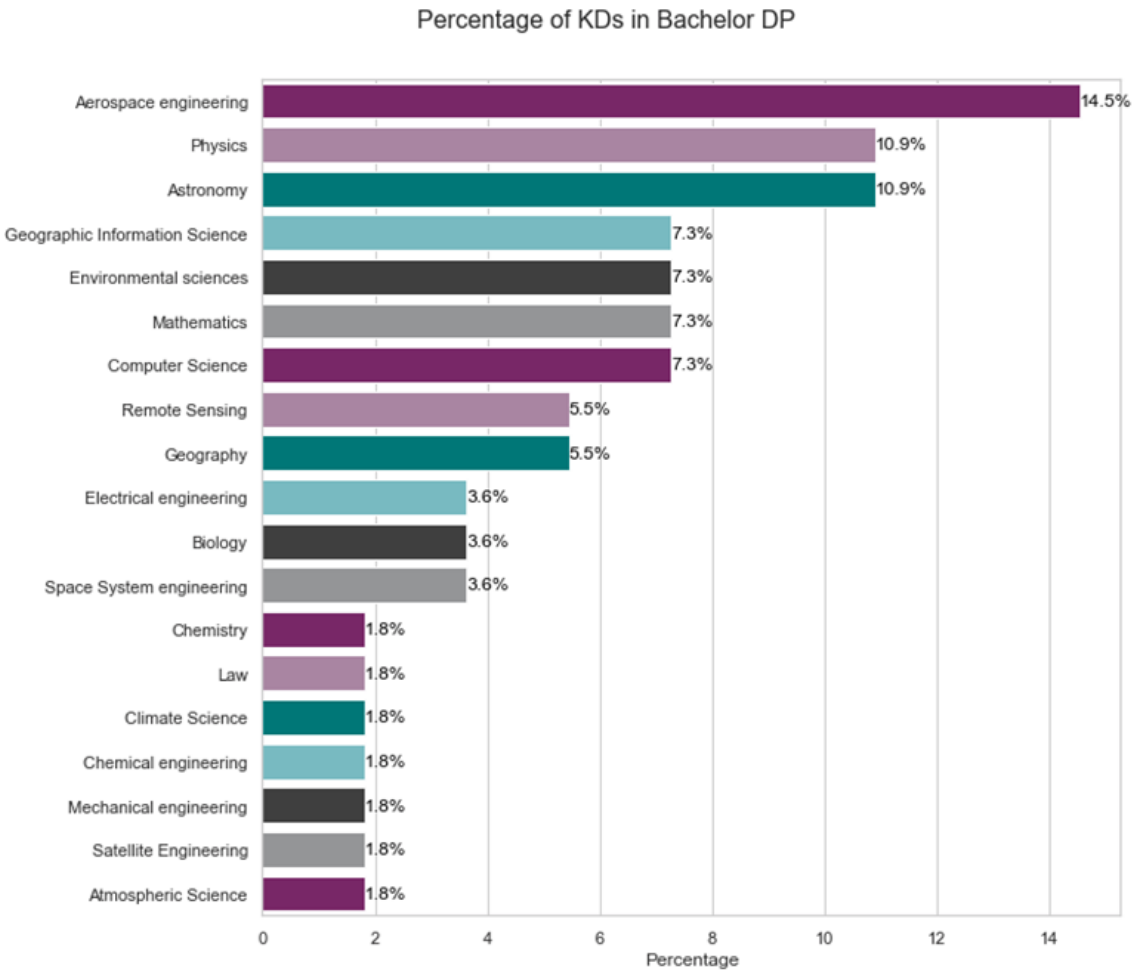

Figure 18. Percentage of Knowledge Domains in the analysed Bachelor Degree Programs

Our analysis revealed a high frequency of the KDs related to the upstream space sector, including aerospace engineering, astronomy, satellite engineering, and space system engineering, with the sum of the percentage accounted for 31.3%. The electrical engineering and mechanical engineering KDs co-occur also with the upstream KDs as they are fundamentals for the designing and building satellite and space systems.

Table 12. Frequency of the KDs of the analyzed Master DPs

knowledge domain	Frequency
Remote Sensing	31
Geographic Information Science	28
Aerospace engineering	27
Astronomy	25
Computer Science	24
Mathematics	20
Satellite Engineering	20

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Space System engineering	20
Physics	19
Environmental sciences	12
Mechanical engineering	12
Electrical engineering	11
Law	9
Economics	9
Geography	8
Geology	4
Climate Science	3
Atmospheric Science	3
Industrial engineering	2
Biology	2
Chemistry	1
Hydrology	1
Marine Science	1
Chemical engineering	1

The other most frequent KDs are computer science and mathematics, which contribute 8.2% and 6.8%, respectively, showing the increasing importance of those domains in the DPs included in our analysis. The two KDs are linked with the upstream sector, such as astronomy and aerospace engineering and the downstream sector, like geographic information science and remote sensing. Mathematics provides the theoretical foundation for algorithms, logic, and strategies. At the same time, computer science utilizes these mathematical concepts to design and implement computational systems, algorithms, and software tailored for the different domains.

The KD physics represents 6.5 % of the analyzed Master DPs, and strongly co-occurs with the KDs in the upstream sector, such as astronomy. The KD Economics and law also appears in the analyzed DPs. This indicates a focus on the space economy while addressing the legal framework to ensure sustainable and authorized space activities. Other KDs are appeared in low frequency in the analyzed DPs.

The results reveal a diverse range of the available KDs in the analyzed DPs. The most dominant KDs (Remote sensing and Geographic Information Science) are related to the downstream sector, which indicates an increasing focus on geospatial technology, science, and earth observations. There is also a high frequency of Mathematics and Computer science KDs. The two KDs are important and interlinked and can be tailored for

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the advancement and development of the upstream and downstream sectors. Besides, the result shows a a high frequency of upstream KDs such as aerospace engineering and astronomy. The remaining KDs such as Hydrology, Oceanography, Marine Science, Biology and Metrology are less representative in our data.

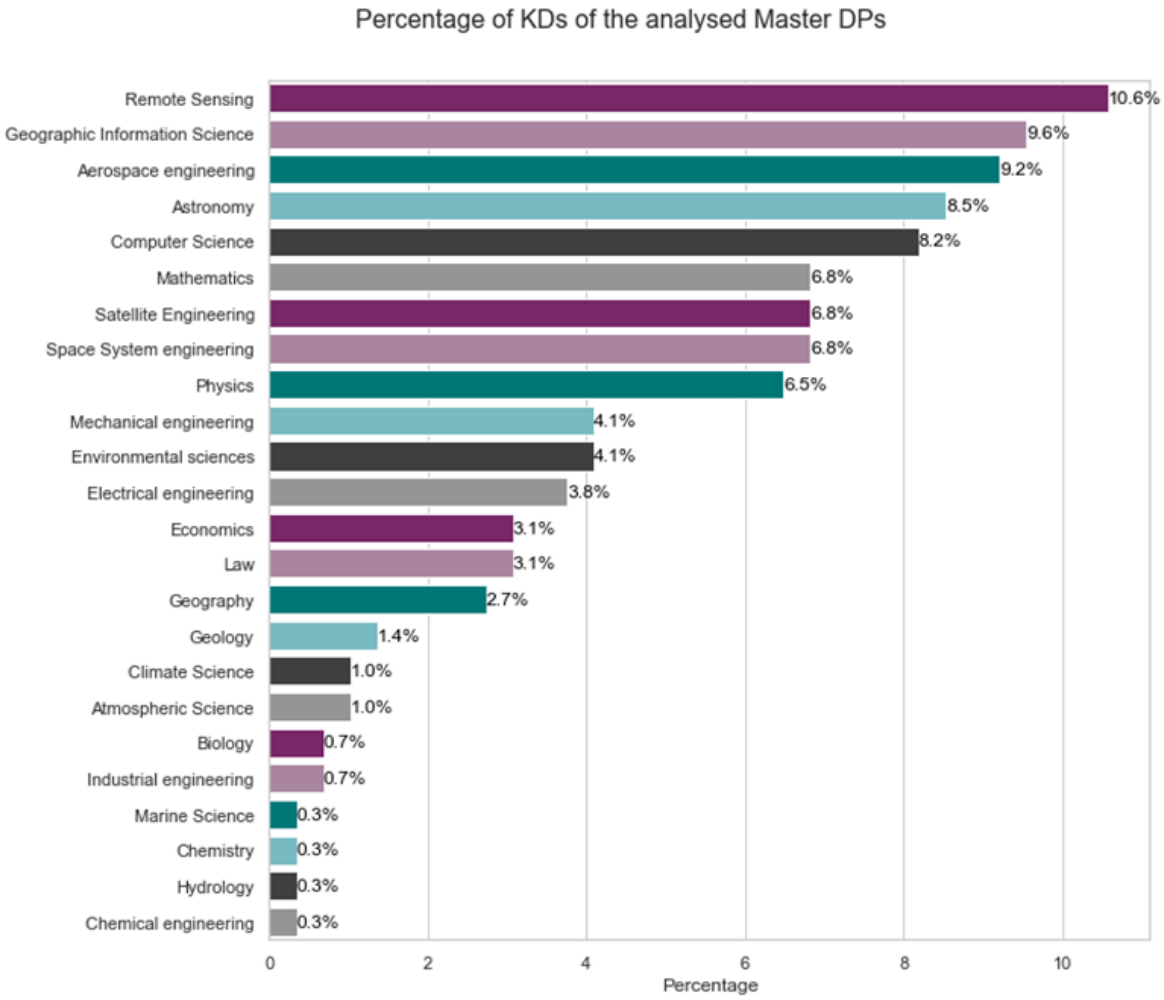

Figure 19. Percentage of Knowledge Domains in the analyzed Master Degree Programs

6.3. Knowledge Areas of the analyzed Bachelor and Master degree programs

We divided the whole dataset of 3591 courses collected by our ASTRAIOS team into two sets: one set includes 1059 courses at the Bachelor level and the other set consists of 2532 courses at the Master level. Then at each level we counted the frequency (number) of courses assigned to each KA, and the percentage of each KA in the total courses at each level. The most representative results are the KAs occurring with highest frequencies (>=1%), and the KAs occurring with lowest frequencies (<=0.1%), which are demonstrated in the following

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tables and figures. Table 13 lists the most frequent KAs occurring at our Bachelor DPs. At this level, it is understandable that fundamental courses such as classical mechanics, applied mathematics, calculus, are the most important KAs being offered. We observed that aeronautics (but not astronautics) is the second most frequent KA in Bachelor courses. KAs applicable in the downstream sector such as remote sensing, geospatial analytics and modelling, algorithms, data structures, complexity, and computability, modeling complex systems, etc. also occur quite frequently. Some of the analyzed DPs were mapped to KAs that belong to the Environmental Sciences KD.

Table 13. List of the most frequent KAs, with each representing at least 1% of courses offered at Bachelor level

KAs	Frequency/Number of courses
classical mechanics	54
aeronautics	41
applied mathematics	38
geodesy	29
other physics KAs	31
algorithms, data structures, complexity, and computability, modeling complex systems	26
environmental engineering and sustainability	25
qualitative, quantitative research skills	27
calculus	22
land management	18
remote sensing	19
cartography and visualization	18
geospatial analytics and modelling	14
electronics	18
finance, business, and management	18
other environmental sciences KAs	18
policy and law	18
manufacturing engineering	14
computer graphics, computer simulation, virtual reality	13
economics	13
algebra	13
climate change	12

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aerodynamics	11
computer systems, architectures, network	11
optics	11
astrophysics	11

Table 14 shows the least frequent KAs at Bachelor level: agricultural mapping and monitoring, artificial intelligence etc.

Table 14. The least frequent KAs, with each representing 0.1% or less of courses offered at Bachelor level.

KAs	Frequency/Number of courses	Percentage
agricultural mapping and monitoring	1	0.1%
artificial intelligence	1	0.1%
astrodynamics	1	0.1%
sensors and instruments	1	0.1%
quantum physics and technology	1	0.1%
satellite platforms and payloads, space mission	1	0.1%
space safety: space debris, planetary defense	1	0.1%
spacecraft engineering	1	0.1%

Many courses at the Master level are related to astrophysics KA (87 courses). Table 15 shows the high occurrences of astrophysics and other physics-related KAs such as classical mechanics, stellar physics, quantum physics and technology andparticle physics strongly imply that the focus of space education at master level is much on upstream sector. An important focus on space education at Master level is on the downstream sector, many courses being related to remote sensing, geospatial analytics and modelling, image processing and analysis.

Table 15. List of the most frequent KAs, with each representing at least 1% of courses offered at Master level.

KAs	Frequency/Number of courses
astrophysics	87
other physics KAs	69
classical mechanics	70
data science, data analysis, data mining	56

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remote sensing	59
environmental engineering and sustainability	59
geospatial analytics and modelling	53
qualitative, quantitative research skills	56
finance, business and management	50
cosmology	50
planetary science	52
algorithms, data structures, complexity, and computability, modeling complex systems	40
applied mathematics	47
other astronomy KAs	42
image processing and analysis	38
space architecture	38
work based experience	43
aeronautics	40
other environmental sciences KAs	41
other geology KAs	42
satellite platforms and payloads, space mission	31
instrumentation-telescopes, detectors, and techniques	37
artificial intelligence	35
cartography and visualization	36
security and privacy	36
stellar physics	36
automation and robotics	30
policy and law	32
quantum physics and technology	28
geospatial data architecture and management	30
particle physics	29
climate change	31
geographic information system	31
other chemistry KAs	25
manufacturing engineering	25
sensors and instruments	26
Geodesy	25

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Table 16 shows the least frequent KAs in courses at Master level: e.g. space safety and space traffic management. The low occurrences of space safety and space traffic management suggest that space systems engineering KD receives less attention in space education at Master level. Interestingly, while astrophysics is the most popular KA at master level, astrobiology and astrochemistry are the least popular ones

Table 16. The least frequent KAs, with each representing 0.1% or less of courses offered at Master level.

KAs	Frequency/Number of courses
space safety: space debris, planetary defence	3
agricultural mapping and monitoring	3
astrobiology	3
astrochemistry	3
mechatronics	3
nanoscience	2
software development	3
space economy	3
space traffic management	3
biodiversity and conservation	2
software engineering	2
thermodynamics	2
biotechnology	1
chemical oceanography	1
geometry	1
metrology and calibration	1
satellite antenna design	1
satellite sensor design, cubeSat design	1
space medicine	1
telemetry tracking and control transponders	1

Transversal skills such as project management are covered by many of the analysed Master DPs but are less frequently encountered in the courses of the gathered Bachelor DPs. These skills might be part of the learning objectives of the discipline related courses: e.g. research projects include programming, teamwork, time management as part of the learning objectives.

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6.4. Text mining and analysis of keywords in course descriptions

Following our text mining procedure described in Section 4.3.4, we present three lists of the most frequent keywords occurring in all our DPs' general descriptions, in Bachelor course descriptions and in Master course descriptions in Table 17, and three Word clouds in Figure 20, 21, 22 to visualize those top keywords.

Table 17 shows the most frequent keywords encountered in all courses (mix of Bachelor and MSc Master DPs) , in the courses analyzed at the Bachelor and MSc Master level respectively:

- all courses: remote sensing, spatial data, theoretical, practical
- Bachelor DPs: spatial data, geodesy geoinformatics
- Master DPs: climate change, solve problems, Earth Observation, combination between theoretical and practical knowledge, communication skills.

We observed some advanced topics that were only taught at Master level, but not Bachelor level: space systems, space mission, space environment, stellar evolution.

Table 17. The most frequent bigrams in course descriptions

	Bigram/Keyword	Frequency in all courses	Frequency in Bachelor DPs with 1059 courses	Frequency in Master DPs with 2532 courses
1.	remote sensing	269	53	216
2.	spatial data	163	87	76
3.	theoretical practical	112	27	85
4.	data analysis	112	28	84
5.	solve problems	91	27	64
6.	data processing	86	28	58
7.	climate change	81	2	79
8.	geospatial data	80	40	40
9.	work team	77	47	30
10.	real estate	74	66	8
11.	geodesy geoinformatics	71	71	N.A.
12.	differential equations	69	22	47
13.	earth observation	69	2	67
14.	space systems	68	N.A.	68
15.	practical work	66	15	51

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16.	propulsion systems	65	11	54
17.	make decisions	63	36	27
18.	new situations	61	48	13
19.	adapt new	59	48	11
20.	real world	58	8	50
21.	communication skills	58	6	52
22.	new technologies	57	48	9
23.	large scale	57	12	45
24.	case studies	55	5	50
25.	space mission	55	N.A.	55
26.	signal processing	55	26	29
27.	space environment	55	N.A.	55
28.	stellar evolution	55	N.A.	55
29.	data collection	55	27	28
30.	control systems	55	23	32

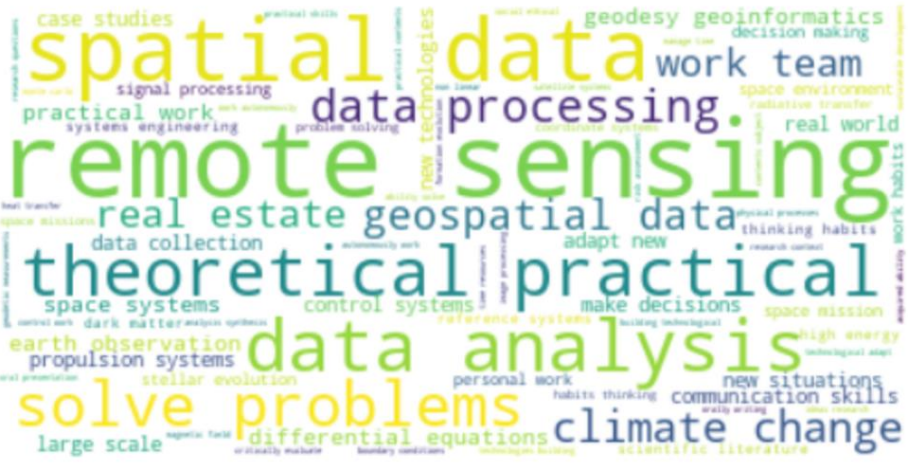

Figure 20. Word Cloud generated from all our DPs course descriptions.

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Figure 21. Word Cloud generated from our Bachelor course descriptions.

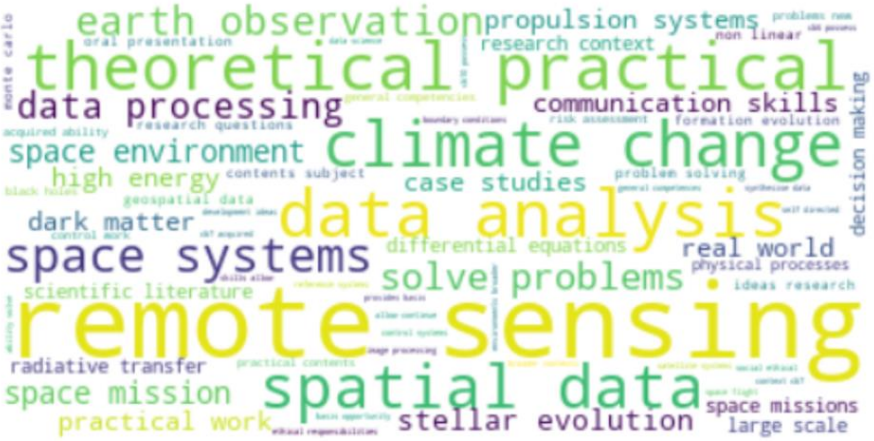

Figure 22. Word Cloud generated from the Master course descriptions included in our analysis

6.5. Analysis of the information collected using the survey

Using the online survey, we collected information about 12 degree programs. Despite the survey being sent to over 700 email addresses (including several reminders) and shared on the ASTRAIOS website and other social media, the number of respondents remained low. This might indicate that the community receives a large number of various surveys from other different projects and initiatives, and it might become impossible for the potential respondents to contribute to all of them. Since the survey is a complementary way of collecting required information, our analysis was not negatively impacted by the low number of respondents. The collected information is depicted in Table 18 and filtered as the following:

- Two DPs collected using this method are discarded as the provided information is not accurate. For example, the list of the courses in the submitted document do not match the list on the website.

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Additional discrepancies between the information provided and those available on the website have been discovered.

- Respondent 3 mentioned 4 DPs: BEng/MEng Aerospace Engineering and BEng/MEng Aerospace Engineering with Pilot Studies. However, BEng and MEng Aerospace Engineering are the only ones has been included in our database because of their high overlap with the remaining two DPs. The difference is by one distinct course in the first year out of five, one mandatory course out of 7 in the third year, and one optional course, Aeroelasticity and Flight Loads versus Aeroelasticity in the fourth year.
- Respondent 6 mentioned 2 DPs: BSc Aerospace Engineering and Master Aerospace Engineering. However, only the Master Aerospace Engineering is included in the database, as the other DP is documented previously by the ASTRAIOS Team.
- Respondent 7 mentioned that the Integrated master's in mechanical engineering is comprised of 4 years for the bachelor's degree while the 5th year is the master's program; thus, only the courses of the 5th year are documented. The same applied for response number 11, where only the 4th year of the MEng Aerospace Engineering courses are added to the database.
- Respondent 4 mentioned that the Master of Engineering (MEng) is structured as an integration of a 3-year Bachelor of Engineering (BEng) program and a subsequent 1-year Master degree component.
- Respondents' numbers 11 and 12 added two types of master's degrees for the same institute, the MEng and one stand-alone Master degree program.

Table 18 shows the list of the respondents, including the institutions collected by the survey, degree programs, allocated city and European Qualification Framework (EQF) level. Please note that numbers 8 and 10 are discarded. The complete survey is available in appendix E.

Table 18. List of the survey respondents

No.	Institute name	City	Degree program	European Qualification Framework level
1	City, University of London	London	Master Space Mission Analysis and Design	EQF7 (Master)
2	University College Dublin	Dublin	Master Space Science and Technology	EQF7 (Master)

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3	UWE Bristol	Bristol	BEng/MEng Aerospace Engineering	EQF7 (Master)
4	University of Bristol	Bristol	Integrated master's in aerospace engineering	EQF7 (Master)
5	AMADE from University of Girona	Girona	Master on Mechanics of Materials and Structures	EQF7 (Master)
6	TU Delft	Delft	Master Aerospace engineering	EQF7 (Master)
7	Aristotle University of Thessaloniki	Thessaloniki	Integrated master's in mechanical engineering	EQF7 (Master)
8	Robby Moto Engineering srl	Casalmaggiore	Master in Aeronautical Engineering	EQF7 (Master)
9	Technische Universität Berlin - Chair of Space Technology	Berlin	Master of Aeronautics and Astronautics	EQF7 (Master)
10	European Aeronautics Science Network (EASN) & Institute of Structural Mechanics and Lightweight Design, RWTH AACHEN University	Aachen	Department of Aerospace Engineering	EQF8 (PhD)
11	Brunel University London	London	MEng Aerospace Engineering	EQF7 (Master)
12	Brunel University London	London	Master Aerospace Engineering	EQF7 (Master)

Thanks to the information collected through this survey, 12 DPs have been added to the ASTRAIOS database (2 Bachelor and 10 Master DPs). Furthermore, 392 courses related to the 12 DPs have been collected and added to the ASTRAIOS database. The 12 DPs collected by the survey are geographically distributed across several countries increasing the geographic coverage of the ASTRAIOS database. The distribution is represented in Figure 23: 7 DPs are located in the United Kingdom, and the other 5 DPs are located in Ireland, Netherlands, Greece, Spain and Germany.

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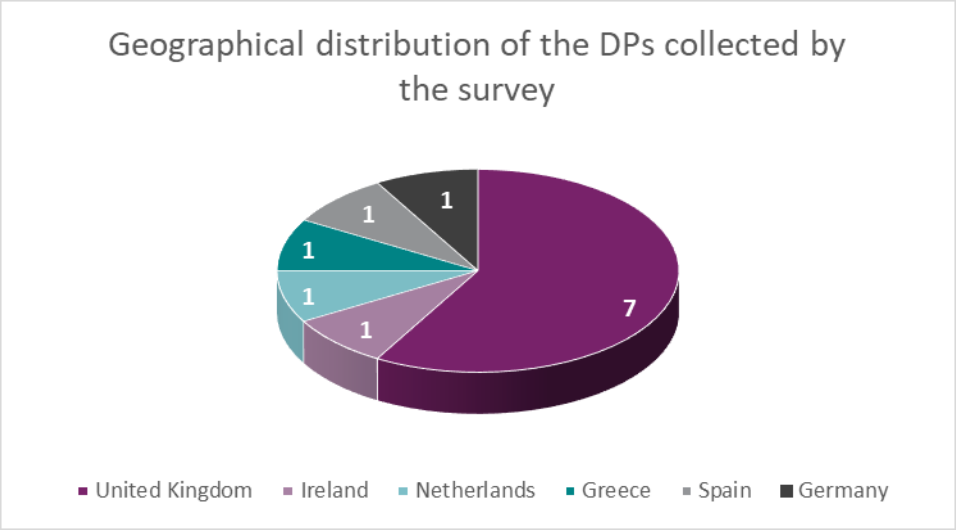

Figure 23. Geographical distribution of the Degree Programs collected by the survey

Six institutions out of nine have more than one campus, some in the same city, such as City, University of London that has two campuses in London. Aristotle University of Thessaloniki has the main campus in Thessaloniki, and additional campuses for Physical Education and Sports Sciences in Serres/Greece. University College Dublin has the main campus in Dublin, but others 3 in China, such as Beijing-Dublin International College (BDIC), which is a collaboration international joint college between University College Dublin and Beijing University of Technology (https://www.ucd.ie/bdic/).

The survey found that 70% of the mentioned DPs offered an industrial placement, emphasizing that those programs help students connect directly with the work market, increasing their employability. Copernicus's thematic areas are land, marine, atmosphere, climate change, emergency, and security. 40% (4 DPs) of the DPs in the survey are linked with the Copernicus thematic areas. The atmosphere thematic area has the highest frequency and is associated with 4 DPs, and the climate thematic area appears 3 times. The thematic areas, emergency, security and land appear two times each. The marine thematic area is missing and does not show with any DPs included in the survey.

Figure 24 shows the skills that students acquired during their study. It also shows that 80% of the collected DPs provide a minimum 6 skills during the study. It shows that all the DPs encourage group work, and nine give the students opportunities to work in culturally diverse teams. 8 DPs encourage students to present their work before a broader audience. 7 DPs focused on sustainability domains such as the environment and society and project management and allowed the students to do lab experiments. 6 DPs give the students the

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opportunity to develop their leadership and other soft skills such as presentation skills. Only three DPs in Master space mission analysis and design and two MSc/MEng aerospace engineering offer course/s on ethics and teach the students to be empathic future employees.

In summary, the analysis revealed that 70% of the DPs mentioned in our survey encourage and give opportunities for collaborative learning, teamwork and presentation skills (skills number 1, 2, and 3) and 60% of the DPs focus on practical skills, academic and professional development and sustainability (skills number 6, 7, 8, 4 and 5). Only 30 % of the DPs focus on work ethics and empathy (skills number 9 and 10). The two skills are important for creating a more harmonious and effective work environment regarding reliability, communication, and collaboration.

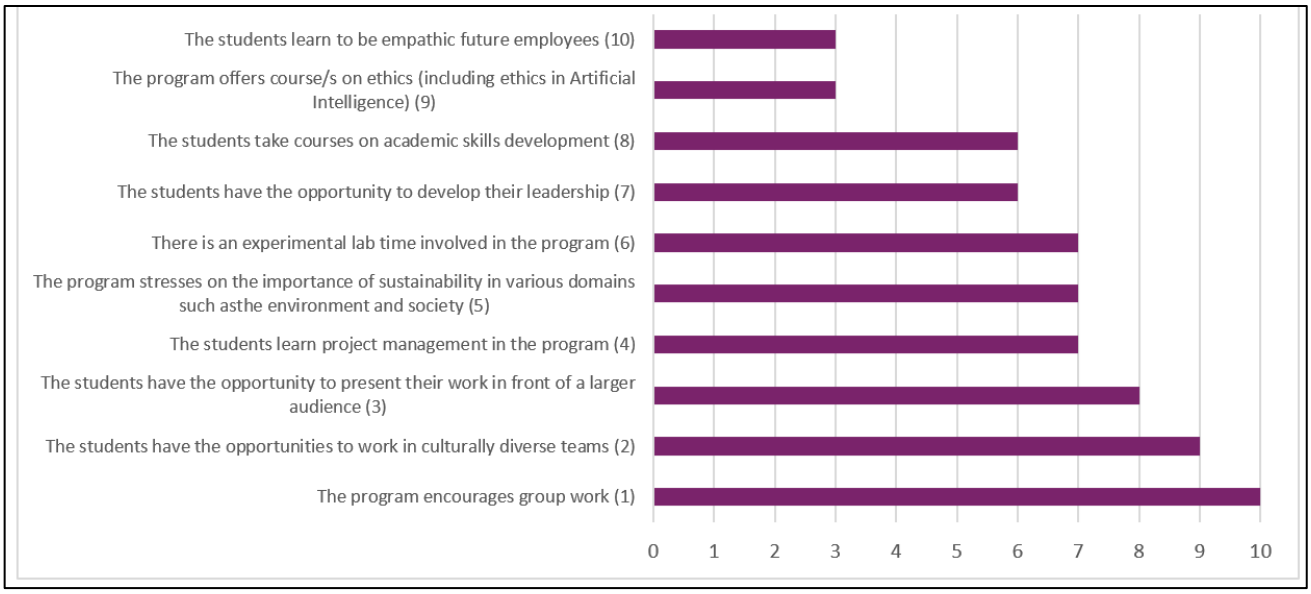

Figure 24. Skills covered by the Degree Programs included in the survey.

To summarize this section, we collected 11 responses using the survey, where 2 are discarded. The other 9 responses added valuable 12 DPs (with 392 associated courses) to the database. The information collected by questions that are specifically related to the DPs such as the KDs, KAs, and graduation condition was analyzed as part of the overall number of documented Master and Bachelor DPs. Thus, in this section, we only interpreted and analyzed the additional questions included in the survey, such as the link of the DPs to the Copernicus's thematic areas.

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7. ANALYSIS OF THE PHD PROGRAMS

By analyzing the description of the PhD programs and courses available on the website of the institute(s) included in this analysis, the following conclusions could be drawn:

Diversity in focus and approach: the analyzed programs have diverse focuses, ranging from aeronautics, space, and energy to environmental changes. Each program tailors its courses to address the specific challenges and domains within its research area.

Comprehensive Skill Development: the analyzed PhD programs share a common emphasis on developing not only discipline-related skills but also transversal skills such as language and communication, and career-oriented training, effective communication, teamwork, and project management. This approach aims to prepare PhD candidates not only as researchers but also as effective communicators and leaders.

Tailored courses to research themes: for example, the University of Twente's approach of organizing PhD research around specific themes, such as 4D Earth and Water cycle, reflects a strategic alignment of courses with the research focus.

A brief description of each of the analyzed PhD programs is provided below.

German Aerospace Center (DLR) Graduate Program:

- General information: offer PhD positions in aeronautics, space, energy, transport and digitalization
- Available courses: introductory course, project management, communication, peer-reviewed publishing, presenting at scientific conferences, work techniques and methodological competences, project management skills, language and intercultural skills, communication and social skills

TU Delft Graduate School of Aerospace Engineering

- General information: Aerospace Engineering Graduate School is part of the Delft University Graduate School
- Available courses: the program contains an educational part to provide skills that help students become successful PhD researchers. Three categories of courses are offered: discipline related skills (scientific knowledge, engineering, design), research skills (developing skills by doing learning on the job activities and by attending various courses that will help develop research management, academic thinking, academic attitude, research data management), transversal skills (effective communication, working with others, teaching, supervising and coaching).

University of Twente Graduate School/ Faculty of Geo-Information Science and Earth Observation:

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- General information: The PhD research is carried out around six research themes: 4D Earth, Acquisition and quality of geo-spatial information, Forest Agriculture and Environment in the spatial sciences, People Land and Urban Systems, Spatial Temporal analytics, maps and processing, Water cycle and climate.
- Available courses: the program offers several courses focused on professional development and support, personal development and support and teaching (Examination Boards: introduction to tasks and responsibilities, Expedition Education online), workshop Scientific Identity - How to stay faithful to your SELF in your work as a scientist?), research support (Presentation skills, Academic Publishing), workshop Scientific Identity - How to stay faithful to your SELF in your work as a scientist?), research support (Presentation skills, Academic Publishing); Language and Communication (Dutch A1 - Dutch Intensive Summer Course), Data management bootcamp, Scientific Information bootcamp, personal effectiveness (TGS Brain training: Focus Management, Speed reading & Memory Techniques

Wageningen University & Research Graduate School

- General information: the Graduate School focuses on developing an integrated understanding of environmental changes and their impact on people, society and nature. It focuses on three grand challenges: climate action, managing our future biosphere, advancing circular systems.
- Available courses: several competences, skills and career-oriented courses are offered by the graduate school. The courses include: PhD competence assessments, writing and presenting training (Creating and Pitching Virtual Posters, The Essentials of Scientific Writing and Presenting, Efficient Writing Strategies, Reviewing a Scientific Manuscript, Science Journalism, Writing Grant proposals, Writing propositions for your PhD, Presenting with Impact), communication skills training (Mobilizing your - scientific – network, Effective and efficient communication in academia and beyond, Making Impact: Increasing the relevance of research through science-society interaction, Effective behavior in your professional surroundings etc.), project management skills training (Mindful Productivity for scientists, Project and Time Management, Research Data Management), Training on teaching, Ethics Training (Scientific Integrity), Career Oriented Training /Assessment, Specialization courses (transformative research for sustainability challenges, Python Programming for PhD students, Big Data Exploration and object-oriented programming with Python, Climate Information for adaptation, Data Science, Artificial Intelligence and Geographic Information Systems (GIS) for Environmental Sciences, Embracingopenness: an introduction to

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Open Science practices, Making Impact: Increasing the relevance of research through science-society interaction.

Jagiellonian University in Krakow/ Doctoral School of Exact and Natural Sciences

- General information: consists of twelve study programs, two of which are focused on Astronomy and Earth and Environmental Sciences. The PhD in the Environmental Sciences is offered by the Faculty of Geography and Geology.
- Available courses: several courses and seminar are offered to PhD candidates including 'Purpose, scope and methodology of the planned dissertation against achievements in the field', Polish for Foreigners, Second foreign language, personal development related courses such as transversal skills and general knowledge, English Language, Field of natural and exact sciences research, Methodology workshop, Humanistic competencies, Personal competence (philosophy of science, rhetoric, psychology, Japanese culture, Mediterranean archeology), PhD internship, physical development (sport), teaching practice, Health and Safety in Education, First Aid general knowledge development course (ethics, artificial intelligence, cosmology, career planning, managerial skills, business communication.

University of Milano-Bicocca/ Doctoral School of Milano – Bicocca

- General information: offers several PHD programs including those in Physics and Astronomy,
- Available courses: PhD program in Chemical, Geological and Environmental Sciences offers several specialized courses on Earth Observation data for environmental monitoring, Open source software for spatial data analysis, Online tools for atmospheric research, Climate Journal Club, Environmental Sustainability, Machine Learning for Multivariate Data Analysis, New lignin-based sustainable materials: science and technological aspects, Geophysical Fluid Dynamics, Scanning probe microscopy: principles, applications in nanoscience and image handling, Spectroscopy: a flexible tool for an integrated approach in scientific research, Critical raw materials and their environmental impact, the role of the oceans in the climate system, Waves and turbulence, Technical Aspects of the Law of the Sea personal development courses (team work and group dynamics, Psychological and social determinants of pro-environmental attitudes and behaviors, Research dissemination, transferring and exploitation etc.). The PhD program in Physics and Astronomy contains five curricula: theoretical physics, subnuclear physics, astrophysics, plasma physics and biophysics, applied physics and electronics. The taught courses include Effective Field

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Theory/QCD, Quantum Computing and technologies, Cosmology, Computational Astrophysics, Physics at Colliders, Topics in Python and C++, Deep Learning and AI.

University of Glasgow/ IAPETUS 2 Doctoral training program

- General Information: IAPETUS2 is a partnership between several research universities of Durham, Heriot Watt, Glasgow, Newcastle, St Andrews and Stirling, together with the British Antarctic Survey, British Geological Survey and the Centre for Ecology & Hydrology. It focuses on several topics: global environmental change, Geodynamics and Earth resources, Carbon and nutrient cycling, Hazards, risks and resilience, Biodiversity and ecosystem resources.

Technical University of Munich

- General Information: strong support for developing both academic knowledge and professional qualification.
- Available course: the main courses are available on transversal skills (Personality and Self-Management, Communication Skills, Leadership and Responsibility, Entrepreneurship and Startups, Business and Industry, Science and Research), subject-specific qualification language courses and language training.

European Aeronautics Science Network (EASN) & Institute of Structural Mechanics and Lightweight Design, RWTH Aachen University Phd program (note: documented using our survey):

- General information: the program is offered by the Department of Aerospace engineering in German, and it is related to the mechanical engineering, aerospace engineering, electrical engineering and satellite engineering knowledge domains defined in our project. The program has been initiated for the university itself.
- Available courses: beside discipline specific courses, the students can develop their transversal skills by taking courses on developing academic, presentation, leadership and teamwork skills.

The Horizon Europe Marie Skłodowska-Curie Actions (MSCA) Phd programs are presented in Table 19.

Table 19. Horizon Europe Marie Skłodowska-Curie Actions (MSCA)

Name	Beneficiaries
Innovating New Space Frontiers: Harmonized Federated and Fractionated Systems Unlocking Fresh Perspectives for Satellite Services (2022-2026)	University of the Bundeswehr Munich, Thales Alenia Space SAA (France), Thales Alenia Space Espana SA, UAB Nanoavionics (Lithuania), M.B.I. SRL (Italy), Centre National de la Recherche Scientifique CNRS (France), Large Space Structures GMBH (Germany

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MWGaiaDN: Revealing the Milky Way with Gaia	Leiden University, Universitat de Barcelona, Lund University, National and Kapodistrian University of Athens, Technische Universitaet Dresden, Université Grenoble Alpes, Universidade de Coimbra, University College London, University of Cambridge, National Institute of Astrophysics (Italy)
ENTRUST-Next Generation of Trustworthy Agri-Data Management	National University of Ireland Maynooth, Linnaeus University, Teagasc – the Agriculture and Food Development Authority, Agricultural University of Athens, Singular Logic, Universita Degli Studi Di Palermo, ENGINEERING Ingegneria Informatica S.p.A., Södra skogsägarna ekonomisk förening
ModConFlex: Modelling and control of flexible structures interacting with fluids	University of Wuppertal, Université de Bordeaux, Communauté d'universités et établissements Université Bourgogne Franche-Comté, Friedrich-Alexander-Universität Erlangen-Nürnberg, Tel Aviv University, Universiteit Twente
MWP4SPACE: MicroWave Photonic Technologies for Communications and Sensing Applications in Space	Right photonics bv, Mbryonics limited, Consorzio nazionale interuniversitario per le telecomunicazioni, Ccuola superiore di studi universitari e di perfezionamento Anna, Dublin city university, University college cork - national university of Ireland, Alter Technology TUV Nord sa, Universiteit Gent, iii-v lab, Camgraphic srl.
GENIUS - Glide-symmetric mEtamaterials for iNnovative radIo-frequency commUnication and Sensing (GENIUS)	Sorbonne University, Royal Institute of Technology, Thales RT, Sinowave, Airbus, United Kingdom, Politecnico di Torino (POLITO)
BiD4BEST: Big Data applications for Black hole Evolution Studies	University of Southampton, Donostia International Physics Centre, Durham University, Instituto de Astrofísica de Cararias (IAC), Ludwig-Maximilians-Universität München (LMU), Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Scuola Internazionale Superiore di Studi Avanzati (SISSA), Universiteit Leiden (ULEI), University of Bath
SWATNET: Space Weather Awareness Training Network	Helsingin Yliopisto, Academy of Athens, Eotvos lorand tudomanyegyetem, Katholieke universiteit Leuven, Universidade de Coimbra, Universita degli studi di Roma tor vergata, The university of Sheffield, Turun Yliopisto, Uniwersytet Marii Curie-Sklodowskiej
TRACES: TRAining the next generation of iCE researcherS	Politecnico di Milano, Technische Universtät Braunschweig, Technische Universtät Darmstadt, Office National d'Etudes et de Researches Aérospatiales, École Polytechnique
ANTERRA: Advanced antenna systems to boost wireless coverage	Technische Universiteit Eindhoven, Ericsson, Consiglio Nazionale delle Ricerche, Chalmers Tekniska Hogskola, Thales Alenia Space France, Satcube, Antennex, The antenna company Nederland, Stichting nederlandse wetenschappelijk onderzoek instituten, Thales Alenia Space Italia

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The PhD programs have been mapped to the ASTRAIOS KDs (Figure 25). For the interdisciplinary PhD programs, more than one KD was assigned. The distribution of KDs has revealed the diversity of PhD programs in the space sector, emphasizing both the practical applications of technology and the need for a diverse skill set to address complex challenges. The main conclusion drawn from this analysis is presented below:

Diversity in knowledge domains: the diversity of KDs, ranging from Astronomy and Aerospace Engineering to Remote Sensing and Agricultural Science, emphasize the multidisciplinary nature of PhD programs in the space sector. This diversity reflects the wide range of skills and expertise needed for space-related research and applications.

Technological focus: Aerospace Engineering, Electrical Engineering, Geographic Information Science, and Satellite Engineering together represent 20% of the KDs. This highlights a significant emphasis on technology-driven disciplines within space-related PhD programs, suggesting a focus on advancing technological solutions for space exploration and applications.

Earth Observation and remote sensing technologies: The inclusion of Remote Sensing, Geographic Information Science, and Water Management as very frequent KDs suggests a strong focus on Earth observation and remote sensing technologies of the analyzed programs. This aligns with the growing importance of monitoring and managing Earth's resources from space.

Limited representation of fundamental sciences: while Physics is present, its relatively lower percentage (3.6%) compared to applied sciences and engineering domains may indicate a greater emphasis on practical applications and technology development rather than fundamental scientific research in certain PhD programs within the space sector.

Opportunities for innovation: fields like Climate Science and Marine Science suggests that some PhD programs in the space sector focus on addressing broader planetary challenges, potentially providing opportunities for innovative solutions at the intersection of space and Earth sciences. Yet, lower percentages suggest a potential need for increased emphasis on these areas in the context of space-related PhD programs.

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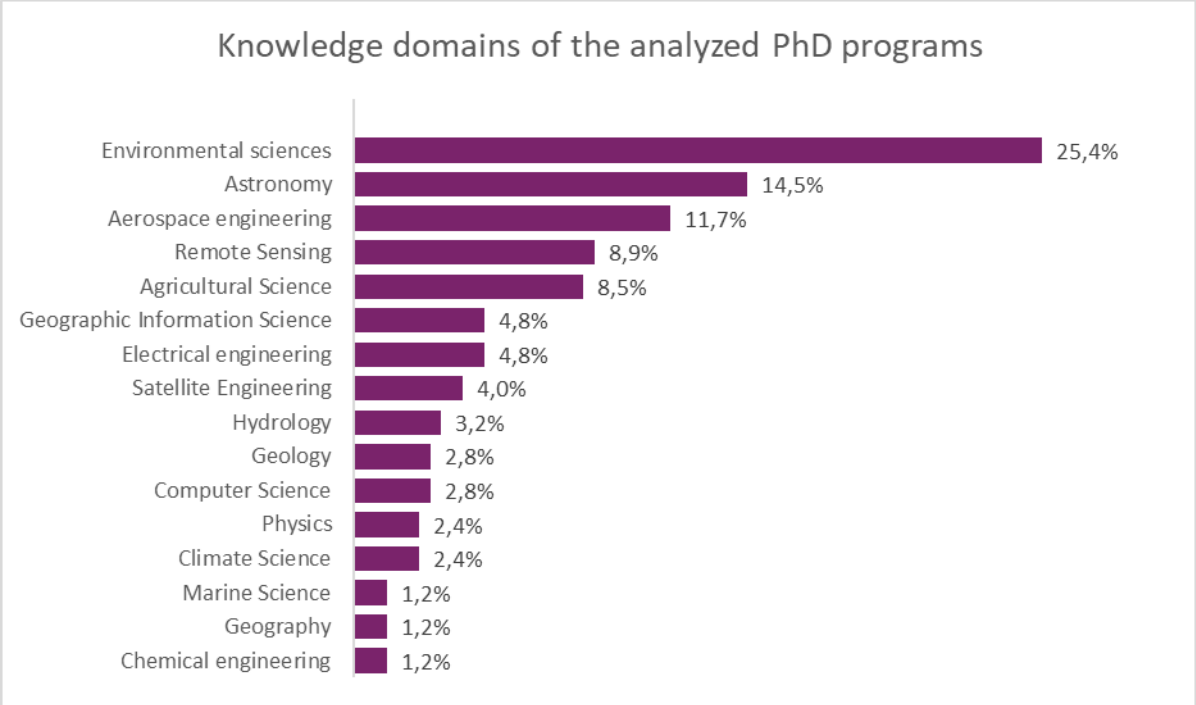

Figure 25. Knowledge domains of the analyzed PhD programs.

The analysis of the additional KDs assigned to the analyzed PhD studies has revealed the dominance of the remote sensing KDs and computer science (Figure 26).

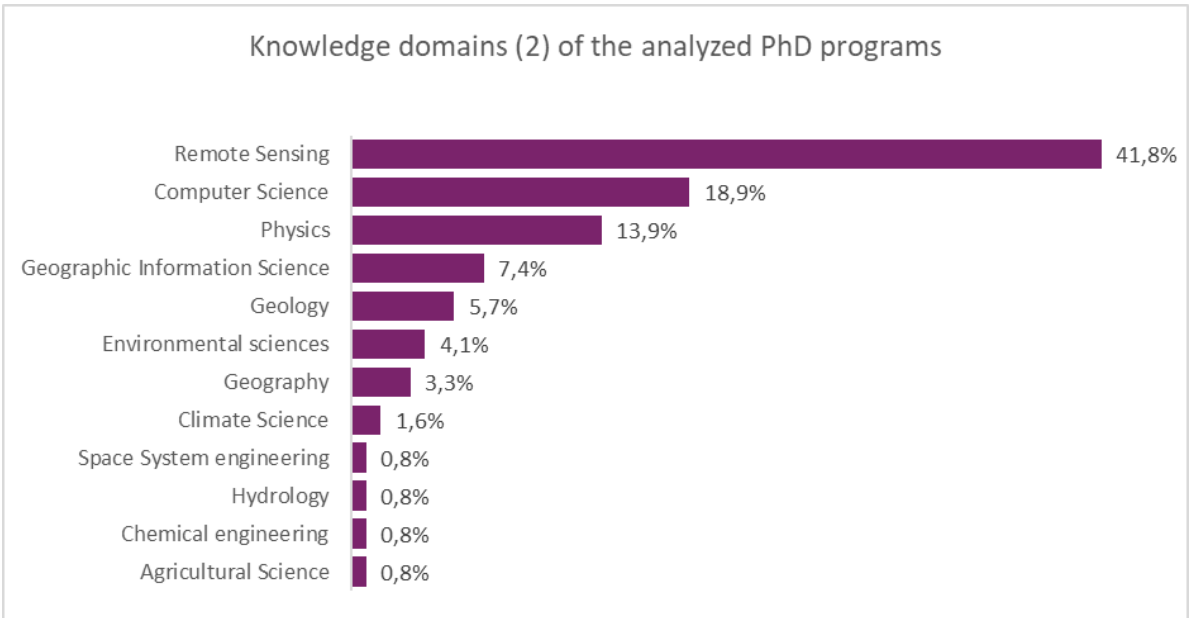

Figure 26. Percentage of knowledge domains (2) of the evaluated PhD programs

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The high frequency of the remote sensing suggests a key role of remote sensing data and technology in the analysis PhD programs. The high frequency of Computer Science emphasizes the increasing importance of computational techniques and data processing within the evaluated PhD programs.

The main KD represented by the analyzed MSCA include astronomy, aerospace engineering, agricultural science, satellite engineering and electrical engineering (Figure 27). Regarding the additional KDs, only computer science and physics have been selected (nine and fifteen programs respectively were assigned to these two KDs).

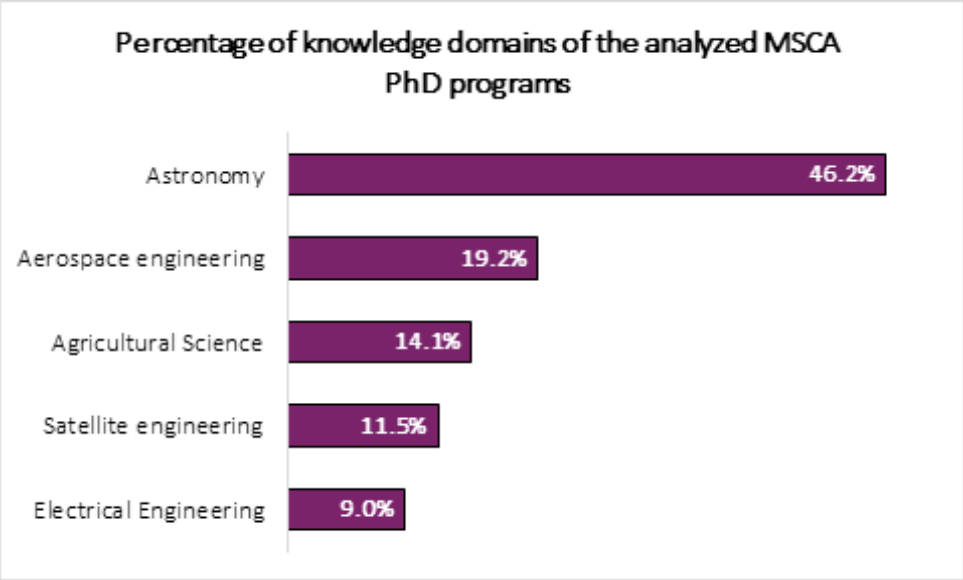

Figure 27. Percentage of knowledge domains (option 2) of the evaluated MSCA PhD programs

The ongoing research projects and PhD positions advertised in 2023 at the investigated PhD programs have been mapped across the KAs determined in the ASTRAIOS project. The conclusions from KAs are presented below (see Figure 28):

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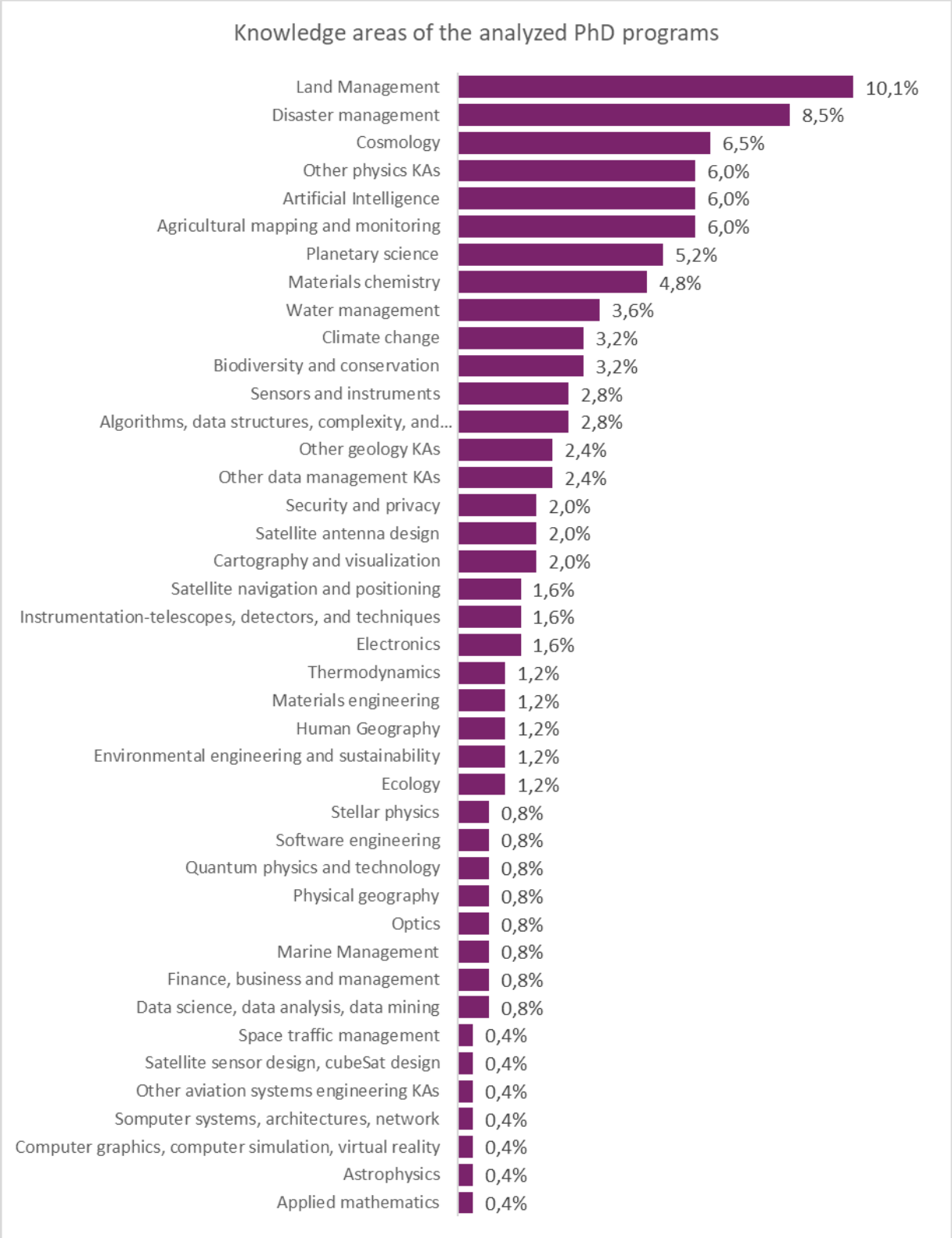

Figure 28. Percentage of knowledge areas of the analyzed PhD programs

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Diversity of research focus: the large number of KAs emphasizes the multidisciplinary nature of space-related research, including domains from Land Management and Disaster Management to Cosmology and Artificial Intelligence.

Emphasis on Earth-Related applications: Land Management, Disaster Management, and Agricultural Mapping and Monitoring collectively constitute 24.5%, indicating a significant emphasis on Earth-related applications and the use of space technology for managing land, disasters, and agriculture. This aligns with the broader trend of utilizing satellite data for practical Earth applications.

Technological innovation through Artificial Intelligence: The inclusion of Artificial Intelligence as a prominent KA (6.4%) reflects a growing trend in leveraging advanced technologies for data analysis and decision-making in space-related research.

Cross-Cutting themes in data management and analytics: several KAs, such as Sensors and Instruments, Analytics and Modeling, and Satellite Antenna Design, emphasize the critical role of data management, analytics, and instrumentation in space research.

The distribution of the additional KAs highlights the focus on image processing, modeling, and technology advancement and the interdisciplinary nature of space-related research (Figure 29). The high frequency of Image Processing and Analysis indicates a strong emphasis on downstream sector of the analyzed PhD research projects/open positions. The sensors and Instruments, along with Satellite Sensor Design and CubeSat Design emphasize the focus on developing skills for advancing technology for data collection and instrumentation. This reflects a commitment to developing cutting-edge tools and systems for space exploration and observation. Agricultural Mapping and Monitoring, Land Management, and Water Management is an indication of the utilization of space technology for practical applications on Earth, particularly in agriculture and environmental management.

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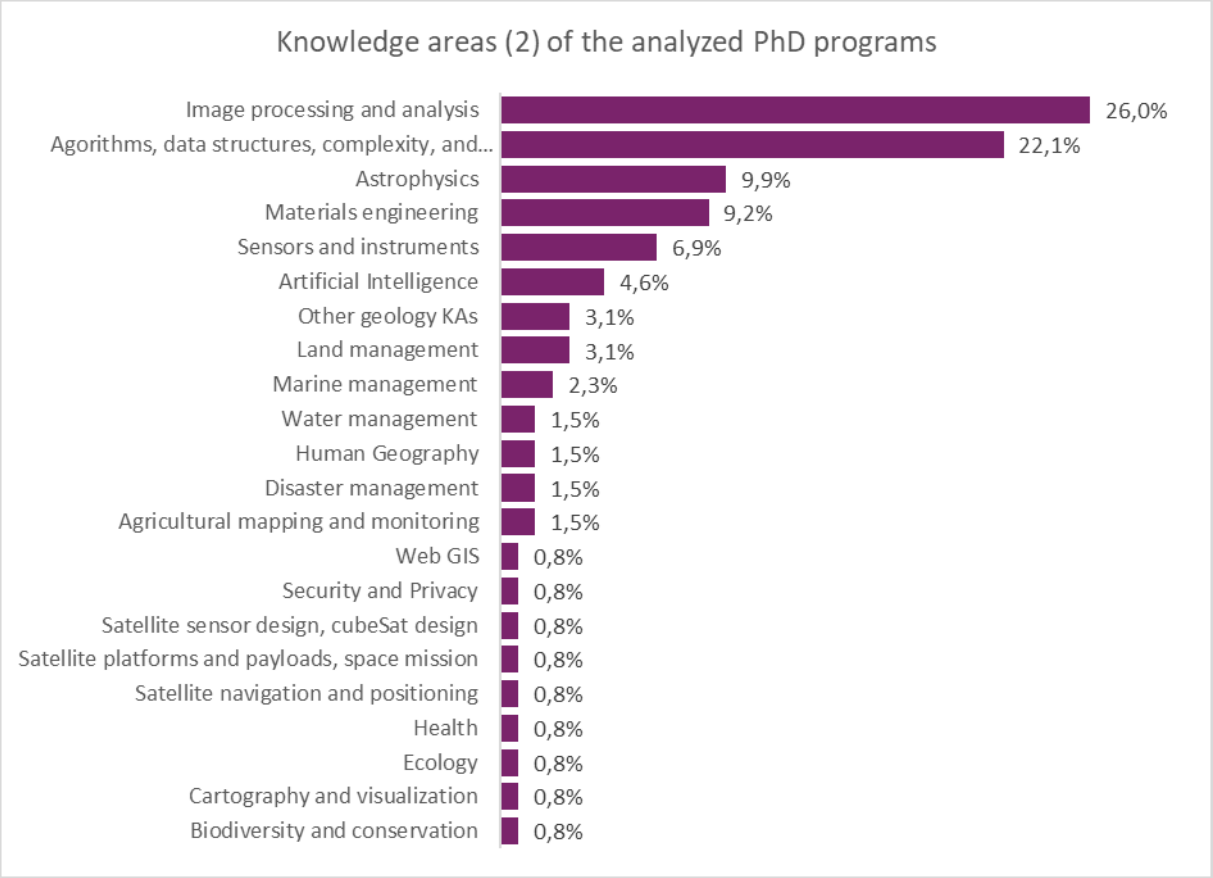

Figure 29. Percentage of knowledge areas (2) of the analyzed PhD programs

By analyzing the KAs of the MSCA programs (Figure 30 and 31), we concluded:

Dominance of Fundamental Sciences: the high frequency of Cosmology (20.5%), Other Physics Knowledge Areas (19.2%), and Planetary Science (15.4%) emphasize a focus of the analyzed PhD research projects on carrying out research on planetary systems, and associated physical phenomena.

Technological Innovation and Expertise: the inclusion of various technology-centric knowledge areas emphasizes the importance of technological innovation (developing advanced instruments and systems). This is evident in areas such as Satellite Antenna Design (6.4%), Instrumentation-Telescopes, Detectors, and Techniques (5.1%), and Electronics (5.1%).

Interdisciplinary considerations and security Focus: the distribution of KAs reflects the interdisciplinary nature of space research. While fundamental sciences dominate, there is also representation in areas such as Data Science, Data Analysis, Data Mining (1.3%), Computer Systems, Architectures, Network (1.3%), and Artificial Intelligence (1.3%), indicating a recognition of the role of interdisciplinary skills in handling data for space exploration. Additionally, the specific inclusion of Security and Privacy (3.8%) highlights the growing awareness of the need to secure space-related data and systems.

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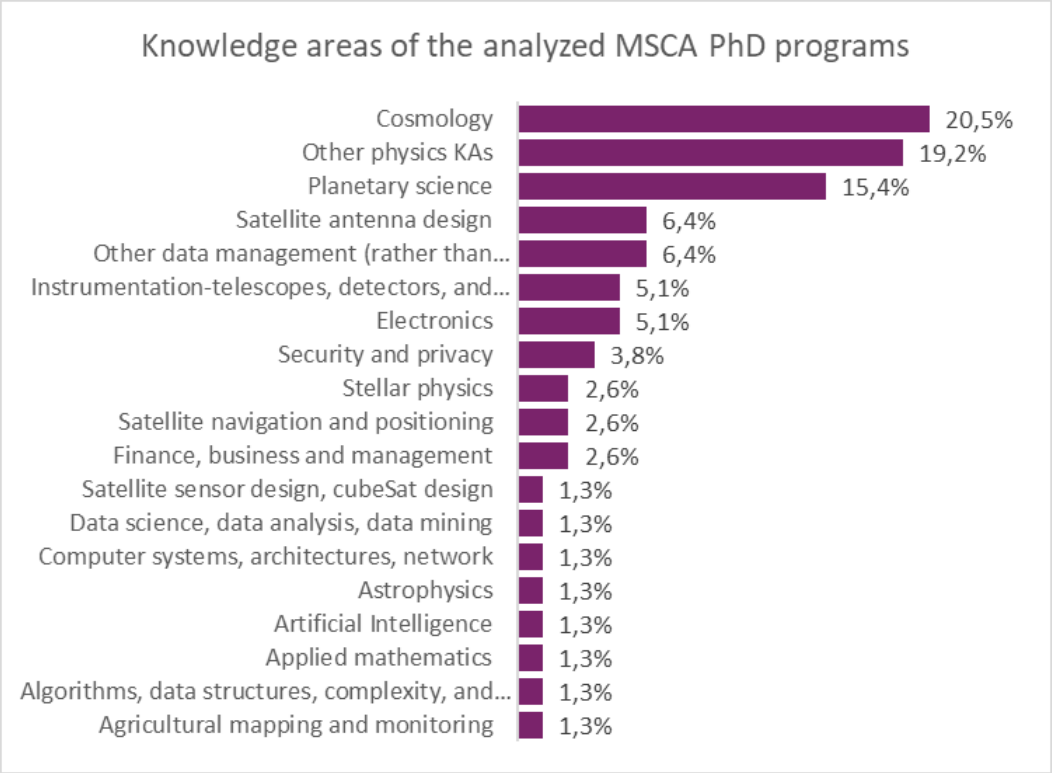

Figure 30. Percentage of knowledge areas of the analysed MSCA PhD programs

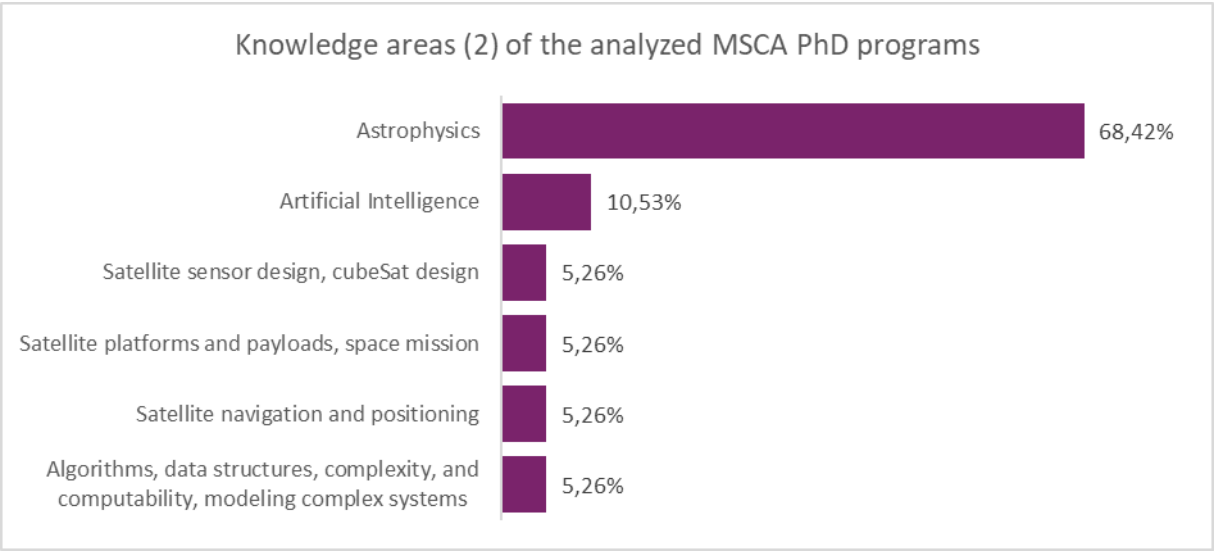

Figure 31. Percentage of knowledge areas (2) of the analyzed MSCA PhD programs

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8. ANALYSIS OF THE CONTINUING EDUCATION COURSES

CE courses play a significant role in fostering professional and personal development, enabling individuals and institutions to stay up-to-date on evolving knowledge, technologies, and skills. In total, 58 courses have been collected following the criteria specified in section 4.1. Table 20 displays the list of these courses, including the institute name, type, and whether the course is conducted online or at a specific location (city/country).

Table 20. List of the selected continuing education courses

No.	Institution Name	Course Name	Type	City/Country
1	Aeronautics and Space Agency of FFG, European Space Agency (ESA)	Alpach Summer School	Summer School	Alpbach/Tyrol ; Austria
2	European Space Agency (ESA)	ESA-FAIR Space Radiation School	Summer School	Darmstadt; Germany
3	European Space Agency (ESA)	ESA/ELGRA Gravity-Related Research Summer School	Summer School	Redu; Belgium
4	Spaceway	Small Satellite Mission Engineering III	Course	Lisbon; Portugal
5	University of Bradford	SatNEx School Bradford	Course	Bradford; UK
6	European Space Agency (ESA)/Joint Research Centre(JRC)	ESA/JRC International Summer School on GNSS	Summer School	Kiruna; Sweden
7	European Space Agency (ESA)	Concurrent engineering workshop	Course	Redu; Belgium
8	European Space Agency (ESA)	Human Space Physiology Training Course	Course	Redu; Belgium
9	European Space Agency (ESA)	Space Systems Engineering	Course	Redu; Belgium
10	European Space Agency (ESA)	Product Assurance Awareness Training	Course	Redu; Belgium
11	European Space Agency (ESA)	CubeSats Hands-on Training	Course	Redu; Belgium
12	European Space Agency (ESA)	Robotics Workshop	Course	Redu; Belgium
13	European Space Agency (ESA)	Space Weather Training Course	Course	Redu; Belgium
14	European Union Agency for the Space Program (EUSPA)	EUSPA Space Academy	Course	Online
15	International Space University (ISU)	Interactive Space Program	Summer School	Online
16	International Space University (ISU)	ESC23 Medications In Space	Course	Oxford; UK
17	International Space University (ISU)	Space * ASTROBIOLOGY	Course	Strasbourg; France
18	International Space University (ISU)	Space * NEWSPACE	Course	Strasbourg; France

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19	International Space University (ISU)	Space * OMICS	Course	Strasbourg; France
20	International Space University (ISU)	Space * SUSTAINABILITY	Course	Strasbourg; France
21	University of Twente	REMOTE SENSING AND DIGITAL IMAGE PROCESSING	Course	Enschede; Netherlands
22	University of Twente	Applications of geo-information science and earth observation	Course	Enschede; Netherlands
23	University of Twente	Spatial decision support systems	Course	Online
24	University of Twente	Advanced Geoinformatics	Course	Enschede; Netherlands
25	University of Twente	MULTI-HAZARD RISK ASSESSMENT	Course	Online
26	Manufacturing Technology Centre (MTC)	Space Graduate Development Program	Course	Oxfordshire, UK
27	Manufacturing Technology Centre (MTC)	Introduction to Robot Programming	Course	varies; UK
28	European Space Agency (ESA) and European Centre for Space Law (ECSL)	ECSL Summer Course on Space Law and Policy	Summer School	Budapest; Hungary
29	European Space Agency (ESA)	ESA Mission Operations Academy	Course	Darmstadt; Germany
30	Alden Legal	Executive training for the space sector	Course	Varies
31	Universidad Carlos III de Madrid	The Conquest of Space: Space Exploration and Rocket Science	Course	Online
32	Imperial College London	Imperial data science online summer school	Summer School	London UK
33	University of Crete	Data science and applied machine learning with Python	Course	Online
34	National Technical University of Athens	Digital Smart Sensor Operation for Smart Cities	Course	Online
35	Aristotle University of Thessaloniki	CVML Short Course on Deep Learning and Computer Vision V5	Summer School	Thessaloniki Greece
36	Technical University of Crete	Using Python and Tensorflow for scientific engineering and artificial intelligence calculations	Course	Crete; Greece
37	Agricultural University of Athens	Intensive course on meteoritics science from A-Z	Course	Online
38	European Space Agency (ESA) plus other organisations	5th edition of the DLR/ESA open PolInSAR training course	Course	Online
39	London Institute of Space Policy and Law	Space Policy & Law Course 2023	Course	Online
40	European Organization for the Exploitation of Meteorological	Joint Training School and Workshop on Dust Aerosol Detection and Monitoring	Course	Online

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	Satellites (EUMETSAT) with other organisations			
41	European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) with other organisations	Operational Satellite Oceanography Workshop	Course	Online
42	Italian Air Force, EUMETSAT & NMS	International Summer School on applications with the newest multi-spectral environmental satellites	Summer School	OSTIA; ITALY
43	Technische Universiteit Delft	Aeroelasticity	Course	Online
44	Technische Universiteit Delft	Geoscience: The Earth and its Resources	Course	Online
45	Technische Universiteit Delft	AI Skills for Engineers: Supervised Machine Learning	Course	Online
46	Technische Universiteit Delft	Introduction to Aeronautical Engineering	Course	Online
47	Eötvös Loránd University	Geoinformatics	Summer School	Budapest; Hungary
48	AARHUS UNIVERSITY/	CubeSat 101	Summer School	Aarhus; Denmark
49	Universitat Autònoma de barcelona(UAB)	Geography of Global Change	Summer School	Barcelona; Spain
50	University College London (UCL)	Astrophysics and Cosmology	Summer School	London; UK
51	The University of Southern Denmark (SDU)	Deep Learning	Summer School	Odense; Denmark
52	Johannes Gutenberg University Mainz.	Forster Summer School 2023 explores – urban climate	Summer School	Mainz; Germany
53	The University of Pannonia	Robotics and Visual Information Processing	Summer School	Veszprém; Hungary
54	Kaunas University of Technology	KTU BIG DATA SCHOOL	Course	Kaunas; Lithuania
55	Technical University of Berlin	CanSat: Hands-On Satellite Design	Summer School	Berlin; Germany
56	Central European University	Geospatial Technologies for Building Resilience	Summer School	Budapest; Hungary
57	University City of Madrid, Spain	A Multidisciplinary Approach to Climate Change	Summer School	Madrid; Spain
58	Lancaster University	Environment and Sustainability	Summer School	Lancaster; United Kingdom;
59	ISPRA, The Italian Institute for Environmental Protection and Research in collaboration with the EO4GEO project.	Landslide affecting Cultural Heritage sites: Roman Thermae of Baia EO4GEO Online Course	Course	Online
60	Novogit AB in collaboration with the EO4GEO project	CO2 budgets for municipalities. An introduction EO4GEO Online Course	Course	Online

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The list shows that different institutions are offering CE courses, including organizations such as ESA, European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and various universities such as the University of Twente, Technical University of Berlin, and the International Space University. Both institutions conduct courses during the year and summer periods as summer schools.
The materials developed by EO4GEO project were also reviewed, and the two courses meeting the criteria as certification courses were incorporated into the database. The materials, such as presentations, workshops, or webinars, that did not align with the definition of CE courses and the summer schools occurred in 2021 were not considered.The highest percentage of courses (66.7 %) are face2face and conducted at the institution's premises or, for example, hosted at associated facilities such as the European Space Operations Centre (ESOC) in Darmstadt, which may include travel expenses and living costs. 30% of the courses are conducted online, which increases the accessibility and flexibility of the courses. In terms of language, a total of 95% of the courses included in our analysis are conducted in English. CE courses taught in English contributed to increasing the accessibility of the courses for a broader audience and removing the language barrier.

We found that 28.3% of the analyzed courses allow participants to earn Credits (ECTS) for specific courses, ranging from 1- 14 credits. For example, the participants following most of the ESA courses receive a certificate and a course transcript, enabling them to receive ECTS from their respective universities. Credits can be important for students to earn additional academic credits, allowing them to progress more quickly towards their degree.

Figure 32 shows the percentage of the KAs in the CE courses. Each CE course is assigned to at least one KA based on its relevance to the course. The most frequent KA presented in the gathered CE courses is spacecraft engineering (9.9%). The second upper-high-value KA is artificial intelligence, accounting for 7.4%, followed by three KAs, remote sensing with 6.6% and finance, business and management, , satellite platforms and payloads, space mission for equal 5.8%. The astrobiology, geographic information system, sensors and instruments, and image processing and analysis KAs presented in the courses within the range of from 3.3-5.0 %. The figure shows the high percentages of KAs in spacecraft engineering and satellite platforms and payloads, space mission (15.7%), indicating the focus on the upstream space sector. 21.6% of the courses were mapped to KAs focused on the downstream space sector (remote sensing, sensors and instruments, image processing and analysis and geographic information system).

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The KA artificial intelligence accounted for 7.4% of the courses. We found that this KA was assigned exclusively to courses or combined with other KAs, such as spacecraft engineering, data science, data analysis, data mining, disaster management and automation and robotics. This indicates the importance of this KA to optimize satellites and spacecraft design, automate complex operations and analyze vast amounts of data efficiently and effectively. The KA finance, business and management also KAs are well represented in the gathered CE courses. These courses were also assigned to KAs such as space economy and policy and law, indicating a focus on space economy while addressing financial, business and management development, and legal framework to ensure sustainable and authorized space activities.

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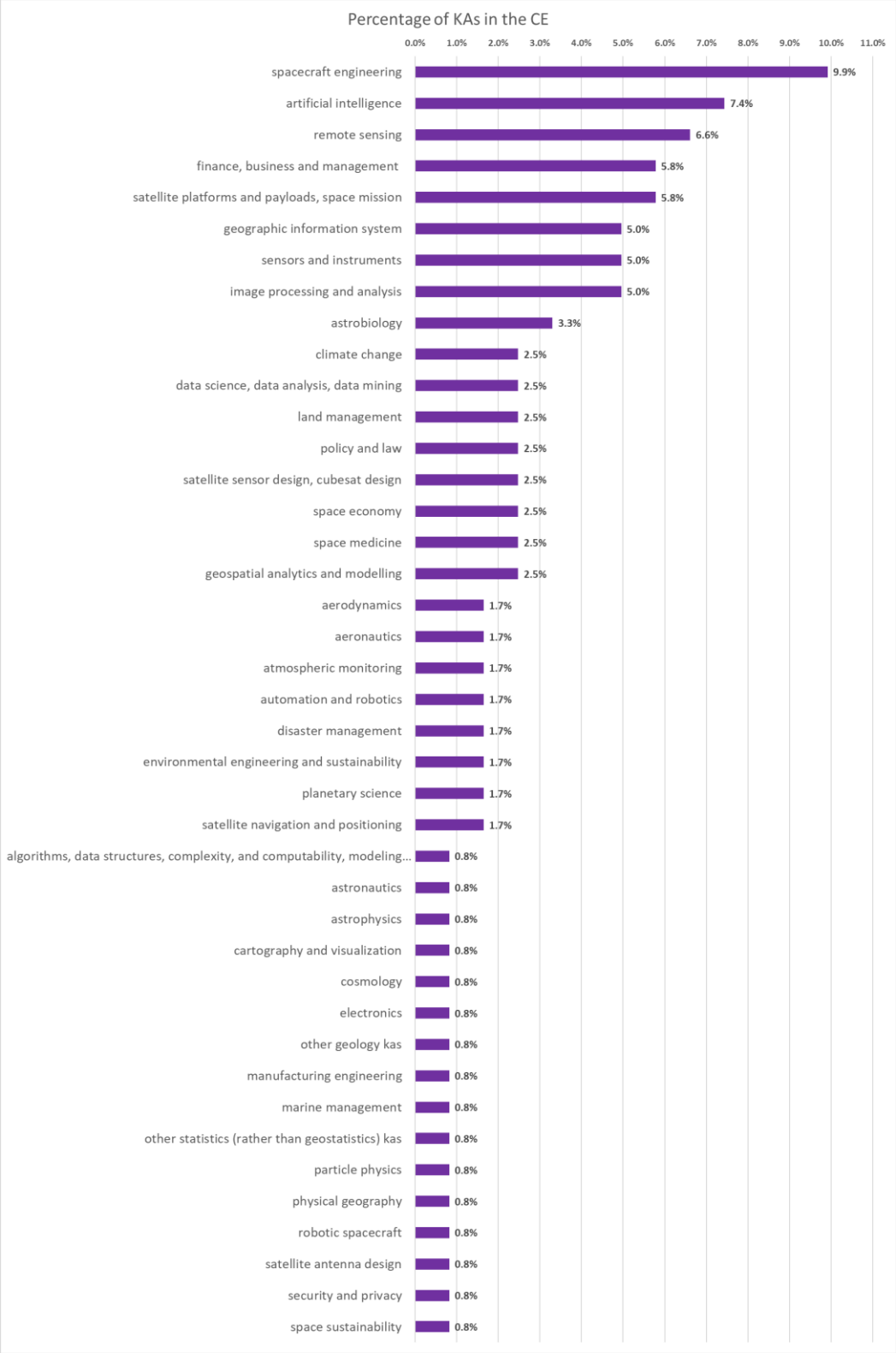

Figure 32. Percentage of the Knowledge Areas in the gathered Continuing Education courses

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23.8% of the courses are assigned to diverse KAs, indicating a wide variety of available CE courses in the project area such as astronautics, atmospheric monitoring, planetary science, marine management, satellite navigation and positioning, among others. On the other hand, only 39.0% of the total KAs determined in the ASTRAIOS project are representative for the analyzed courses, indicating some missing areas related to water management, web GIS, space and ethics, quantum physics and technology, and stellar physics, among others.

Summer schools represented 33.3% of the total selected CE courses. 90% of the collected summer schools are offered face2face (i.e. presential) and all of them are taught in English. In terms of KAs, the most frequent are Artificial intelligence (10.3%), Spacecraft engineering and satellite platforms and payloads, space mission (15.4 %), Remote sensing and geographic information system (12.8%), climate change, environmental engineering and sustainability, and disaster management (17.9%). Besides, 17 KAs are less frequent, such as astrobiology and space economy.

The target audiences of the CE courses can be experts, professionals with a diverse background, scientists, PhD students, postdocs, and master and fresh graduates, depending on the type of CE course, purposes, and entry requirements. Some organizations and universities are targeting students, while others are open to different participants, both students and professionals who require upskill/reskill. The majority of the EC courses require a fee, but some can be sponsored by the organization, or the university.

In this section, we showed the availability and flexibility of EC courses in terms of location, languages, credits, and areas of knowledge. CE is a great pathway for different audiences to foster professional and development in many areas in the space sector. While acknowledging the importance of non-formal learning, i.e. the available different types of training such as webinars and workshops offers also from previous projects such as EO4GEO, these trainings have not been included in our analysis given that they do not match the definition and selection criteria of CE Consequently, the findings presented in this section are representative to the number and the type of courses analyzed.

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9. CONCLUSIONS

In this report, we systematically identified and analyzed space-relevant educational programs and standards across the EU-27 (+UK) covering upstream, midstream, and downstream sectors. This information is important to identify the gap between the European space sector's needs and the actual qualifications of the European workforce. It is very important to mention that the findings included in this report reflect the characteristics of the DPs and courses included in our analysis. The list of DPs do not include all of the existing programs and courses in EU27+UK. Nevertheless, we consider that the sample size of 132 DPs (for Bachelor and Master), 60 CE courses and 16 PhD programs is representative to help us gain insights into the educational offer in the space sector in Europe.

Summary of the analyzed educational programs at the Bachelor and Master levels

We analyzed a total of 132 DP at Bachelor (25 DPs) and Master (107 DPs) levels. A total of 3591 courses offered by these DPs have been collected: 1055 courses at the Bachelor level and 2799 courses at the Master level. The main language of instruction is English (more than 80% of the analyzed DPs) with a few DPs offered in other languages such as French, German, Greek, Spanish, or Polish. Only 19% of the analyzed Master Programs are jointly offered by several HEIs. The number of courses offered online is relatively low for all analyzed DPs. Our analysis revealed that the educational system is structured and named differently across different countries, although sometimes similar content is taught and that the number of courses offered by various DPs varies considerably. Some of the analyzed DPs encouraged self-learning by offering the students the opportunity to work on projects, research, and fieldwork, in addition to internships.

Diversity of space relevant KDs and KAs

The diversity of KDs ranging from environmental sciences, physics, astronomy, aerospace engineering, mathematics, and computer science to law, biology, and chemistry suggests the diversity nature of space-related studies. This highlights that the space domain requires a combination of scientific knowledge, technological skills, legal understanding, and interdisciplinary collaboration to advance further explorations in this domain. The KDs and KAs used to categorize the analyzed space space-related educational programs and courses are expected to serve as an ongoing vocabulary (i.e. categories) that should be continuously updated and scrutinized by the space sector communities. They can also serve as input for Space sector related BOKs.

Upstream and downstream space sectors representative in the analyzed educational programs

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The analyzed DPs have been mapped across the different segments of the value chain of space activities relevant to the three space sectors: upstream, midstream, and downstream. The majority of the analyzed Bachelor DPs are related to the upstream sector, whereas the Master and PhD DPs are equally related to the downstream and upstream sectors.

Availability of courses designed to develop and enhance transversal skills differs among Master and Bachelor DPs

The courses designed to develop transversal skills such as programming skills or presentation and communication skills are offered as elective courses in the analyzed Master programs but are rarely offered by the analyzed Bachelor DPs. The development of these skills at Bachelor DP level might be implicitly integrated into the learning objectives of discipline-specific courses. Our analysis also revealed a higher emphasis on practical experience and professional exposure at the Master level compared to the Bachelor level.

Diversity in focus and approach of the analyzed ongoing PhD research projects

The analyzed PhD programs have diverse focuses, ranging from aeronautics, satellite engineering, and computer science to Earth Sciences-related applications. Each program tailors its courses to address the specific challenges and domains within its research area. The programs included in our analysis share a common emphasis on developing not only discipline-related skills but also transversal skills such as language and communication, career-oriented training, effective communication, teamwork, and project management skills. This approach aims to prepare PhD candidates not only as researchers but also as effective communicators and leaders.

Opportunities for expanding current space educational programs

Some of the analyzed DPs are focused on understanding Earth's environment, and climate using space technologies. This aligns with the growing importance of monitoring and managing Earth's resources from space. Yet, the lower representation of these knowledge categories suggests a potential need for increased emphasis on these areas in the context of space-related educational programs. Similarly, the low occurrences of space safety and space traffic management KAs suggest that space systems engineering KD receives less attention in the gathered space education at the Master level.

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Development of a time series of educational offer and standards in the space sector

The ASTRAIOS web catalogue contains information on the analyzed space-related educational programs and courses offered in 2023. A similar analysis needs to be conducted regularly so that we can create a time series of space-relevant DPs and courses that will help us assess the changes in the educational offerings and standards over time. The geographic coverage of the analyzed data should also be extended beyond EU-27+UK.

Geographic Coverage limitation

Although the analysis covers the EU-27 and UK, we suggest that geographic coverage should be extended beyond this scope to ensure a more comprehensive analysis of the space sector's educational landscape.

Copernicus Academy Network

Our database includes 18 DPs from the Copernicus Academy Networks. The remaining DPs in the downstream sector listed in our database are provided by HEIs that are not part of the Copernicus Academy. We suggest these institutions consider joining the Copernicus Academy, and that future projects focusing on space sector skills should broaden their analysis to include Copernicus Academy members not yet in the ASTRAIOS database.

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10. REFERENCES

EUROSTAT, Glossary: Lifelong learning (LLL)
https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Lifelong_learning_(LLL) (last accessed: 20.12.2023)

Space, PwC, 2023, https://www.pwc.co.uk/industries/aerospace/space.html (last accessed: 20.12.2023)

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11. APPENDIX A – ASTRAIOS KDS AND KAS

Knowledge Domain (KD)	Knowledge Area (KA)	Description	Keywords
(1) Chemistry	astrochemistry	Astrochemistry is (chemistry|astronomy) the study of the chemical composition of stars and outer space	astrochemistry, astrochemical
	cosmochemistry	Cosmochemistry is (chemistry) the science that deals with the creation of the elements, and their isotopic distribution, in the universe; also with the synthesis and reactions of simple molecules in interstellar space	cosmochemistry
	materials chemistry	Materials chemistry involves the use of chemistry for the design and synthesis of materials with interesting or potentially useful physical characteristics, such as magnetic, optical, structural or catalytic properties.	materials chemistry, chemistry of materials, minerals as materials, spectroscopic methods of analysis, spectroscopy techniques, study of materials, polymer science, characterization of materials and components, design of lightweight structures, designing materials, structures & materials, design & analysis of composite structure, design of self-healing materials
	physical chemistry	Physical chemistry deals with the principles of physics involved in chemical interactions.	physical chemistry
	other chemistry KAs		chemistry, chemical, chemistry of combustion, geochemistry, stable isotopes in earth sciences, general toxicology
(2) Agricultural Science	agricultural mapping and monitoring	Such as Precision farming	agricultural monitoring, precision farming, agricultural mapping, nutrients in a circular agriculture, agriculture, agricultural, food security
(3) Oceanography	chemical oceanography	Chemical oceanography encompasses the study of the chemical components of the oceans, their reactions, and their pathways of transformation.	chemical oceanography, radiative transfer in the atmosphere and ocean
(4) Atmospheric Science	atmospheric monitoring	Greenhouse gases, reactive gases, ozone and solar UV radiation, aerosols	atmospheric monitoring
(5) Geology	planetary geology	Planetary geology focuses on understanding the properties and processes of solid-surface objects in the Solar System.	planetary geology
	other geology KAs	Climate geology, Seismology; Sedimentary; micropaleontology	geology, geological, seismology, sedimentary, micropaleontology, geo-energy engineering applications, structural geology, geo-energy, characterisation of the subsurface, subsurface characterization, subsurface characterisation, dynamics of basins and orogens, sedimentation, seismic exploration, seismic, physical landscape and the geosphere, geothermal, petrogenesis,

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			geodynamics, stratigraphy, stratigraphic, slope, magmatic petrology
(6) Climate Science	climate change	Studies dedicated to understanding and assessing the impact of long-term shifts in temperature and weather patterns	climate, weather, an introduction to meteorology, meteorology, dynamics of atmospheres
(7) Geography	physical geography	Geomorphology	physical geography, geomorphology, river and delta systems, geomorphometry, landscape evolution
	human geography	Citizen Science, Governance	human geography, citizen science, demography, economic geography, geography and data background of the information society
(8) Hydrology	water management	Water treatment, water reuse	water treatment, water reuse, water supply networks, water quality, water governance, groundwater, land surface hydrology, wastewater, modelling future water stress, water management, unsaturated zone hydrology, hydrology and sediment dynamics, water resources management, surface water modelling, water resource management
(9) Marine Science	marine management	Marine safety, marine resources, marine and coastal environment, sea ice	marine monitoring, marine safety, marine resources, marine and coastal environment, sea ice, coastal remote sensing, coastal applications, remote sensing of ocean color and temperature, ocean sar, submeoscale oceanic and autonomous observing systems, marine, coastal, offshore engineering, offshore
(10) Geographic Information Science	cartography and visualization	Maps, 3D visualization	cartography, map, topography, geovizualization, 3d visualization, cartographic design, cartographic, geovisualisation, geovisualization, arcgis software, spatial visualization, space visualization
	geographic information system	Introduction to GIS, spatial data systems, Geographic Information systems	introduction to gis, spatial data systems, geographic information systems, giscience, spatial data aquisition methods, principles of gis, geographical information system, geographical

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			information, applied gis, gis programming, geographic information, geo-information tools, spatial-social data sources, geospatial information
	geospatial analytics and modelling	Cellular Automate, Agent-based modelling, Geostatistics, geocomputation	cellular automate, agent-based modelling, geospatial analysis and modeling, geoanalytics and modeling, geostatistics, geocomputation, geo-application development, spatial analysis and modeling, spatial analysis and modelling, spatial analysis, spatial data analyses, spatial data analysis, geospatial analysis and modelling, geospatial analysis and modeling, geoinformatics, geohumanitarian actions, spatial planning, spatial statistics, geomatics, gis software, agents and multi-agent systems, terrain modelling, advanced gis, geographic knowledge representation, geospatial science, geospatial fundamentals, gis in r
	web gis	Web mapping, web services,SDI,web GIS standards and specifications	web mapping, web services,sdi,web gis standards and specifications , geo-multimedia, webgis, web-based gis, geoweb technology
	geospatial data architecture and management		spatial database, geodata management, geospatial data, geodata acquisition, location based service, opengis, spatial data infrastructure, big earth data, big geodata, data assimilation for geosciences, spatial data, geo-information governance, spatial reference system
(11) Physics	classical mechanics	Gravity theory, relativity theory, rational mechanics, Structural Mechanics; Fluid dynamics	classical mechanics, gravity theory, relativity theory, rational mechanics, structural mechanics, fluid dynamics, mechanics, fluid mechanics, mechanics of structures, relativity, microgravity flows, dynamics of gravitational systems, gravitational
	thermodynamics		thermodynamic
	quantum physics and technology	quantum mechanics, self-explanatory	quantum, field theory, gauge theory, gauge field, field theories

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	plasma physics	self-explanatory	plasma, waves & diffraction
	electromagnetism	Electromagnetic radiation	electromagnet, electricity and magnetism, propagation and antennas, waves and light
	nuclear physics	nuclear, atom	nuclear, atom, theory of nucleosynthesis, radioactivity, radiation
	optics	laser	optic, laser, terahertz spectroscopy, light scattering, photonics
	particle physics	high energy physics, self-explanatory	particle, subatomic, high energy physics, molecular physics, electrodynamics, hadrons, nuclei, electroweak and strong interactions
	nanoscience		nanoscience, nanomagnetism
	nanotechnology		nanotechnology, nanoscale material, nanomaterial, nanostructure, nanofabrication
	other physics KAs	Introduction to Physics, General Physics, condensed matter physics (condensed and solid state)	introduction to physics, general physics, condensed matter physics, solid state physics, physics, physics of the system earth, general relativity, engineering physics, electric circuits, physics of the space environment, geophysics, physics of condensed matter, analysis for physicists, paleomagnetism, gravimetry, geomagnetism, analysis of space-time dynamics
(12) Astronomy	planetary science	Study of planets and celestial bodies	planet, space science, comets
	instrumentation-telescopes, detectors, and techniques	self-explanatory	instrument, telescope, observational techniques, observational astronomy, practice in astronomy/meteorology/geophysics, reflectance spectroscopy of asteroids, detection of light, high contrast imaging
	astrophysics	Solar physics, Exoplanets	solar physics, exoplanet, astrophysics, physical concepts in astronomy, astrophysical, the sun and the heliosphere, population of meteoroids, solar system, galactic dynamics, nebulae, astro-hydro-dynamics, stellar pulsation
	stellar physics	self-explanatory	stellar physic, stellar structure, stellar astronomy, stellar atmosphere, stellar photometry, stellar evolution, star formation, stellar formation, star, stars,

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			asteroseismology, stellar systems, stellar magnetic activity
	cosmology	self-explanatory	cosmology, early universe, interstellar medium, interstellar matter, galaxies, galaxy, origin and evolution of the universe, universe, milky way
	large databases in astronomy: archiving, handling, and analysis	self-explanatory	large databases in astronomy
	other astronomy KAs		astronomy, astronomical, bachelor seminar on astronomy, extragalactic astronomy, radiation processes in astronomy, introduction to astronomy, general astronomy
(13) Biology	biotechnology		biotechnology, genetic, biomolecular catalysis, biomedical engineering, bioengineering
	astrobiology	Study the life in the universe	astrobiolog
	other biology KAs	soil biology, molecular biology, synthetic biology, cell biology, system biology;	soil biology, molecular biology, synthetic biology, cell biology, system biology, applications in biology, vertebrate evolution, molecular systems biology , cell, cellular reactions, protein, microbiology, systems biology
(14) Remote Sensing	remote sensing		fundamentals of remote sensing, basics of remote sensing, active and multitemporal remote sensing, introduction to remote sensing, remote sensing, sensing technologies, photogrammetry, sensing and measurement, photogrammetric
	sensors and instruments	radar, thermal, lidar, satellite remote sensing, UAVs	sensor, radar, lidar, satellite remote sensing, uav, physical principles of earth system observation, earth system observation, microwave remote sensing of the earths surface, point cloud processing, fundamentals of space applications and services, sar interferometry, unmanned vehicles, drones, unmanned aerial vehicle, remote monitoring, microsystem technology, 3d sensing

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	image processing and analysis	Image processing and analysis comprises all relevant steps to reach from (raw) image data to information via image interpretation and digital image classification. In traditional remote sensing workflows, this step follows the image acquisition process. There are two main components, i.e. (1) image processing, (2) analysis, which emphasizes the sequential nature of the process â€“ while increasingly this dichotomy disappears.	image processing, image analysis, advanced remote sensing, image, earth observation technologies, state of the art remote sensing technologies, earth observation, advanced processing of remote sensing data, computing for remote sensing
(15) Mathematics	algebra	self-explanatory	algebra, single mathematics, mathematics workshop, discrete structures, multivariate mathematics, symmetry group
	geometry	self-explanatory	geometry, geometric,
	applied mathematics	Control Theory, Probability	control theory, probability, numerical methods, probabilities, dynamics of solids and fluids, vector, tensor, engineering mathematics, mathematical modeling, stochastic processes and applications, stochastic decision making, stochastic, mathematics, mathematical analysis, numerical modeling, mathematical methods, numerical analysis
	dynamical systems	self-explanatory	dynamical system
	logic and set theory	self-explanatory	logic, set theory
	mathematical optimisation	self-explanatory	optimisation, optimization
	calculus	Differential Calculus, Introduction to Calculus, Variational calculus	differential calculus, introduction to calculus, variational calculus, calculus, finite element method, differential equations
	other statistics (rather than geostatistics) KAs	self-explanatory	statistics, time series, mathematical and statistical techniques, statistical, model identification and data fitting, statistical techniques, multivariate analysis, linear modeling, non-linear modeling
(16) Environmental Sciences	environmental engineering and sustainability	Using the principles of engineering, soil science, biology, and chemistry to develop solutions to environmental problems. environmental engineering, environmental Impact assessment	environmental engineering, environmental Impact assessment, natural resources management, waste management, environment protection, sustainability, soil, sustainable development, sustainable, energy and society, reactive transport in the hydrosphere, spatial energy

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			planning, contemporary challenges, low carbon technologies, habitat management and building resilience, atmospheric composition, air quality, pollutant, contaminant remediation, design of urban hydraulic infrastructures, solid waste, energy recovery from waste, near-zero-energy technologies, renewable energies, terrestrial carbon, air pollution, wind energy, morphodynamics, wind turbine, hydrogen technology, energy resources management, pollution control, greenhouse gas reduction technologies
	ecology		ecology, ecological, ecohydraulics, ecosystem
	land management	Land Cover, Use and Change Detection Mapping; Bio-geophysical Variable Mapping; Risk Mapping; Forest Monitoring; Desertification; Snow and Ice,	land monitoring, land consolidation and rearrangement, land management, land cover, use and change detection, forest monitoring, desertification, snow and ice, urban planning, real estate, forest applications, glaciers, cadastre, land surveying, land consolidation, land information systems, cadastral, rural, land administration, land surface process modelling
	biodiversity and conservation	self-explanatory	biodiversity, conservation, water audit
	disaster management	floods, fires, landslides, earthquakes, oil spills	disaster management, floods, fires, landslides, earthquakes, oil spills, seismology, gis analysis of natural hazards and risk phenomena, natural hazards and disasters, hazards, disasters, modelling multi-hazards
	geodesy		geodesy, geodetic, earth deformation, altimetry through satellite
	other environmental sciences KAs		environment, environmental,
(17) Electrical Engineering	telemetry tracking and control transponders	https://www.esa.int/esapub/bulletin/bullet86/wint86.htm	telemetry, control transponder,
	signal processing	Digital signal processing, digitalization of signals	signal processing, digitalization of signals, communication engineering, advanced

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			telecommunication system applications and services, aerospace signal, optimal filtering, signal, microwave engineering, radioengineering, space communication
	avionics	Avionics is the application of electrical and electronic systems to aircraft and spacecraft	avionic, avionics, microcontrollers with aerospace application
	electronics	self-explanatory	electronics, electronic circuits, electronic, circuits & systems, antennas and propagation, high frequency circuit, applied electrotechnics, power sources
(18) Chemical Engineering	materials engineering	self-explanatory	materials engineering, materials in aerospace technology, luminescence, advanced materials, functional coating, materials for space, composite materials, composite engineering
(19) Industrial Engineering	manufacturing engineering	self-explanatory	manufacturing engineering, engineering survey, machine design, manufacturing technology, integrated cad/cam/cae systems, smart manufacturing, space technology, computer aided design, aircraft manufacturing technologies, in-space manufacturing, reverse engineering, rapid prototyping, coating applications in manufacturing, polymer composite manufacturing, sheet metal forming, manufacturing, industrial refrigeration, flexible manufacturing system
(20) Metrology	metrology and calibration	https://sma.nasa.gov/sma-disciplines/metrology-and-calibration Photogrammetry	metrology, calibration
(21) Satellite Engineering	satellite platforms and payloads, space mission	https://www.esa.int/Enabling_Support/Space_Engineering_Technology/About_Payload_Systems space mission	satellite platform, payload, space mission, satellites and launcher systems, fundamentals of satellite systems and subsystems, mission, satellite systems, satellite communication, satellite operation, satellite design
	satellite sensor design, cubeSat design	self-explanatory	satellite sensor design, programming of nanosatellites
	satellite antenna design	self-explanatory	satellite antenna design, satellite constructions

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	satellite navigation and positioning	self-explanatory	satellite navigation, global navigation satellite system, gps, galileo, glonass, navigation systems, gnss applications, navigation, positioning, satellite geodesy
(22) Mechanical Engineering	automation and robotics	https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Mechanical_engineering	automation, space software, robotic systems, robotics, basics of mechanical engineering, autonomous, parametric modelling of mechanical objects, embodied intelligence, robotic technologies, mechanical structure, space robots, tribology, numerical control of machine tools, industrial robot, diagnostic control of machine tools
(23) Space Systems Engineering	mechatronics		mechatronic
	guidance, navigation and control for space systems (gncss)	self-explanatory	guidance, navigation and control for space systems, gncss, management issues of space systems and missions, space telecom and navigation systems/subsystems and technologies, flight & gnc systems, spacecraft communication and localization, control systems engineering, control systems, spacecraft attitude dynamics and control, systems theory
	space safety: space debris, planetary defence	self-explanatory	planetary defence, space debris, space safety, space data systems, risk and reliability analysis
	space sustainability	https://www.weforum.org/projects/space-sustainability-rating	space sustainability
	space architecture	Space Architecture is the theory and practice of designing and building inhabited environments in outer space	space architecture, aerospace design, aerospace construction, aerospace system design, aerospace systems engineering, design synthesis, space system structures, space system dynamics and control, space system, multibody space structures, space device, space vehicle, aerospace vehicle, hydropneumatic system, aerospace human-machine system
	space traffic management	self-explanatory	space traffic management, space transport management, space planning and operations
	spacecraft engineering	self-explanatory	spacecraft engineering, spacecraft design, spacecraft

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			power systems, spacecraft control, spacecraft dynamics, spacecraft system, spacecraft structure, spacecraft thermal design, microsat engineering
	space mining	self-explanatory	space mining,
(24) Aerospace Engineering	air safety and security		air safety, air security, risk and reliability in aviation, reliability in aviation, air accident investigation, reliability and maintainability of aircraft, flight safety, aviation transport reliability, airport certification and safety, quality assurance and reliability
	air transport control		air transport, air traffic, aerodrome operation, logistics, airport operation, flight control
	astrodynamics	Astrodynamics is the study of the motion of artificial bodies moving under the influence of gravity from one or more large natural bodies.	astrodynamic, vibrations and aeroelasticity, orbital dynamics, orbital design, satellite orbit
	aerodynamics		aerodynamic, dynamics of aerospace structure, aeroelasticity
	robotic spacecraft	Cargo or resupply spacecraft	robotic spacecraft,
	astronautics	Spaceflight, Space habituation	astronautic, cosmonautic, space propulsion, space habituation, advanced spacecraft dynamics, solid rocket motors, liquid rocket engines, fluid handling in spacecrafts, space structures, questions in space studies, space flight, spaceflight, space habituation, rocket motion, re-entry systems, applied exploration, space exploration, manned space travel
	aeronautics	Aircraft systems	aeronautics, flight test, flight dynamics, vibrational analysis, propulsion, orbital mechanics, aeronautical systems, introduction to aerospace, mechanics of flight, rotorcraft aeromechanics, simulators, space downstream, aeronautical regulations, space upstream, aerospace control, gas dynamics, dynamics and control of launch vehicles, aerospace thermal structures, hypersonics, mechanical vibrations, aero elasticity, numerical modelling of aeronautical components, dynamics of flight, aeronautical

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			safety systems, aircraft design, aircraft engine design, aircraft maintenance, airframe, aircraft engines maintenance, aircraft performance, aircraft structure, aircraft system, aircraft power supply system, extra aeronautical activities, aircraft materials, aircraft construction, aircraft engine, aircraft measurement, aircraft power systems, aircraft fuels and lubricants, aeroengine technology
	other aerospace engineering KAs		air systems engineering, aviation systems engineering, noise and vibrations in aviation, aviation communication, airport design, airport infrastructure, ground handling, passengers terminals, propellers and rotors, aircraft noise, airport and cargo operation, experimental methods in vibration
(25) Computer Science	artificial intelligence	Machine learning, Computer vision	machine learning, computer vision, deep learning, artificial intelligence
	software development	self-explanatory	software development, object-oriented programming, programming and user interface design, software technology, human-computer interaction
	algorithms, data structures, complexity, and computability, modeling complex systems	self-explanatory	algorithm, data structures, complexity, computational, computability, code, introduction to programming, adjustment computations, computer science, data for engineers, fundamentals of programming, parallel computing, data fusion, symbolic computation and control, computing science, computer programming, space data systems, metaheuristics, scientific computing, estimation and dynamic systems, basics in computing, computation for scientists
	computer systems, architectures, network	self-explanatory	computer system, computer architecture, computer network, basic computer knowledge, operating systems, smart solutions, information networks, computer

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			engineering, digital systems, microcontrollers and embedded systems, web application architecture, embedded systems, microprocessor system
	data science, data analysis, data mining	data mining, big data analysis, self-explanatory	data science, data analytics, big data, data mining, cloud-based, data analysis, data vizualization, data visualization, vizualization method, space data processing for space exploration, representing and manipulating data, analysis of environmental data, commercial and scientific applications, building and mining knowledge graphs, information retrieval and text mining, 3d modelling, information retrieval, search engines, data acquisition, mining social and geographic datasets, information analysis
	information theory	https://researcher.watson.ibm.com/researcher/view_page.php?id=6863	information theory, informatics
	security and privacy	Design, develop, and deploy principled solutions for improving the security and privacy aspects of computer systems	security, privacy, cryptography, cyber incident handling, secure software design, system forensics, cryptographic, secure programming techniques, criptology
	software engineering	self-explanatory	software engineering, structured programming
	computer graphics, computer simulation, virtual reality	self-explanatory	graphics, virtual reality, simulation
	other data management (rather than geospatial data architecture and management) KAs	self-explanatory	data management, database, introduction to databases, databases, collective intelligence
(26) Economics	economics	economic simulation models	economic, economy, cost benefit analysis, game theory, econometrics, tourism
	space insurance	Space risk management, self-explanatory	space insurance, space risk management
	space economy	Space commercialization	space economy, technology advancements in space, space trends, space tourism
	finance, business and management		finance, financial, space business, strategic partnerships, space applications, marketing, space

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			organisations, aerospace companies, business, management and strategy, human resources management, human resource management, airport strategy, crisis management, innovation, technology management, social responsibility, human factor
(27) Law	policy and law	https://www.unoosa.org/oosa/en/ourwork/spacelaw/index.html	space policy, space law, law and policy, law, policy, legislation, protection of intellectual property, space resources fundamentals, regulations, court, geopolitics, politic, regulatory framework
	space and ethics	https://www.nature.com/articles/d41586-023-01551-7	ethic, ethics, ethical
(28) Health and Medicine	health	Geohealth	health, health and safety training, general safety, fire protection, human factors
	space medicine	https://www.esa.int/About_Us/EAC/Space_Medicine	space medicine, toxicological, life sciences in space
(29) (Transversal) Skills	qualitative, quantitative research skills	lab work	qualitative skill, quantitative skill, interview, questionnaire, research method, scientific method, lab work, academic skill, lab, engineering diploma seminar, engineering diploma thesis, research skills, learning skills, laboratory skills, experimental work, research seminar , technical drawing, cad, Master guided research, research practice, academic consultancy training, fundamentals of research, diploma seminar, quantitative and qualitative, research work, scientific research, practical science skills, research assignment, methods of gathering and analysing results, scientific monitoring, complementary activities to research, data collection, experimental techniques
	programming skills		programming skill, coding, python, java, c++
	academic writing	Scientific writing	academic writing, scientific writing, writing, preparation and defence of a bsc thesis, thesis preparation, thesis seminar
	language		bulgarian, croatian, czech, danish, dutch, english, estonian, finnish, french, german, greek, hungarian, irish,

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			italian, latvian, lithuanian, maltese, polish, portuguese, romanian, slovak, slovenian, spanish, swedish, russian, japanese, language,
	problem-solving		problem-solving, problem solving
	written / oral communication		written communication, oral communication, presentation skills, science communication, communication skills, risk communication
	teamwork		team
	decision-making		work based experience, field trip, field techniques, field measurements, excursion, professional skills, professional studies and skills, professional development, integrated work-study program, professional engineering practice, work experience, work placement, practical training, fieldwork, practical experience, practicum, internship, practical work, professionalism, professional training, space engineering practical, practical exercise
	project management	Project management related including project risk management, project assignment	project, planning and scheduling
	entrepreneurship		entrepreneurship, entrepreneur, entrepreneurial
	conflict mediation		conflict mediation

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12. APPENDIX B – ONLINE FORM TO COLLECT INFORMATION ABOUT DPS

ASTRAIOS

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

Degree Program Source Cadaster ASTRAIOS

Online Form

This form was designed to collect sources of information about the institutions (HEIs) and degree programs for the next phases of ASTRAIOS. In the first section, you will be able to fill in information related to the institutions/HEIs, and the link for those institutions' webpages. This will serve as a source of information for our text mining tools, in an attempt to automatically populate our database.

* *Required*

Institution/HEI *Webpage 1*

In this section, you will fill in the information related to the HEI to be registered in our database. These information will be used by our team to attempt to mine the HEI website and acquire the information needed to populate ASTRAIOS database.

1. Name (e.g. University of Twente) *

You should fill in here the name of the institution you are registering.

[Control]

2. Country (Where is the institution located?) *

[Control]

3. Physical Address (i.e. Street name + Number, Postcode, City) *

Which is the physical address of the institution? In case it has more than one address (e.g. universities with several campuses), please fill in the main one.

[Control]

4. Link (HEI website) *

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[Control]

Next

* *Required*

Degree Program *Webpage 2*

In this section, you will fill in the information related to the degree program (curricula). Note that each university can have more than one degree program related to the space sector. In that case, in the end of the section, you should mark that there are more programs to be added, and then a new section like this will appear and you will be able to enter the new program.

5. Name of the degree program (e.g. Masters on Spatial Engineering) *

[Control]

6. Degree program *

[Control]Master
[Control]Bachelor

7. Space Sector *

Which is the branch of the space sector of the degree program (curricula) you are registering?

[Control]Downstream
[Control]Midstream
[Control]Upstream

8. Link to the degree program *

[Control]

9. Reason for selecting this program *

Why do you think this program is relevant? Please describe the reason in a short answer.

[Control]

10. Does this university have another program that you want to add? *

[Control]Yes
[Control]No

If yes is selected then a new webpage will be open

* *Required*

Degree Program 2 Webpage 3

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In this section, you will fill in the information related to the degree program (curricula). Note that each university can have more than one degree program related to the space sector. In that case, in the end of the section, you should mark that there are more programs to be added, and then a new section like this will appear and you will be able to enter the new program.

11. Name of the degree program (e.g. Masters of Spatial Engineering) *

[Control]

12. Degree program *

[Control]Master
[Control]Bachelor

13. Space Sector *

Which is the branch of the space sector of the degree program (curricula) you are registering?

[Control]Downstream
[Control]Midstream
[Control]Upstream

14. Link to the degree program *

Why do you think this program is relevant? Please describe the reason in a short answer.

[Control]

15. Reason for selecting this program *

[Control]

16. Does this university have another program that you want to add? *

[Control]Yes
[Control]No

If No is selected then you can select Submit

Submit **Back**

Completed

Your answers have been submitted successfully. You can check your score now.

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View results

Submit another response

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13. APPENDIX C – LIST OF MASTER AND BACHELOR DPS

No.	Name	Degree	Space Sector
1	Bachelor in Astronomy	Bachelor	Upstream
2	Bachelor in Telecommunication Systems Engineering	Bachelor	Midstream
3	Bachelor in Astrophysics, Meteorology and Geophysics	Bachelor	Upstream
4	Bachelor in Aerospace engineering	Bachelor	Upstream
5	Bachelor in Aerospace engineering	Bachelor	Upstream
6	Bachelor in Geodesy and Geoinformatics	Bachelor	Downstream
7	Bachelor in Aerospace Engineering	Bachelor	Upstream
8	Bachelor in Geography	Bachelor	Downstream
9	Bachelor in Physics with Astronomy & Space Science	Bachelor	Upstream
10	Bachelor in Geoinformatics	Bachelor	Downstream
11	Bachelor in Astronomy	Bachelor	Upstream
12	Bachelor in Astrophysics and Cosmology	Bachelor	Upstream
13	Bachelor in Physics	Bachelor	Upstream
14	Bachelor in Geodesy and Cartography	Bachelor	Downstream
15	Bachelor in Telecommunications and Informatics Engineering	Bachelor	Midstream
16	BEng Aerospace Engineering	Bachelor	Upstream
17	BEng in Aerospace Engineering	Bachelor	Upstream
18	BSc (Hons) Environmental Geography	Bachelor	Downstream
19	Bachelor in Aerospace Engineering	Bachelor	Upstream
20	Bachelor in Surveying Engineering and Geoinformatics Engineering	Bachelor	Downstream
21	BEng Aerospace Engineering	Bachelor	Upstream
22	Bachelor in Environment, Sustainability and Climate Change	Bachelor	Downstream
23	Bachelor in Science and technology	Bachelor	Upstream
24	Bachelor of Science (Honours) in Environmental Science and Sustainable Technologies	Bachelor	Downstream
25	Bachelor in Aeronautics and Astronautics	Bachelor	Upstream
26	Master in Geospatial Engineering	Master	Downstream
27	Master in Geomatique (M1)	Master	Downstream
28	Master in Interdisciplinary Space Master	Master	Upstream
29	Master in Astronomy	Master	Upstream
30	Master in Astronomy	Master	Upstream
31	Master in Space Mission Analysis and Design	Master	Upstream
32	Master in Space Science and Technology	Master	Upstream
33	Master in Environmental Sciences	Master	Downstream
34	Master of Aerospace Engineering	Master	Upstream
35	Master in Geodesy and Geoinformation	Master	Downstream

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36	Master of Aeronautics and Astronautics	Master	Upstream
37	Master of Aerospace Engineering and Management	Master	Upstream
38	Master in Geographic Information Systems	Master	Downstream
39	Master in Environmental Remote Sensing Geospatial Sciences	Master	Downstream
40	Master in programme in Astronomy	Master	Upstream
41	Master in Physics and Astronomy	Master	Downstream
42	Master in Earth and Space Physics and Engineering	Master	Downstream
43	Master in Space Technologies, Applications and SeRvices - STAR	Master	Upstream
44	Master of Astronomy	Master	Upstream
45	Master in Aeronautics and Astronautics	Master	Upstream
46	Master in Remote Sensing	Master	Downstream
47	Master in Earth, Planetary, and Environmental Sciences (EPS)	Master	Downstream
48	Integrated Masters in Aerospace Engineering	Master	Upstream
49	Master in Space Sciences and Earth from Space	Master	Downstream
50	Master in Applied Earth Sciences	Master	Downstream
51	Master in Cybersecurity	Master	Midstream
52	Master of Geograp Information Systems (GIS) & Remote Sensing	Master	Downstream
53	Master of Geoinformatics and Earth Observation	Master	Downstream
54	Master in Applied Geoinformatics	Master	Downstream
55	Master in Cartography and Geoinformation	Master	Downstream
56	Master in Remote Sensing	Master	Downstream
57	Master in Environmental Engineering	Master	Downstream
58	Master of Air and Space Law	Master	Midstream
59	Master of Big Data Analytics	Master	Midstream
60	Master of Cybersecurity Engineering	Master	Midstream
61	Master of Science in Aerospace Engineering and Communications	Master	Upstream
62	Master in Astronomy and Astrophysics	Master	Upstream
63	Master in Astrophysics, Particle Physics and Cosmology	Master	Upstream
64	Master in Geoinformatics	Master	Downstream
65	Master of Space Studies	Master	Midstream
66	Master of Geoinformatics for Urbanised Society	Master	Downstream
67	Master in Geoinformatics	Master	Downstream
68	Master of Aeronautical Engineering	Master	Upstream
69	Master in Aeronautical Engineering (in English)	Master	Upstream
70	Master in Physics	Master	Upstream
71	Master in Machine Learning and Machine Intelligence	Master	Midstream
72	Master Science de la Terre et des Planetes, Environnement	Master	Downstream
73	Master in Spacecraft Design	Master	Upstream
74	Master in Space Engineering	Master	Upstream

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75	Master in Space Applications	Master	Downstream
76	Master of Science in Space Sciences and Astronomy	Master	Upstream
77	Master in Astrophysics and Space Science	Master	Upstream
78	Master of Geo-Information Science and Earth Observation	Master	Downstream
79	Master of Geomatics in Technologies des systèmes d'information (Information Systems Technologies)	Master	Downstream
80	Master of Earth, Life and Climate	Master	Downstream
81	Master in Aerospace	Master	Upstream
82	Master of Geospatial & Mapping Sciences	Master	Downstream
83	Master in Aerospace Engineering	Master	Upstream
84	Master in Physics and Astronomy (PandA)	Master	Upstream
85	Master in Earth Surface and Water	Master	Downstream
86	Master in Sensor and Imaging Systems	Master	Downstream
87	Master in Science and Technology from Space	Master	Upstream
88	MEng in Aerospace Engineering	Master	Upstream
89	Master in Remote Sensing and Geo Informatics	Master	Downstream
90	Master of Earth and Planetary Sciences, Environment	Master	Downstream
91	Master in Geosciences	Master	Downstream
92	Master in Astrophysics and Cosmology	Master	Upstream
93	Master Program Space Entrepreneurship	Master	Downstream
94	Advanced Master in Airport Management	Master	Midstream
95	International Master in Space Sciences and Applications (SSA)	Master	Upstream
96	Master in Space and astronautical engineering	Master	Downstream
97	Master in Data Science for Decision Making	Master	Midstream
98	Master in Remote Sensing and Geographical Information Systems	Master	Downstream
99	Master of Aviation Transport	Master	Midstream
100	Master's programme in Particle Physics and Astrophysical Sciences	Master	Upstream
101	Master in Aerospace Engineering	Master	Upstream
102	Master in Aerospace engineering	Master	Upstream
103	MEng in Aerospace Engineering	Master	Upstream
104	Master in Mechanics of Materials and Structures	Master	Upstream
105	Master of Science in Data Science	Master	Midstream
106	Master of Astronomy and Data Science	Master	Upstream
107	Master in Space Science and Technology	Master	Upstream
108	Master in Geodesy and Geoinformatics	Master	Downstream
109	Master in Geographical Information Management and Applications (GIMA)	Master	Downstream
110	Master in earth and planet sciences, environment: fundamentals of remote sensing (FRS)	Master	Downstream
111	Copernicus Master in Digital Earth	Master	Downstream
112	Master in Geographic Information Systems	Master	Downstream

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113	Master of Astronomy and Astrophysics	Master	Upstream
114	Master in Marine Sciences	Master	Downstream
115	Master in Space, Communication and Media Law	Master	Upstream
116	Master of Astronomy and Astrophysics	Master	Upstream
117	Master in Geoinformation Technology & Cartography	Master	Downstream
118	Master in Remote Sensing and Environmental Mapping	Master	Downstream
119	Master of Science in Physics and Astronomy	Master	Upstream
120	Master in Computer Science	Master	Midstream
121	Master (EN) in Geomatics (IGAST) Geographical Information: Spatial Analysis and Remote Sensing (M1)	Master	Downstream
122	Master of Space Engineering	Master	Upstream
123	Master in Space Science and Technology	Master	Upstream
124	Master in Aerospace Systems - Navigation and Telecommunications (AS-NAT)	Master	Midstream
125	Master of Aerospace Engineering	Master	Upstream
126	Master of Science Geomatics	Master	Downstream
127	Master in Astrophysics	Master	Upstream
128	Master in Earth Sciences	Master	Downstream
129	Master in Astronomy	Master	Upstream
130	Master in Astrophysics	Master	Upstream
131	Integrated Master in Mechanical Engineering	Master	Upstream
132	Specialized Master "Defense and Security in Space" (MS DefSiS)	Master	Upstream

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14. APPENDIX D – ASTRAIOS SURVEY ON SUPPLY OF THE SPACE RELATED EDUCATION

Top of Form

ASTRAIOS Survey on supply of the Space related Education

Fields marked with * are mandatory.

Disclaimer

The European Commission is not responsible for the content of questionnaires created using the EUSurvey service - it remains the sole responsibility of the form creator and manager. The use of EUSurvey service does not imply a recommendation or endorsement, by the European Commission, of the views expressed within them.

Anonymous mode

The anonymous option has been activated. As a result, your contribution to this survey will be anonymous as the system will not save any personal data such as your IP address.

AASTRAIOS Survey on Supply of the Space related Education

Introduction

ASTRAIOS (Analysis of Skills, Training, Research and Innovation Opportunities in Space) aims at providing an exhaustive view and understanding of **the current and future offer of Space curricula and courses in the EU-27 and the UK.** The project will also characterize the demand from the European Space industry and identify actionable ways towards a better alignment between the educational offer and the skills required by the future European space industry.

As the first phase of the project, we aim to collect **the status quo (year 2023)** information about Master, Bachelor and PhD degrees covering upstream, midstream, and downstream space sectors across EU-27 and UK. We would really appreciate it if you could complete

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the following survey at your earliest convenience.

The time required to complete this survey is **around 20 minutes**, but it depends on the amount of material that is intended to be described. Please note that you have ***an unlimited number of contributions*** to this survey, and you can save your contribution as a ***draft*** and continue later.

Please do not hesitate to contact us if you have any questions.

Thank you in advance for your contribution. The ASTRAIOS Team

https://www.astraios.eu/

Disclaimer!
The survey is designed to maintain the anonymity of participants. All the data provided will be handled confidentially, and the information will be published in an aggregated form that does not trace to individual entries. The analysis does not include any personal data, but in case you choose to share your personal information, it will be processed solely for purposes related to the project and in compliance with the General Data Protection Regulation (GDPR).
Do you consent to us storing and processing your information as clarified above? *

- I accept your Terms show

By accepting our terms, you give us consent to store and process your information as clarified above.

This field is required.

B Section 1: The Institute

* **Q1.1** Please indicate the institute name that your are responding on behalf of ?

* **Q1.2** Please specify your job title/ role in the institute.

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

* **Q2.1** Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

* **Q2.2** Please select the European Qualification Framework (EQF) level

- EQF5/6 (Bachelor)

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- EQF7 (Master)
- EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

Q2.4 Please indicate the duration in months of the degree program.

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

Additional help available
ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

- Yes
- No

Q2.7 Please indicate the Language or Languages of the degree program

- Bulgarian
- Croatian
- Czech
- Danish
- Dutch
- English
- Estonian
- Finnish
- French
- German
- Greek
- Hungarian
- Irish
- Italian
- Latvian
- Lithuanian
- Maltese
- Polish
- Portuguese
- Romanian
- Slovak

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- Slovenian
- Spanish
- Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program
Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.

Please upload your file here

Select file(s) to upload

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

- The program offers an Internal Internship (done in the same country of study)
- The program offers an abroad Internship (done in a foreign country)
- The program offers an industrial placement
- The program is a joint program with other universities
- There is a research project involved in the program
- The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

- Atmosphere
- Marine
- Land
- Climate
- Emergency
- Security
- None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.
More information regarding the ASTRAIOS KDs and KAs can be downloaded using the link below.

Please download the file

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KA_KD.pdf

Mathematics and Natural sciences

- Mathematics
- Physics
- Biology
- Chemistry
- Astronomy

Environmental and Earth Sciences

- Environmental sciences
- Remote Sensing
- Atmospheric Science
- Geology
- Climate Science
- Geographic Information Science
- Agriculture science
- Geography
- Oceanography
- Metrology
- Marine Science

Engineering and Technology

- Mechanical engineering
- Industrial engineering
- Aerospace engineering
- Space System engineering
- Electrical engineering
- Chemical engineering
- Satellite Engineering
- Computer Science

Business and management

- Economics
- Business and marketing

Law and Medicine

- Law
- Medicine

Other knowledge areas please specify here :

Q2.13 Which elements does your program offer *(more than one option can be selected)*

- The students learn project management in the program.
- The students take courses on academic skills development
- The students have the opportunity to present their work in front of a larger audience
- The students have the opportunity to develop their leadership

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- The students have the opportunities to work in culturally diverse teams
- The students learn to be empathic future employees
- There is an experimental lab time involved in the program
- The program encourages group work
- The program offers course/s on ethics (including ethics in Artificial Intelligence)
- The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others Additional help available

Please answer only for PhD program degree

D **Section 3: Courses**

In this survey, we aim to collect both mandatory courses and elective courses (courses providing essential knowledge for the space sector)

Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

Please upload your file here

Select file(s) to upload

Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Please add another degree program:

- Yes, I want to add another degree program
- No, I want to submit the survey

Submit

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15. APPENDIX E – OUTPUTS OF THE SURVEY

ASTRAIOS Survey on supply of the Space related Education

Fields marked with * are mandatory.

A ASTRAIOS Survey on Supply of the Space related Education

Introduction

ASTRAIOS (Analysis of Skills, Training, Research and Innovation Opportunities in Space) aims at providing an exhaustive view and understanding of **the current and future offer of Space curricula and courses in the EU-27 and the UK.** The project will also characterize the demand from the European Space industry and identify actionable ways towards a better alignment between the educational offer and the skills required by the future European space industry. As the first phase of the project, we aim to collect **the status quo (year 2023)** information about Master, Bachelor and PhD degrees covering upstream, midstream, and downstream space sectors across EU-27 and UK. We would really appreciate it if you could complete the following survey at your earliest convenience. We aim to collect the survey results by the **8th of September, 2023.**

The time required to complete this survey is **around 20 minutes**, but it depends on the amount of material that is intended to be described. Please note that you ***unlimited number of contributions*** to this survey, and you can save your contribution as a ***draft*** and continue later. Please do not hesitate to contact us if you have any questions.

Thank you in advance for your contribution. The ASTRAIOS Team https://www.astraios.eu/

Disclaimer!

The survey is designed to maintain the anonymity of participants. All the data provided will be handled confidentially, and the information will be published in an aggregated form that does not trace to individual entries. The analysis does not include any personal data, but in case you

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choose to share your personal information, it will be processed solely for purposes related to the project and in compliance with the General Data Protection Regulation (GDPR).

Do you consent to us storing and processing your information as clarified above?

☑ I accept your Terms

Show

B Section 1: The Institute

***Q1.1** Please indicate the institute name that your are responding on behalf of ?

UWE Bristol

***Q1.2** Please specify your job title/ role in the institute.

Associate Head of Department (Aerospace & Aviation) / Principal Lecturer & Associate Professor **Q1.3** Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Bristol, BS16 1QY

Q1.4 How many diverse campuses do you have and where are they located?

3

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

***Q2.1** Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

BEng/MEng Aerospace Engineering / BEng/MEng Aerospace Engineering with Pilot Studies

***Q2.2** Please select the European Qualification Framework (EQF) level

- ◉ EQF5/6 (Bachelor)
- ☐ EQF7 (Master)
- ☐ EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

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We provide industry-ready students by using an innovative integrated learning framework that includes technical modules of theory, experimentation, simulation content; alongside professional practice.

Q2.4 Please indicate the duration in months of the degree program.

48 (full-time) + 12 months for placement or sandwich year.

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

- Yes
- No

Q2.7 Please indicate the Language or Languages of the degree program

- Bulgarian
- Croatian
- Czech
- Danish
- Dutch
- English
- Estonian
- Finnish
- French
- German

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Greek
Hungarian
Irish
Italian
Latvian
Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak
Slovenian
Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

https://courses.uwe.ac.uk/H404/aerospace-engineering /
https://courses.uwe.ac.uk/H406/aerospaceengineering-with-pilot-studies / Specifications on request

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

The program offers an Internal Internship (done in the same country of study)
The program offers an abroad Internship (done in a foreign country)
The program offers an industrial placement

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☐ The program is a joint program with other universities
There is a research project involved in the program
The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

Atmosphere
☐ Marine
Land
☐ Climate
☐ Emergency
☐ Security
☐ None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.

More information regarding the ASTRAIOS KDs and KAs can be downloaded using the link below.

Please download the file
KA_KD.pdf

Mathematics and Natural sciences

Mathematics Physics ☐ Biology
☐ Chemistry ☐ Astronomy

Environmental and Earth Sciences

☐ Environmental sciences ☐ Remote Sensing
☐ Atmospheric Science ☐ Geology
☐ Climate Science ☐ Geographic Information Science
☐ Agriculture science ☐ Geography
☐ Oceanography ☐ Metrology
☐ Marine Science

Engineering and Technology

Mechanical engineering Industrial engineering
Aerospace engineering Space System engineering
☐ Electrical engineering ☐ Chemical engineering
Satellite Engineering ☐ Computer Science

Business and management

Economics Business and marketing

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Law and Medicine

☑ ☐ Law Medicine

Other knowledge areas please specify here :

Q2.13 Which elements does your program offer *(more than one option can be selected)* The students learn project management in the program.
The students take courses on academic skills development
The students have the opportunity to present their work in front of a larger audience
The students have the opportunity to develop their leadership
The students have the opportunities to work in culturally diverse teams
The students learn to be empathic future employees
There is an experimental lab time involved in the program
The program encourages group work
The program offers course/s on ethics (including ethics in Artificial Intelligence) The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

Case by case basis but based on propulsion (space / atmosphere), aerodynamics, structures, systems.

D Section 3: Courses

In this survey, we aim to collect both mandatory courses and elective courses (courses providing essential knowledge for the space sector)

Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

https://info.uwe.ac.uk/programmes/displayentry.asp?code=H404 / https://info.uwe.ac.uk/programmes/displayentry.asp?code=H405

Please upload your file here

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Please add another degree program:

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Yes, I want to add another degree program

No, I want to submit the survey

Contact

Contact Form

Response 2

ASTRAIOS Survey on supply of the Space related Education

A ASTRAIOS Survey on Supply of the Space related Education

Introduction

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Thank you in advance for your contribution. The ASTRAIOS Team https://www.astraios.eu/

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Do you consent to us storing and processing your information as clarified above?

I accept your Terms

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B Section 1: The Institute

*Q1.1 Please indicate the institute name that your are responding on behalf of ?

*Q1.2 Please specify your job title/ role in the institute.

Full professor/Master program director

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

*Q2.1 Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

*Q2.2 Please select the European Qualification Framework (EQF) level

EQF5/6 (Bachelor)

EQF7 (Master)

EQF8 (PhD)

Q2.4 Please indicate the duration in months of the degree program.

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

Yes

No

Q2.7 Please indicate the Language or Languages of the degree program

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☐
☐ Bulgarian
Croatian
Czech
Danish
Dutch
English
Estonian
Finnish
French
German
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☐ Greek
Hungarian
Irish
Italian
Latvian
Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak
Slovenian

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Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

https://hub.ucd.ie/usis/!W_HU_MENU.P_PUBLISH?p_tag=PROG&MAJR=F060 and https://www.ucd.ie/physics/spacescience/

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

The program offers an Internal Internship (done in the same country of study)
The program offers an abroad Internship (done in a foreign country)
The program offers an industrial placement
The program is a joint program with other universities
There is a research project involved in the program
The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

Atmosphere
Marine
Land
Climate
Emergency
Security
None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.
More information regarding this can be downloaded using the link below.

Please download the file
KA_KD.pdf

Mathematics and Natural sciences

Mathematics Physics Biology

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☐ Chemistry ☐ Astronomy

Environmental and Earth Sciences

☐ Environmental sciences ☐ Remote Sensing

☐ Atmospheric Science ☐ Geology

☐ Climate Science ☐ Geographic Information Science

☐ Agriculture science ☐ Geography

☐ Oceanography ☐ Metrology

☐ Marine Science

Engineering and Technology

☐ Mechanical engineering ☐ Industrial engineering

☐ Aerospace engineering ☐ Space System engineering

☐ Electrical engineering ☐ Chemical engineering

☐ Satellite Engineering ☐ Computer Science

Business and management

☐ Economics ☐ Business and marketing

Law and Medicine

☐ Law ☐ Medicine

Other knowledge areas please specify here :

☐

Q2.13 Which elements does your program offer *(more than one option can be selected)* The students learn project management in the program.

☐ The students take courses on academic skills development

☐ The students have the opportunity to present their work in front of a larger audience

☐ The students have the opportunity to develop their leadership

☐ The students have the opportunities to work in culturally diverse teams

☐ The students learn to be empathic future employees

☐ There is an experimental lab time involved in the program

☐ The program encourages group work

☐ The program offers course/s on ethics (including ethics in Artificial Intelligence)

☐ The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

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D Section 3: Courses

In this survey, we aim to collect both mandatory courses and elective courses (courses providing essential knowledge for the space sector)

Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

https://hub.ucd.ie/usis/!W_HU_MENU.P_PUBLISH?p_tag=MODULES&MAJR=F060

Please upload your file here

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Please add another degree program:

Yes, I want to add another degree program

No, I want to submit the survey

Contact

Contact Form

ASTRAIOS Survey on supply of the Space related Education

A ASTRAIOS Survey on Supply of the Space related Education

Introduction

ASTRAIOS (Analysis of Skills, Training, Research and Innovation Opportunities in Space) aims at providing an exhaustive view and understanding of **the current and future offer of Space curricula and courses in the EU-27 and the UK.** The project will also characterize the demand from the European Space industry and identify actionable ways towards a better alignment between the educational offer and the skills required by the future European space industry.

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As the first phase of the project, we aim to collect **the status quo (year 2023)** information about Master, Bachelor and PhD degrees covering upstream, midstream, and downstream space sectors across EU-27 and UK. We would really appreciate it if you could complete the following survey at your earliest convenience. We aim to collect the survey results by the **8th of September, 2023.**

The time required to complete this survey is **around 20 minutes**, but it depends on the amount of material that is intended to be described. Please note that you ***unlimited number of contributions*** to this survey, and you can save your contribution as a ***draft*** and continue later. Please do not hesitate to contact us if you have any questions.
Thank you in advance for your contribution. The ASTRAIOS Team https://www.astraios.eu/
Disclaimer!
The survey is designed to maintain the anonymity of participants. All the data provided will be handled confidentially, and the information will be published in an aggregated form that does not trace to individual entries. The analysis does not include any personal data, but in case you choose to share your personal information, it will be processed solely for purposes related to the project and in compliance with the General Data Protection Regulation (GDPR).

Do you consent to us storing and processing your information as clarified above?
I accept your Terms
Show

B Section 1: The Institute

- **Q1.1** Please indicate the institute name that your are responding on behalf of ?

Technische Universität Berlin - Chair of Space Technology

- **Q1.2** Please specify your job title/ role in the institute.

Assistant Professor / Responsible for teaching program

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

for space technology everything is in the same campus

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

- **Q2.1** Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

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- **Q2.2** Please select the European Qualification Framework (EQF) level

EQF5/6 (Bachelor)

EQF7 (Master)

EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

Hands-on experience. From design until operating real space craft in space are part of the program

Q2.4 Please indicate the duration in months of the degree program.

24 months. But the students tend to need around 36 months

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

Yes

No

Q2.7 Please indicate the Language or Languages of the degree program

Bulgarian
Croatian
Czech
Danish
Dutch
English
Estonian
Finnish
French

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German
Greek
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☐
☐ Hungarian
Irish
Italian
Latvian
Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak
Slovenian
Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

https://www.tu.berlin/en/studying/study-programs/all-programs-offered/study-course/aeronautics-andastronautics-m-sc --> this is general for the program. it is devided into Aeronautics and Astronautics

Please upload your file here

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

The program offers an Internal Internship (done in the same country of study)
The program offers an abroad Internship (done in a foreign country)
The program offers an industrial placement
The program is a joint program with other universities

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There is a research project involved in the program
The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

- ☐ Atmosphere
- ☐ Marine
- ☐ Land
- ☐ Climate
- ☐ Emergency
- ☐ Security

None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.

More information regarding this can be downloaded using the link below.

Please download the file

KA_KD.pdf

Mathematics and Natural sciences

Mathematics ☐ Physics ☐ Biology
☐ Chemistry Astronomy

Environmental and Earth Sciences

☐ Environmental sciences Remote Sensing
☐ Atmospheric Science ☐ Geology
☐ Climate Science ☐ Geographic Information Science
☐ Agriculture science ☐ Geography
☐ Oceanography ☐ Metrology
☐ Marine Science

Engineering and Technology

Mechanical engineering ☐ Industrial engineering
Aerospace engineering Space System engineering
Electrical engineering Chemical engineering
Satellite Engineering ☐ Computer Science

Business and management

☐ Economics ☐ Business and marketing

Law and Medicine

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☑ ☐ Law Medicine

Other knowledge areas please specify here :

Q2.13 Which elements does your program offer *(more than one option can be selected)* The students learn project management in the program.
The students take courses on academic skills development
The students have the opportunity to present their work in front of a larger audience
The students have the opportunity to develop their leadership
The students have the opportunities to work in culturally diverse teams
The students learn to be empathic future employees
There is an experimental lab time involved in the program
The program encourages group work
The program offers course/s on ethics (including ethics in Artificial Intelligence)
The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

PhD topics are initiated via the Prof or initiative of the respective researcher. Sometimes industry is involved.

D Section 3: Courses

In this survey, we aim to collect both mandatory courses and elective courses (courses providing essential knowledge for the space sector)

Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

some of them are only available in German. you might have to translate.

Please upload your file here **cc620786-3d91-4363-b9a1-e25b0a83ce82/Syllabus_compressed.pdf**

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

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there are 2 master programs. One is a regular, open degree program for the outlined Master's in Aeronautics and Astronautics. The other is a private Master's program, "Master of Space Engineering", for which an enrolment fee is charged.

Please add another degree program:

- Yes, I want to add another degree program
- No, I want to submit the survey

Contact

Contact Form

Response 4

ASTRAIOS Survey on supply of the Space related Education

A ASTRAIOS Survey on Supply of the Space related Education

Introduction

ASTRAIOS (Analysis of Skills, Training, Research and Innovation Opportunities in Space) aims at providing an exhaustive view and understanding of **the current and future offer of Space curricula and courses in the EU-27 and the UK.** The project will also characterize the demand from the European Space industry and identify actionable ways towards a better alignment between the educational offer and the skills required by the future European space industry. As the first phase of the project, we aim to collect **the status quo (year 2023)** information about Master, Bachelor and PhD degrees covering upstream, midstream, and downstream space sectors across EU-27 and UK. We would really appreciate it if you could complete the following survey at your earliest convenience. We aim to collect the survey results by the **8th of September, 2023.**

The time required to complete this survey is **around 20 minutes**, but it depends on the amount of material that is intended to be described. Please note that you ***unlimited number of contributions*** to this survey, and you can save your contribution as a ***draft*** and continue later. Please do not hesitate to contact us if you have any questions.

Thank you in advance for your contribution. The ASTRAIOS Team https://www.astraios.eu/

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Disclaimer!

The survey is designed to maintain the anonymity of participants. All the data provided will be handled confidentially, and the information will be published in an aggregated form that does not trace to individual entries. The analysis does not include any personal data, but in case you choose to share your personal information, it will be processed solely for purposes related to the project and in compliance with the General Data Protection Regulation (GDPR).

Do you consent to us storing and processing your information as clarified above?

I accept your Terms

Show

B Section 1: The Institute

***Q1.1** Please indicate the institute name that your are responding on behalf of ?

***Q1.2** Please specify your job title/ role in the institute.

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

***Q2.1** Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

***Q2.2** Please select the European Qualification Framework (EQF) level

- EQF5/6 (Bachelor)
- EQF7 (Master)
- EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

Specific focus on composite materials and their structural behviour. Design and simulation.

Q2.4 Please indicate the duration in months of the degree program.

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

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Q2.6 Is your degree program accredited?

- Yes
- No

Q2.7 Please indicate the Language or Languages of the degree program

- Bulgarian
- Croatian
- Czech
- Danish
- Dutch
- English
- Estonian
- Finnish
- French
- German
- Greek
- Hungarian
- Irish
- Italian

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Latvian
Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak
Slovenian
Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

The program offers an Internal Internship (done in the same country of study)
The program offers an abroad Internship (done in a foreign country)
The program offers an industrial placement
The program is a joint program with other universities
There is a research project involved in the program
The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

Atmosphere
Marine
Land
Climate
Emergency
Security
None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.
More information regarding the this can be downloaded using the link below.

Please download the file

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KA_KD.pdf

Mathematics and Natural sciences

Mathematics Physics Biology

Chemistry Astronomy

Environmental and Earth Sciences

Environmental sciences Remote Sensing

Atmospheric Science Geology

Climate Science Geographic Information Science

Agriculture science Geography

Oceanography Metrology

Marine Science

Engineering and Technology

Mechanical engineering Industrial engineering

Aerospace engineering Space System engineering

Electrical engineering Chemical engineering

Satellite Engineering Computer Science

Business and management

Economics Business and marketing

Law and Medicine

Law Medicine

Other knowledge areas please specify here :

Q2.13 Which elements does your program offer *(more than one option can be selected)*

The students learn project management in the program.

The students take courses on academic skills development

The students have the opportunity to present their work in front of a larger audience

The students have the opportunity to develop their leadership

The students have the opportunities to work in culturally diverse teams

The students learn to be empathic future employees

There is an experimental lab time involved in the program

The program encourages group work

The program offers course/s on ethics (including ethics in Artificial Intelligence)

The program stresses on the importance of sustainability in various domains such as the environment and society.

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Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

PhD on experimental characterization, design and simulation of composite materials. 2/3 of these PhD's are funded by companies.

D Section 3: Courses

In this survey, we aim to collect both mandatory courses and elective courses (courses providing essential knowledge for the space sector)

Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

Please upload your file here

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Please add another degree program:

Yes, I want to add another degree program

No, I want to submit the survey

Contact

Contact Form

ASTRAIOS Survey on supply of the Space related Education

A ASTRAIOS Survey on Supply of the Space related Education

Introduction

ASTRAIOS (Analysis of Skills, Training, Research and Innovation Opportunities in Space) aims at providing an exhaustive view and understanding of **the current and future offer of Space**

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curricula and courses in the EU-27 and the UK. The project will also characterize the demand from the European Space industry and identify actionable ways towards a better alignment between the educational offer and the skills required by the future European space industry. As the first phase of the project, we aim to collect **the status quo (year 2023)** information about Master, Bachelor and PhD degrees covering upstream, midstream, and downstream space sectors across EU-27 and UK. We would really appreciate it if you could complete the following survey at your earliest convenience. We aim to collect the survey results by the **8th of September, 2023.**

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Thank you in advance for your contribution. The ASTRAIOS Team https://www.astraios.eu/
Disclaimer!
The survey is designed to maintain the anonymity of participants. All the data provided will be handled confidentially, and the information will be published in an aggregated form that does not trace to individual entries. The analysis does not include any personal data, but in case you choose to share your personal information, it will be processed solely for purposes related to the project and in compliance with the General Data Protection Regulation (GDPR).

Do you consent to us storing and processing your information as clarified above?
I accept your Terms
Show

B Section 1: The Institute

*Q1.1 Please indicate the institute name that your are responding on behalf of ?

European Aeronautics Science Network (EASN) & Institute of Structural Mechanics and Lightweight Design, RWTH AACHEN University

*Q1.2 Please specify your job title/ role in the institute.

Dr.-Ing., Head of Structural Dynamics, Aeroelasticity and Space Technology, Vice Director of the Institute

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

C Section 2: Degree program

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Please answer the questions in section 2 that are related to the degree program

*Q2.1 Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

*Q2.2 Please select the European Qualification Framework (EQF) level

- EQF5/6 (Bachelor)
- EQF7 (Master)
- EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

Clear separation between aviation and aerospace only during the masterdegree study program.

Q2.4 Please indicate the duration in months of the degree program.

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

- Yes
- No

Q2.7 Please indicate the Language or Languages of the degree program

- [x] Bulgarian
- Croatian
- Czech
- Danish
- Dutch
- English
- Estonian
- Finnish
- French
- German

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Greek
Hungarian
Irish
Italian
Latvian
Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak
Slovenian
Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

https://www.rwth-aachen.de/cms/root/studium/Vor-dem-Studium/Studiengaenge/Liste-AktuelleStudiengaenge/Studiengangbeschreibung/~bkoe/Luft-und-Raumfahrttechnik-M-Sc-/?lidx=1

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

The program offers an Internal Internship (done in the same country of study)
The program offers an abroad Internship (done in a foreign country)

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☐ The program offers an industrial placement
☐ The program is a joint program with other universities
☐ There is a research project involved in the program
The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

☐ Atmosphere
☐ Marine
☐ Land
☐ Climate
☐ Emergency
☐ Security
None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.
More information regarding this can be downloaded using the link below.

Please download the file
KA_KD.pdf

Mathematics and Natural sciences

☐ Mathematics ☐ Physics ☐ Biology
☐ Chemistry ☐ Astronomy

Environmental and Earth Sciences

☐ Environmental sciences ☐ Remote Sensing
☐ Atmospheric Science ☐ Geology
☐ Climate Science ☐ Geographic Information Science
☐ Agriculture science ☐ Geography
☐ Oceanography ☐ Metrology
☐ Marine Science

Engineering and Technology

Mechanical engineering ☐ Industrial engineering
Aerospace engineering Space System engineering
Electrical engineering ☐ Chemical engineering

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Satellite Engineering ☐ Computer Science

Business and management

☐ Economics ☐ Business and marketing

Law and Medicine

☐ Law ☐ Medicine

Other knowledge areas please specify here :

☐

Q2.13 Which elements does your program offer *(more than one option can be selected)* ☐

The students learn project management in the program.

The students take courses on academic skills development

The students have the opportunity to present their work in front of a larger audience

The students have the opportunity to develop their leadership

The students have the opportunities to work in culturally diverse teams

☐ The students learn to be empathic future employees

☐ There is an experimental lab time involved in the program

The program encourages group work

☐ The program offers course/s on ethics (including ethics in Artificial Intelligence) ☐

The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

☐

D Section 3: Courses

In this survey, we aim to collect both mandatory courses and elective courses (courses providing essential knowledge for the space sector)

Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

https://www.rwth-aachen.de/cms/root/studium/Vor-dem-Studium/Studiengaenge/Liste-AktuelleStudiengaenge/Studiengangbeschreibung/~bkoe/Luft-und-Raumfahrttechnik-M-Sc-/?lidx=1

Please upload your file here

E Section 4: Additional Information and Submission

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Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Please add another degree program:

Yes, I want to add another degree program

No, I want to submit the survey

Contact

Contact Form

ASTRAIOS Survey on supply of the Space related Education

A ASTRAIOS Survey on Supply of the Space related Education

Introduction

ASTRAIOS (Analysis of Skills, Training, Research and Innovation Opportunities in Space) aims at providing an exhaustive view and understanding of **the current and future offer of Space curricula and courses in the EU-27 and the UK.** The project will also characterize the demand from the European Space industry and identify actionable ways towards a better alignment between the educational offer and the skills required by the future European space industry. As the first phase of the project, we aim to collect **the status quo (year 2023)** information about Master, Bachelor and PhD degrees covering upstream, midstream, and downstream space sectors across EU-27 and UK. We would really appreciate it if you could complete the following survey at your earliest convenience. We aim to collect the survey results by the **8th of September, 2023.**

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Thank you in advance for your contribution. The ASTRAIOS Team https://www.astraios.eu/

Disclaimer!

The survey is designed to maintain the anonymity of participants. All the data provided will be handled confidentially, and the information will be published in an aggregated form that does not trace to individual entries. The analysis does not include any personal data, but in case you choose to share your personal information, it will be processed solely for purposes related to the project and in compliance with the General Data Protection Regulation (GDPR).

Do you consent to us storing and processing your information as clarified above?

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I accept your Terms

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B Section 1: The Institute

*Q1.1 Please indicate the institute name that your are responding on behalf of ?

*Q1.2 Please specify your job title/ role in the institute.

Professor Space Systems Engineering

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

*Q2.1 Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

*Q2.2 Please select the European Qualification Framework (EQF) level

EQF5/6 (Bachelor)

EQF7 (Master)

EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

Concentrates on whole mission design, with elements of Space Law and Spacecraft Launch

Q2.4 Please indicate the duration in months of the degree program.

12 months full time, an 24 months part-time

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

6 x 15 credits modules (120 credits) + 60 credit industry-focused project

Q2.6 Is your degree program accredited?

Yes

No

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Q2.7 Please indicate the Language or Languages of the degree program

- ☐
- ☐
- ☐
- ☐
- ☐
- ☑
- ☐
- ☐
- ☐
- ☐

☐ Bulgarian
Croatian
Czech
Danish
Dutch
English
Estonian
Finnish
French
German
Greek

- ☐
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- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐

☐ Hungarian
Irish
Italian
Latvian
Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak

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Slovenian
Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

The program offers an Internal Internship (done in the same country of study)
The program offers an abroad Internship (done in a foreign country)
The program offers an industrial placement
The program is a joint program with other universities
There is a research project involved in the program
The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

Atmosphere
Marine
Land
Climate
Emergency
Security
None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.

More information regarding this can be downloaded using the link below.

Please download the file

KA_KD.pdf

Mathematics and Natural sciences

Mathematics Physics Biology
Chemistry Astronomy

Environmental and Earth Sciences

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Environmental sciences Remote Sensing
Atmospheric Science ☐ Geology
Climate Science Geographic Information Science
☐ Agriculture science ☐ Geography
☐ Oceanography ☐ Metrology
☐ Marine Science

Engineering and Technology

Mechanical engineering ☐ Industrial engineering
Aerospace engineering Space System engineering
Electrical engineering ☐ Chemical engineering
Satellite Engineering Computer Science

Business and management

Economics ☐ Business and marketing

Law and Medicine

☑ ☐ Law Medicine

Other knowledge areas please specify here :

☐

Q2.13 Which elements does your program offer *(more than one option can be selected)* The students learn project management in the program.
The students take courses on academic skills development
The students have the opportunity to present their work in front of a larger audience
The students have the opportunity to develop their leadership
The students have the opportunities to work in culturally diverse teams
The students learn to be empathic future employees
There is an experimental lab time involved in the program
The program encourages group work
The program offers course/s on ethics (including ethics in Artificial Intelligence) The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

Autonomous Systems, Robotics, Artificial Intelligence, Sensors, Lasers, In-orbit maintenance, Navigation.
Through City, University of London

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D Section 3: Courses

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Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described. ☐ File to be sent from University System
Please upload your file here

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Course design included advice from UKSA, MOD, Space Industry, Space Operators

Please add another degree program:

☐ Yes, I want to add another degree program

☐ No, I want to submit the survey

Contact
Contact Form

ASTRAIOS Survey on supply of the Space related Education

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A ASTRAIOS Survey on Supply of the Space related Education

Introduction

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Disclaimer!
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I accept your Terms
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B Section 1: The Institute

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*Q1.2 Please specify your job title/ role in the institute.

Professor of Space Engineering

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

*Q2.1 Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

*Q2.2 Please select the European Qualification Framework (EQF) level

EQF5/6 (Bachelor)

EQF7 (Master)

EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

Q2.4 Please indicate the duration in months of the degree program.

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Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

- Yes
- No

Q2.7 Please indicate the Language or Languages of the degree program

- Bulgarian
- Croatian
- Czech
- Danish
- Dutch
- English
- Estonian
- Finnish
- French
- German
- Greek

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☐ Hungarian
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Italian
Latvian
Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak
Slovenian
Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

https://www.bris.ac.uk/unit-program-catalogue/RouteSpecification.jsa;jsessionid=4386D2DE0888F16D68F2D677D31CAE35?ayrCode=22%2F23&selectedCatalogue=PROGRAM&orgCode=AERO&programCode=4AERO014U

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

☐ The program offers an Internal Internship (done in the same country of study)
☐ The program offers an abroad Internship (done in a foreign country)

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The program offers an industrial placement

☐ The program is a joint program with other universities

There is a research project involved in the program

The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

☐ Atmosphere

☐ Marine

☐ Land

☐ Climate

☐ Emergency

☐ Security

None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.

More information regarding this can be downloaded using the link below.

Please download the file

KA_KD.pdf

Mathematics and Natural sciences

☐ Mathematics ☐ Physics ☐ Biology

☐ Chemistry ☐ Astronomy

Environmental and Earth Sciences

☐ Environmental sciences ☐ Remote Sensing

☐ Atmospheric Science ☐ Geology

☐ Climate Science ☐ Geographic Information Science

☐ Agriculture science ☐ Geography

☐ Oceanography ☐ Metrology

☐ Marine Science

Engineering and Technology

☐ Mechanical engineering ☐ Industrial engineering

Aerospace engineering ☐ Space System engineering

☐ Electrical engineering ☐ Chemical engineering

☐ Satellite Engineering ☐ Computer Science

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Business and management

Economics Business and marketing

Law and Medicine

Law Medicine

Other knowledge areas please specify here :

Q2.13 Which elements does your program offer *(more than one option can be selected)* The students learn project management in the program.
The students take courses on academic skills development
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There is an experimental lab time involved in the program
The program encourages group work

The program offers course/s on ethics (including ethics in Artificial Intelligence) The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

There are many many PhD topics. In terms of within space education topics such as composites for space, LEO materials, VLEO orbits, MBSE for space, Chemical weapons detection from space, Lightning on other planets, Electric propulsion thruster design have all been covered.

D Section 3: Courses

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Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

https://www.bris.ac.uk/unit-program-catalogue/RouteStructureCohort.jsa?byCohort=24%

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2F25&byCohort=Y&selectedCatalogue=PROGRAM&orgCode=AERO&programCode=4AERO014U&_gl=1*1o5hmrp*_ga*MTY4Nzk1MjUxOC4xNjQyODY1NTM3*_ga_6R8SPL3HLT*MTY4OTU4NTY1OC40My4xLjE2ODk1ODU2NzMuNDUuMC4w&_ga=2.144450742.2047178312.1689513643-1687952518.1642865537

Please upload your file here

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Please add another degree program:

- Yes, I want to add another degree program
- No, I want to submit the survey

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Q1.4 How many diverse campuses do you have and where are they located?

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- **Q2.2** Please select the European Qualification Framework (EQF) level

EQF5/6 (Bachelor)
EQF7 (Master)
EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

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Erasmus+ Double degree with Ecole Centrale Lyon in aeronautical engineering with specialisation in external aerodynamics and propulsion turbomachinery

Q2.4 Please indicate the duration in months of the degree program.

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

- Yes
- No

Q2.7 Please indicate the Language or Languages of the degree program

- Bulgarian
- Croatian
- Czech
- Danish
- Dutch
- English
- Estonian
- Finnish
- French
- German

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☐ Greek
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Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak
Slovenian
Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

Please upload your file here

028f8a98-d9b5-4401-b811-3ff3dacd4373/920952-DS-EN-224535_2022-01-03_19_07_21.pdf

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

☐ The program offers an Internal Internship (done in the same country of study)
☐ The program offers an abroad Internship (done in a foreign country)
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The program is a joint program with other universities

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☐ There is a research project involved in the program

The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

Atmosphere

☐ Marine

☐ Land

☐ Climate

☐ Emergency

☐ Security

☐ None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.

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Mathematics and Natural sciences

☐ Mathematics ☐ Physics ☐ Biology

☐ Chemistry ☐ Astronomy

Environmental and Earth Sciences

☐ Environmental sciences ☐ Remote Sensing

☐ Atmospheric Science ☐ Geology

☐ Climate Science ☐ Geographic Information Science

☐ Agriculture science ☐ Geography

☐ Oceanography ☐ Metrology

☐ Marine Science

Engineering and Technology

Mechanical engineering ☐ Industrial engineering

Aerospace engineering ☐ Space System engineering

☐ Electrical engineering ☐ Chemical engineering

☐ Satellite Engineering ☐ Computer Science

Business and management

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Economics Business and marketing

Law and Medicine

Law Medicine

Other knowledge areas please specify here :

Q2.13 Which elements does your program offer *(more than one option can be selected)*

The students learn project management in the program.

The students take courses on academic skills development

The students have the opportunity to present their work in front of a larger audience

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Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

Please upload your file here **e95bc6f7-be66-42f2-801b-4362a0ac129c/920952-DS-AT-EN-224535_2022-01-03_19_07_22.pdf**

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

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Please add another degree program:

Yes, I want to add another degree program

No, I want to submit the survey

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B Section 1: The Institute

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*Q1.1 Please indicate the institute name that your are responding on behalf of ?

*Q1.2 Please specify your job title/ role in the institute.

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

Main campus in the city of Thessaloniki, mainly in the city center but some facilities are scattered, additional campuses for Physical Education and Sports Sciences in Serres

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

*Q2.1 Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

*Q2.2 Please select the European Qualification Framework (EQF) level

- EQF5/6 (Bachelor)
- EQF7 (Master)
- EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

The Bachelor phase is comprised of 4 years while the 5th year is the Masters program which includes a Diplomatic Thesis and extra courses focusing on a specific field of Engineering

Q2.4 Please indicate the duration in months of the degree program.

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

- Yes
- No

Q2.7 Please indicate the Language or Languages of the degree program

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English
Estonian
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French
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☐
☐ German
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Irish
Italian
Latvian
Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak
Slovenian

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Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

https://www.meng.auth.gr/wp-content/uploads/sites/97/2019/01/%CE%9F%CE%B4%CE%B7%CE%B3%

CF%8C%CF%82-%CE%A3%CF%80%CE%BF%CF%85%CE%B4%CF%8E%CE%BD-2022-2023_V3.pdf

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

- The program offers an Internal Internship (done in the same country of study)
- The program offers an abroad Internship (done in a foreign country)
- The program offers an industrial placement
- The program is a joint program with other universities
- There is a research project involved in the program

The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

Atmosphere
Marine
Land
Climate
Emergency
Security
None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected).*

More information regarding this can be downloaded using the link below.

Please download the file

KA_KD.pdf

Mathematics and Natural sciences

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Mathematics Physics ☐ Biology

Chemistry ☐ Astronomy

Environmental and Earth Sciences

Environmental sciences Remote Sensing

Atmospheric Science ☐ Geology

☐ Climate Science ☐ Geographic Information Science

☐ Agriculture science ☐ Geography

☐ Oceanography ☐ Metrology

☐ Marine Science

Engineering and Technology

Mechanical engineering Industrial engineering

Aerospace engineering ☐ Space System engineering

☐ Electrical engineering Chemical engineering

☐ Satellite Engineering ☐ Computer Science

Business and management

☐ Economics ☐ Business and marketing

Law and Medicine

☐ ☐ Law Medicine

Other knowledge areas please specify here :

☐

Q2.13 Which elements does your program offer *(more than one option can be selected)* The students learn project management in the program.

☐ The students take courses on academic skills development

The students have the opportunity to present their work in front of a larger audience

☐ The students have the opportunity to develop their leadership

☐ The students have the opportunities to work in culturally diverse teams

☐ The students learn to be empathic future employees

☐ There is an experimental lab time involved in the program

The program encourages group work

☐ The program offers course/s on ethics (including ethics in Artificial Intelligence) The program stresses on the importance of sustainability in various domains such as the environment and society.

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Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

D Section 3: Courses

In this survey, we aim to collect both mandatory courses and elective courses (courses providing essential knowledge for the space sector)

Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

https://www.meng.auth.gr/wp-content/uploads/sites/97/2019/01/%CE%9F%CE%B4%CE%B7%CE%B3%

CF%8C%CF%82-%CE%A3%CF%80%CE%BF%CF%85%CE%B4%CF%8E%CE%BD-2022-2023_V3.pdf

Please upload your file here

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Please add another degree program:

Yes, I want to add another degree program

No, I want to submit the survey

Contact

Contact Form

ASTRAIOS Survey on supply of the Space related Education

A ASTRAIOS Survey on Supply of the Space related Education

Introduction

ASTRAIOS (Analysis of Skills, Training, Research and Innovation Opportunities in Space) aims at providing an exhaustive view and understanding of **the current and future offer of Space curricula and courses in the EU-27 and the UK.** The project will also characterize the demand from the

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European Space industry and identify actionable ways towards a better alignment between the educational offer and the skills required by the future European space industry.
As the first phase of the project, we aim to collect **the status quo (year 2023)** information about Master, Bachelor and PhD degrees covering upstream, midstream, and downstream space sectors across EU-27 and UK. We would really appreciate it if you could complete the following survey at your earliest convenience. We aim to collect the survey results by the **8th of September, 2023.**

The time required to complete this survey is **around 20 minutes**, but it depends on the amount of material that is intended to be described. Please note that you ***unlimited number of contributions*** to this survey, and you can save your contribution as a ***draft*** and continue later.
Please do not hesitate to contact us if you have any questions.
Thank you in advance for your contribution. The ASTRAIOS Team https://www.astraios.eu/
Disclaimer!
The survey is designed to maintain the anonymity of participants. All the data provided will be handled confidentially, and the information will be published in an aggregated form that does not trace to individual entries. The analysis does not include any personal data, but in case you choose to share your personal information, it will be processed solely for purposes related to the project and in compliance with the General Data Protection Regulation (GDPR).

Do you consent to us storing and processing your information as clarified above?
I accept your Terms
Show

B Section 1: The Institute

***Q1.1** Please indicate the institute name that your are responding on behalf of ?

***Q1.2** Please specify your job title/ role in the institute.

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

***Q2.1** Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

***Q2.2** Please select the European Qualification Framework (EQF) level

- EQF5/6 (Bachelor)
- EQF7 (Master)
- EQF8 (PhD)

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Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

Q2.4 Please indicate the duration in months of the degree program.

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

- Yes
- No

Q2.7 Please indicate the Language or Languages of the degree program

- Bulgarian
- Croatian
- Czech
- Danish
- Dutch
- English
- Estonian
- Finnish
- French
- German
- Greek

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Hungarian
Irish
Italian
Latvian
Lithuanian
Maltese
Polish
Portuguese
Romanian
Slovak
Slovenian
Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program
Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.

https://www.brunel.ac.uk/study/undergraduate/aerospace-engineering-meng

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

The program offers an Internal Internship (done in the same country of study)
The program offers an abroad Internship (done in a foreign country)
The program offers an industrial placement
The program is a joint program with other universities
There is a research project involved in the program
The program's teaching approach is in-person classes conducted at the institute.

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Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

- ☐ Atmosphere
- ☐ Marine
- ☐ Land
- ☐ Climate
- ☐ Emergency
- ☐ Security
- ☐ None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.
More information regarding the this can be downloaded using the link below.

Please download the file
KA_KD.pdf

Mathematics and Natural sciences

☐ Mathematics ☐ Physics ☐ Biology
☐ Chemistry ☐ Astronomy

Environmental and Earth Sciences

☐ Environmental sciences ☐ Remote Sensing
☐ Atmospheric Science ☐ Geology
☐ Climate Science ☐ Geographic Information Science
☐ Agriculture science ☐ Geography
☐ Oceanography ☐ Metrology
☐ Marine Science

Engineering and Technology

☐ Mechanical engineering ☐ Industrial engineering
Aerospace engineering ☐ Space System engineering
☐ Electrical engineering ☐ Chemical engineering
Satellite Engineering ☐ Computer Science

Business and management

☐ Economics ☐ Business and marketing

Law and Medicine

☐ Law ☐ Medicine

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Other knowledge areas please specify here :

Q2.13 Which elements does your program offer *(more than one option can be selected)* The students learn project management in the program.

The students take courses on academic skills development

The students have the opportunity to present their work in front of a larger audience

The students have the opportunity to develop their leadership

The students have the opportunities to work in culturally diverse teams

The students learn to be empathic future employees

There is an experimental lab time involved in the program

The program encourages group work

The program offers course/s on ethics (including ethics in Artificial Intelligence) The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

D Section 3: Courses

In this survey, we aim to collect both mandatory courses and elective courses (courses providing essential knowledge for the space sector)

Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

Please upload your file here

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Please add another degree program:

Yes, I want to add another degree program

No, I want to submit the survey

F Section 2: Degree program (2)

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Please answer the questions in section 2 that are related to the **second** degree program

*__Q2.1__ Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

*__Q2.2__ Please select the European Qualification Framework (EQF) level

- EQF5/6 (Bachelor)
- EQF7 (Master)
- EQF8 (PhD)

__Q2.3__ Please elaborate on the factors/elements that distinguish your degree program?

__Q2.4__ Please indicate the duration in months of the degree program.

__Q2.5__ Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

__Q2.6__ Is your degree program accredited?

- Yes
- No

__Q2.7__ Please indicate the Language or Languages of the degree program Bulgarian

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- German
- Greek
- Hungarian
- Irish
- Italian
- Latvian
- Lithuanian
- Maltese
- Polish
- Portuguese
- Romanian
- Slovak
- Slovenian
- Spanish

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Swedish

Q2.8 Please provide the learning outcomes of the degree program
Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

- The program offers an Internal Internship (done in the same country of study)
- The program offers an abroad Internship (done in a foreign country)
- The program offers an industrial placement
- The program is a joint program with other universities

There is a research project involved in the program
The program's teaching approach is in-person classes conducted at the institute.

Q2.11 Please select one or more of the Copernicus thematic areas *(if applicable to your Program Degree)*

- Atmosphere
- Marine
- Land
- Climate
- Emergency
- Security
- None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.
More information regarding this can be downloaded here

Please download the file
KA_KD.pdf

Mathematics and Natural sciences

Mathematics Physics Biology
Chemistry Astronomy

Environmental and Earth Sciences

Environmental sciences Remote Sensing
Atmospheric Science Geology

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Climate Science
Geographic Information Science
Agriculture science
Geography
Oceanography
Metrology
Marine Science

Engineering and Technology

Mechanical engineering
Industrial engineering
Aerospace engineering
Space System engineering
Electrical engineering
Chemical engineering
Satellite Engineering
Computer Science

Business and management

Economics
Business and marketing

Law and Medicine

Law
Medicine

Other knowledge areas please specify here :

Q2.13 Which elements does your program offer *(more than one option can be selected)*
The students learn project management in the program.
The students take courses on academic skills development
The students have the opportunity to present their work in front of a larger audience
The students have the opportunity to develop their leadership
The students have the opportunities to work in culturally diverse teams
The students learn to be empathic future employees
There is an experimental lab time involved in the program
The program encourages group work
The program offers course/s on ethics (including ethics in Artificial Intelligence) The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

G Section 3: Courses (2)

In this survey, we aim to collect both mandatory courses and elective courses (courses providing essential knowledge for the space sector)

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Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

Please upload your file here

H Section 4: Additional Information and Submission (2)

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Contact
Contact Form

ASTRAIOS Survey on supply of the Space related Education

A ASTRAIOS Survey on Supply of the Space related Education

Introduction
ASTRAIOS (Analysis of Skills, Training, Research and Innovation Opportunities in Space) aims at providing an exhaustive view and understanding of **the current and future offer of Space curricula and courses in the EU-27 and the UK.** The project will also characterize the demand from the European Space industry and identify actionable ways towards a better alignment between the educational offer and the skills required by the future European space industry. As the first phase of the project, we aim to collect **the status quo (year 2023)** information about Master, Bachelor and PhD degrees covering upstream, midstream, and downstream space sectors across EU-27 and UK. We would really appreciate it if you could complete the following survey at your earliest convenience. We aim to collect the survey results by the **8th of September, 2023.**

The time required to complete this survey is **around 20 minutes**, but it depends on the amount of material that is intended to be described. Please note that you ***unlimited number of contributions*** to this survey, and you can save your contribution as a ***draft*** and continue later. Please do not hesitate to contact us if you have any questions.
Thank you in advance for your contribution. The ASTRAIOS Team https://www.astraios.eu/
Disclaimer!
The survey is designed to maintain the anonymity of participants. All the data provided will be handled confidentially, and the information will be published in an aggregated form that does not trace to individual entries. The analysis does not include any personal data, but in case you

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choose to share your personal information, it will be processed solely for purposes related to the project and in compliance with the General Data Protection Regulation (GDPR).

Do you consent to us storing and processing your information as clarified above?
I accept your Terms
Show

B Section 1: The Institute

***Q1.1** Please indicate the institute name that your are responding on behalf of ?

***Q1.2** Please specify your job title/ role in the institute.

Q1.3 Please indicate the City and postcode of your institute? (e.g. Enschede; 7522 NH)

Q1.4 How many diverse campuses do you have and where are they located?

C Section 2: Degree program

Please answer the questions in section 2 that are related to the degree program

***Q2.1** Please write down the Name of the degree program (e.g. Master of Spatial Engineering)

BSc Aerospace Engineering + Master Aerospace engineering

***Q2.2** Please select the European Qualification Framework (EQF) level

- EQF5/6 (Bachelor)
- EQF7 (Master)
- EQF8 (PhD)

Q2.3 Please elaborate on the factors/elements that distinguish your degree program?

Q2.4 Please indicate the duration in months of the degree program.

Q2.5 Please indicate the Size in ECTS credits of the degree program (if applicable)

ECTS: European Credit Transfer and Accumulation System. 1 credit equals 28 hours of study load

Q2.6 Is your degree program accredited?

- Yes

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No

Q2.7 Please indicate the Language or Languages of the degree program

Bulgarian
Croatian
Czech
Danish
Dutch
English
Estonian
Finnish
French
German
Greek

Hungarian
Irish
Italian
Latvian
Lithuanian
Maltese
Polish
Portuguese

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Romanian
Slovak
Slovenian
Spanish
Swedish

Q2.8 Please provide the descriptions including the learning outcomes of the degree program *Alternatively, please provide us with a link to a website or a document (e.g. pdf. File) where the learning outcomes are described.*

Please upload your file here

Q2.9 Please specify the Average number of graduates per academic year

Q2.10 Please select the options that apply to your program *(more than one option can be selected) :*

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Atmosphere
Marine
Land
Climate
Emergency
Security
None

Q2.12 Please select the Knowledge Area/s (KA) of the degree program *(more than one area can be selected)*.
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Mathematics and Natural sciences

Mathematics Physics Biology
Chemistry Astronomy

Environmental and Earth Sciences

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Environmental sciences Remote Sensing
Atmospheric Science Geology
Climate Science Geographic Information Science
Agriculture science Geography
Oceanography Metrology
Marine Science

Engineering and Technology

Mechanical engineering Industrial engineering
Aerospace engineering Space System engineering
Electrical engineering Chemical engineering
Satellite Engineering Computer Science

Business and management

Economics Business and marketing

Law and Medicine

Law Medicine

Other knowledge areas please specify here :

Q2.13 Which elements does your program offer *(more than one option can be selected)* The students learn project management in the program.
The students take courses on academic skills development
The students have the opportunity to present their work in front of a larger audience
The students have the opportunity to develop their leadership
The students have the opportunities to work in culturally diverse teams
The students learn to be empathic future employees
There is an experimental lab time involved in the program
The program encourages group work
The program offers course/s on ethics (including ethics in Artificial Intelligence) The program stresses on the importance of sustainability in various domains such as the environment and society.

Q2.14 Please provide details on the focus of the PhD topics offered at the institute. And how are the topics initiated? For example, by the institute or via a collaboration with the industry or others

Please answer only for PhD program degree

D Section 3: Courses

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Q3.1 Please provide us with the link to the website or document (e.g. pdf. File) where the list of the courses, including their descriptions and learning outcomes, are described.

Please upload your file here

E Section 4: Additional Information and Submission

Q4.1 If you have any additional information/comments regarding the degree program or this survey, please add them here.

Please add another degree program:

- Yes, I want to add another degree program
- No, I want to submit the survey

Contact

Contact Form

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16. APPENDIX F – DATA A THON COMPETITION WINNERS AND THE UT TEAM

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