Aerospace Districts: Acceleration of the Strategic Transfer of Regional Advancements

Innovation inventory

D1.1 – Innovation inventory

Abstract:

During Task 1.1 the existing innovation ecosystems have been characterized for each region involved in the project, creating an innovation map for each region. In particular, the relevant stakeholders (public authorities, industry, RTOs, universities, investors, etc.) and their innovation and technical capabilities, as well as any already existing innovation programmes and policies, have been identified in each region. Then the already established inter- and intra-regional connections, and the relevant international connections, have been identified. Both for the identification of the capabilities and pre-existing networks and connections, an exhaustive screening of existing databases and directories has been performed. As task result, this deliverable has been created. It collects all the information gathered by the participants within a complete inventory of relevant innovation and technical capabilities, inter- and intra-regional connections, and established international connections.

Keywords:

Innovation, aerospace, international cooperation, innovation ecosystems, capabilities.

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Acronyms and Terminology

Term	Definition
AD-ASTRA	Aerospace Districts: Acceleration of the Strategic Transfer of Regional Advancements
AIAD	Federation Italian Companies for Aerospace, Defence and Security
AIDAA	Associazione italiana di aeronautica e astronautica
AIPAS	Association Of Italian Space Enterprises
AIT	Assembly, Integration and Test
ANITI	aerospace: artificial intelligence
ASAS	Association for Services, Applications and ICT Technologies for Space
ASD	European Aerospace, Security and Defence Industries
ASI	Italian Space Agency
ASTRE	Toulouse Space Association for Student Research
ATL	Airport Technology Lab
AZEA	Alliance for Zero Emission Aviation
BOIH	Bari Open Innovation Hub
CDTI	Centre for the Development of Industrial Technology
CERFACS	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique
CICLoPE	Center for International Cooperation in Long Pipe Experiments
CINES	National Computer Center for Higher Education
CMCC	Euro-Mediterranean Center on Climate Change
CNES	Centre National D'Etudes Spatiales
CNR	National Research Council
CTA	Cherenkov Telescope Array
CTNA	National Technological Cluster for Aerospace
CTNA	National Aerospace Technology Cluster
DLL	Drone Living Lab
DTA	Distretto Tecnologico Aerospaziale

DTA	Aerospace Technology Cluster
ECARE	European Clean Aviation Regional Ecosystem
EDA	European Defence Agency
EDIH	European Digital Innovation Hub
EGNOS	European Geostationary Navigation Overlay Service
ENAC	École Nationale de l'Aviation Civile
E-R	Emilia-Romagna
EREA	Association of European Research Establishments in Aeronautics
ESA	European Space Agency
ESAC	European Space Astronomy Centre
ESO	Southern Observatory
ESTEC	European Space Research and Technology Centre
GATB	Grottaglie Airport Test-Bed
GIS	Geographical Information Systems
GRC	Galileo Reference Center
HPC	High Performance Computers
I.R.T.	Technological Research Institute
IDR/UPM	Insituto de Microgravedad Ignacio Da Riva
INAF	National Institute of Astrophysics
INAF/OAS	Astrophysics and Space Science Observatory
INFN	National Institute for Nuclear Physics
INGV	National Institute of Geophysics and Vulcanology
INP-ENIT	École nationale d'Ingénieurs de Tarbes
INP-ENSEEIHT	École nationale supérieure d'électrotechnique, d'électronique, d'informatique, d'hydraulique et des télécommunications
INSA	Institut National des Sciences Appliquées de Toulouse
INTA	National Institute of Aerospace Technology
IQ	Innovation Quarter
IR4I	Innovation & Research for Industry Consortium

ISAE SUPAERO	Institut Supérieur de l'Aéronautique et de l'Espace
ITS	Istituto Tecnico Superiore
LiS	Leidse Instrument maker School
LST	Large-Sized Telescope
MRO	French provider of maintenance
MST	Medium-Sized Telescope
NEREUS	Network of European Regions Using Space Technologies
OMP	Observatoire Midi-Pyrénées
ONERA	Office National D'Etudes et de Recherches Aérospatiales
OPB	One Piece Barrel
PAE	Aerospace Technological Platform
PNRR	Recovery and Resilience Plan: Next Generation Italy
PTA	Aeronautical Technological Program
RHIA	Rotterdam The Hague Innovation Airport
RTHA	Rotterdam The Hague Airport
S3	Smart Specialisation Strategy
SAF	Sustainable Aviation Fuel
SAM	Smart Advanced Manufacturing
SIRIUS	Space Institute for Research on Innovative Uses of Satellites
SKAO	SKA Observatory
SME	Small and medium enterprises
SRON	Dutch national expertise institute for scientific space research
SSTS	Small-Sized Telescope
TEDAE	Association of Defense, Security, Aeronautics and Space Technology Companies
TEMAF	Laboratory of Material Technologies Faenza
TéSA	Cooperative research Laboratory in Telecommunications for Space and Aeronautics
TM	Toulouse Metropole
TU Delft	Technical University of Delft

UAM	Urban Air Mobility
UAH	University of ALcala
UAS	Unmanned Aero Systems
UC3M	Universidad Carlos III de Madrid
UIC2	Urban Air Mobility Initiative City Communities
UPM	Universidad Politecnica de Madrid
UPM	Universidad Politécnica de Madrid
WP	Work Package

1. Introduction to the project

AD-ASTRA (Aerospace Districts: Acceleration of the Strategic Transfer of Regional Advancements) is a project about the positive interconnection among innovation ecosystems, with a focus on aerospace sectors.

The project aims at the development of a connected, competitive, interregional innovation ecosystem between five European (EU) regions (Emilia-Romagna, Madrid, Occitania, Puglia and South Holland) with:

- a shared interest in fostering aerospace sectors, enhancing the cross-contamination to and from other innovative sectors (e.g., automotive, biomedical, agri-food, big data);
- different innovation readiness levels;
- aerospace districts with different levels of maturity and consolidation.

"Diversity generates wealth": the collaboration of these markedly diverse regions, furthermore represented by partners from different spheres of the Quadruple Helix, will be a growth opportunity. The establishment of a solid and long-lasting collaborative EU network, able to exploit complementary skills, experiences, territorial and industrial vocations, will contribute to create a "critical mass" in EU strategic sectors such as innovation and aerospace, where global competition leads to a confrontation with actors of increasing size and requires innovative models and approaches.

This ambitious goal will be achieved through an iterative process:

- Starting from the collection, analysis and systematization of the experiences (competencies, technologies, networks) of the partner regions with reference to their aerospace districts;
- Analyzing the future evolutions of the ecosystems, in response to technological, economic, political, and social megatrends;
- Correcting or validating hypotheses and evolution models with the support of stakeholder groups;
- Defining an action plan for the development of each of the regional aerospace ecosystems, valuing experiences and good practices stemming from other regions and strengthening spin-in and spin-out processes to and from other industrial sectors and territories.

In particular, the first step of this process is represented by the present deliverable D1.1 – Innovation Inventory. Indeed, within WP1 and in particular task 1.1 the partners worked together on the characterization of the already existing innovation ecosystems in the regions involved in the project. This activity is preparatory and necessary for the next steps of the project: having a deep knowledge of what is actually existing in each ecosystem is the first step to start exchanging such information and build up from this further advancements in each ecosystem in a coordinated and harmonic way.

1.1 Consortium

AD-ASTRA brings together five partners from five major EU regions (Emilia-Romagna, Madrid, Occitanie, Puglia and South Holland), with diversified experiences and expertises in the aerospace sector and in other related sectors.
In particular the partnership is composed by:

- ART-ER
- Universidad Politecnica de Madrid
- DTA – Distretto Tecnologico Aerospaziale
- Toulouse Metropole
- Innovation Quarter

2. Innovation inventory

This document corresponds to the report D1.1. Innovation inventory, which is the first deliverable of the first work package (WP1) of the AD-ASTRA project.

WP1 (Ecosystem network analysis) has the following objectives:

- Identification of the existing innovation capabilities and networks
- Analysis of the former successful connections
- Future regional development megatrends

This work package is organized in three tasks:

- T1.1 Innovation inventory creation (connections, technical and innovation capabilities)
- T1.2 Former successful interregional connections analysis
- T1.3 Future regional developments and megatrends

Associated to these three tasks, there are three deliverables:

- D1.1 Innovation inventory
- D1.2 Former successful connections and case studies
- D1.3 Megatrends and future developments analysis

The purpose of task T1.1. Innovation inventory creation, is to characterize the already existing innovation ecosystem in the regions involved in the project. In first place, it is needed to identify, in each region, the relevant stakeholders (public authorities, industry, RTOs, universities, investors, etc.) and their innovation and technical capabilities, as well as any already existing innovation programmes and policies. Once the innovation ecosystem map of each participating region has been outlined during the task evolution, then the already established inter- and intra-regional connections, and other relevant international connections, have been identified. Both for the identification of the capabilities and pre-existing networks and connections, an exhaustive screening of existing databases and directories has been performed. This activity has been complemented with dedicated internal meetings among the partners of the projects to discuss the rationale behind the selection and definition of each data collected, but also locally with meetings, interviews or questionnaires with local

stakeholders whenever deemed necessary for the completeness of the information collected. Finally, as task result, an inventory has been created, containing stakeholders' relevant innovation and technical capabilities of each region, already established inter- and intra-regional connections, and the established international connections.
The structure of the innovation inventory that has been prepared can be seen in Figure 1. Each participating region works locally on this kind of structure, collecting information to fill in each box in the most proper way.

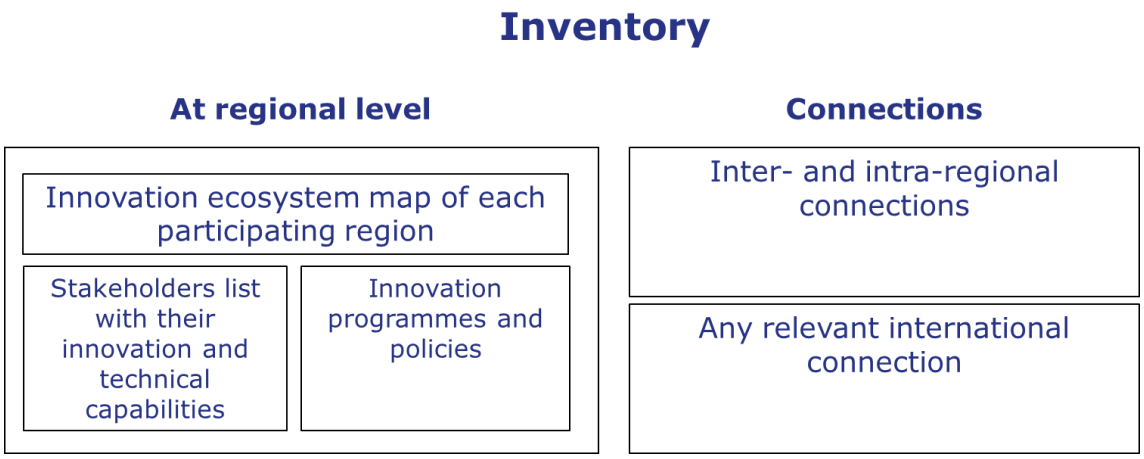

Figure 1. Innovation inventory structure

In the following sections of this report, the innovation ecosystem in each of the five regions of AD-ASTRA is described. At the end of the report, in an Annex, the detailed tables containing the innovation inventory for each report are included.
In particular, each chapter (from 3 to 7) is dedicated to each participating region. As detailed before, the rationale behind the collection of data coming from each ecosystem has been identified in agreement with all the partners, then each partner provided information on each ecosystem with the same rationale, but underlining different aspects, according to the specific characteristics of each ecosystem. Thus, information arising might be slightly different for each chapter, but with the common purpose of creating a common and extended knowledge of each ecosystem.

3. Emilia-Romagna

3.1 Introduction

Emilia-Romagna (E-R) is one of the 20 italian regions, located in the north-east side of the Nation. E-R Region's development model ensures both economic competitiveness and social cohesion and it has successfully pursued job creation as its top economic priority. Small and medium sized enterprises (SMEs) are the driving force of the economy (about 75% of the total regional employees) fostering an extraordinary spread of wealth across the entire regional territory. E-R is an Italian leading region in terms of per capita income, and for years now it has been classified as one of the richest regions in Europe (as outlined in data reported in the Figure 2).

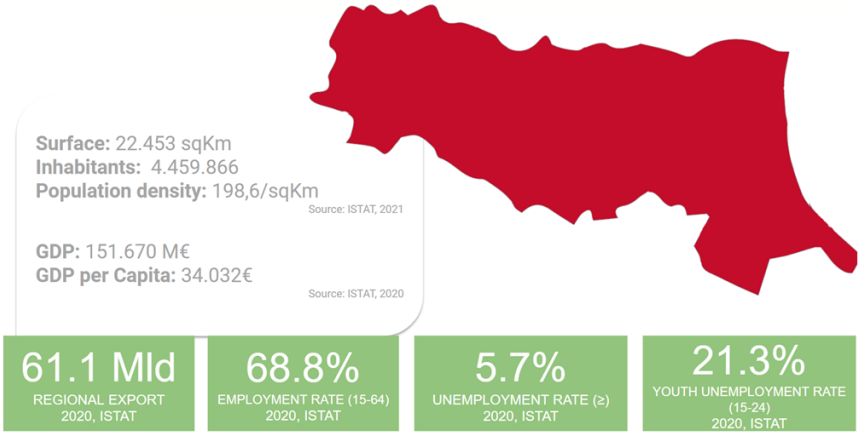

Figure 2. Economic characteristics of E-R region

Emilia-Romagna is a very competitive Italian region, due to an economic system that is increasingly active in international markets and featuring:

- a strong manufacturing sector: 26.9% of total employees (Eurostat, 2020)
- highest labour productivity in manufacturing sectors in Italy (2018)
- a willingness to innovate: 44.9k employees and 3.4 Bln of investment in Research and development (R&D) in 2019 (by Italian National Insitute os Statistics - Istat).

The Regional Innovation Scoreboard 2021 elaborated by the EU Commission[1] confirms the performance of the region as a "strong" European Innovator. Research expenditure in E-R, including both the public and private sector, is the second highest in Italy and has increased steadily over the last years, with 45 thousand employees

[1] https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/regional-innovation-scoreboard_en#regional-innovation-scoreboard-2021

(full-time equivalent) in the public and private research system (Istat, 2019). Research activity is carried out by universities and research centres as well as by a network of industrial research labs and dynamic companies, both corporates and small and medium caps. About 1.3 thousand innovative startups complete the picture.
Considering the aerospace sector, the region is moving in a complex and highly advanced national context, trying to reach a more developed position, thanks to the high-level competencies present in the region and mainly related to sectors complementary to the aerospace one (i.e. automotive, automation, HPC and Big Data, etc.).
Regarding the national situation, the aerospace economy is a sector of strategic interest for Italy and in which Italy holds a global leadership position, with a turnover of about EUR 13.5 billion and a direct workforce of over 50,000, it ranks 7th in the world and 4th in Europe by revenue generated, representing the largest manufacturing sector in Italy in the field of high-tech integrated systems. In this context, a prominent role is played by research and innovation, which may count on about 10% of its turnover, keeping within the European average.
The overall aerospace industry, can be divided into 2 main areas:

- SPACE: it includes research, development and deployment of enabling space upstream infrastructure (launch platforms, control centres, launchers, rockets, satellites and spacecraft) and all the downstream systems and services;
- AERONAUTIC: it includes the design, construction and assembly of structures and systems for the manufacture of aircraft for flight and transport (human or material) within the earth's atmosphere (e.g. civil and military aircraft, helicopters and drones, as well as the construction and management of airport infrastructure).

With reference to the Space activity, Figure 3 shows the value generated by each sector on a global[2] and Italian level[3].

[2] Bryce, 2020, "The2019 Space Economy at a Glance"
[3] Italian Data: Space Economy Observatory Politecnico di Milano, 2021

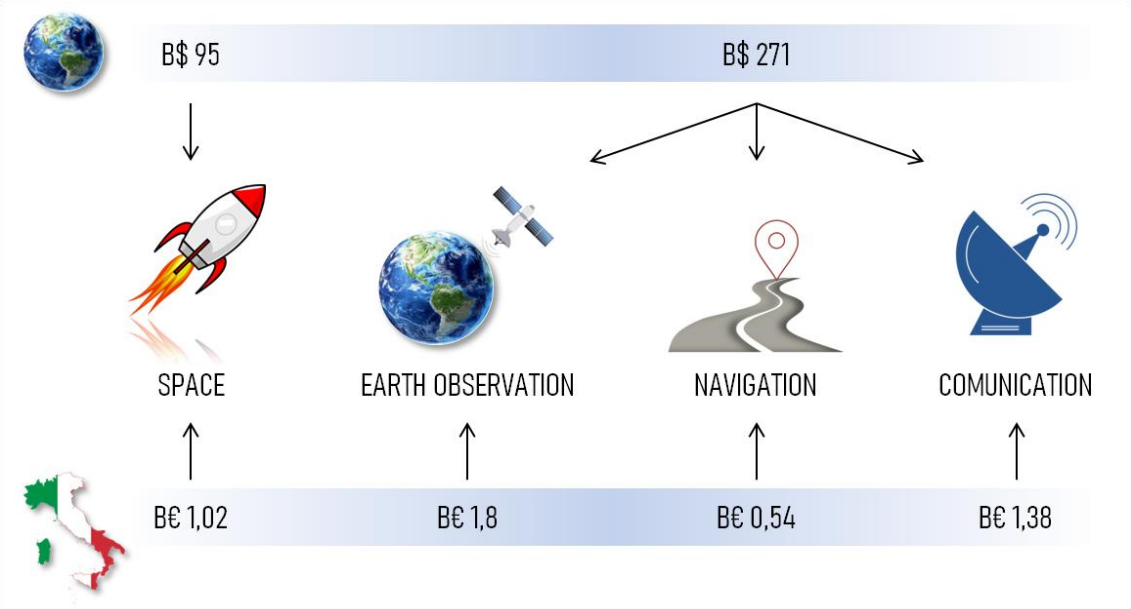

Figure 3. Value of space, earth observation, navigation and communication sectors on a global and Italian level

In general, the Italian ecosystem of Aerospace is very articulated and covers the whole value chain, both in the aeronautic and space areas, with big players well known from a global perspective, but also with a sub-system of hi-tech SMEs that are able to collaborate with big players around the world.
In particular in Italy there are three national industry associations: AIAD (Federation Italian Companies for Aerospace, Defence and Security), AIPAS (Association Of Italian Space Enterprises) and ASAS (Association for Services, Applications and ICT Technologies for Space); a series of Regional Districts in Aerospace, with different peculiarities for each region; a vast and articulated research system represented by Universities/Departments and Research Centres, but also private companies, with recognised peaks of excellence and unicum capabilities. Among all of these, there is a National Technological Cluster for Aerospace (CTNA), that is intended to gather all the national competences and capabilities (public and private) distributed in the whole country.
Currently, the aerospace sector represents one of the main priorities of the development smart specialisation strategy (S3) of the E-R region, with a fast growing profile. The sector has strong synergies and potential spill-overs with mechanical engineering and the automotive industry, which are positioned among the main production sectors in the region. Indeed, there are many companies in these sectors that are competitive in areas related to aerospace: helicopters, planes, drones, composite and advanced materials, fasteners, cubesats, nano-satellites and additive manufacturing.

3.2 Stakeholders

As mentioned above, the Aerospace sector is growing rapidly in the region, with an institutional effort of harmonising a sector that from the past has always been very fragmented. As a matter of fact, looking in detail at the stakeholders list based in the E-R region (Annex A1), it is possible to list about 176 players, divided into: 148 companies, 11 Consulting Societies, 9 Research Centres, 4 Universities, 2 Laboratories and 2 Training Institutions as reported as percentage in Figure 4.

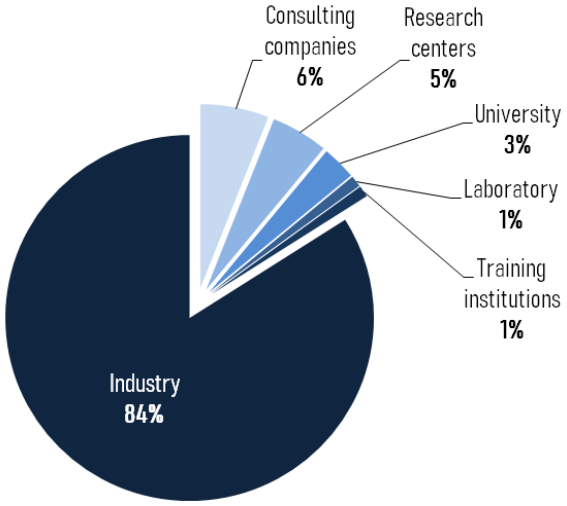

Figure 4. Composition of the aerospace ecosystem in Emilia-Romagna

The complete value chain of Aerospace is then active in the territory, from training to global companies in vertical application domains and to qualified research centres.
The companies are based in E-R, mainly in the provinces of Bologna and Modena, employing about 4500 employees and having a turnover of 1% of the regional GDP. Figure 5 gives more detailed information about this wide and complex scenario: about 29% of companies are active exclusively in the aviation sector, about 11% exclusively in the space sector while around 60% operate in both sectors. Going into details of the aeronautical sector: 11% deals with "Design & engineering" with particular interest for fixed-wing and rotary-wing aircraft; 60% deals with "Components production & testing", this refers to a wider set of applications, but with particular reference to the use of composite and metallic materials; 6% deals with "System & integration" with an increasing interest on the production of drones; 22% deals with "Post-sales services"; and only 1% deals with "Sales & operation", with reference to selling and hiring of helicopters or small aircrafts.

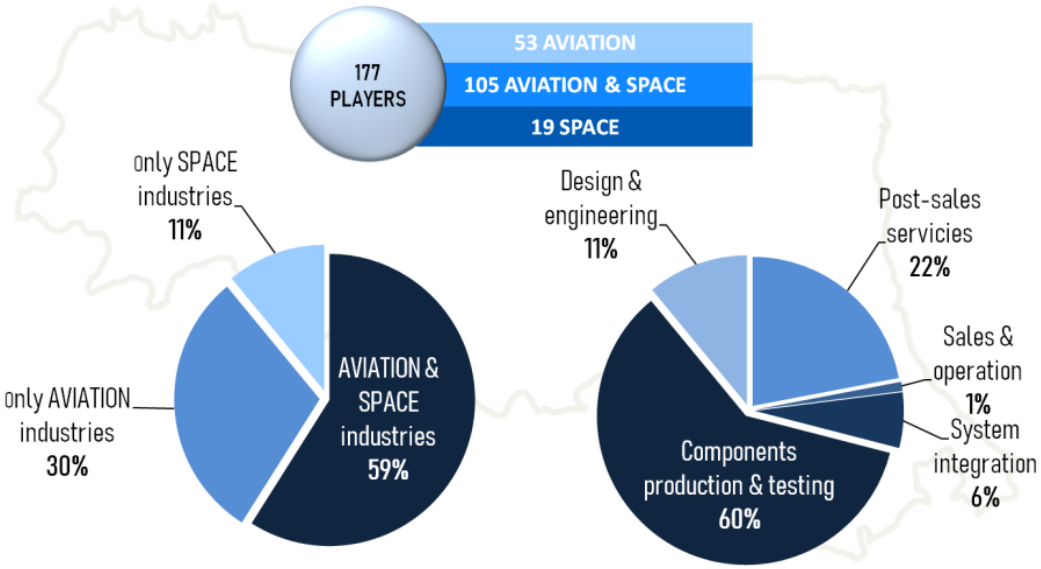

Figure 5. Companies distribution in E-R aerospace sector and their specific activities

With respect to the actual global trends, Figure 6 shows the most important insights of the aerospace sector for regional stakeholders. Looking more into detail at the percentage distribution of companies for the different trends, it can be seen that the highest value is that of "Climate Resilience & Neutrality" whose objective is reducing the weight of aircrafts to limit emissions through the use of advanced composite materials and 3D printing. With reference to the trend "Data from satellites & drones" there are 21% of companies that manage satellite data in order to make them available to the end users, mainly for added-value applications in precision agriculture, energy, smart city and Real-Estate-Insurance. In the region there are also companies active in "Advanced air mobility" dealing and providing innovative technologies mainly for the drone industry. The "Commercial space flight" accounts for 15% of the total and deals with different realities and in general with those companies that are starting to look at space as a potential destination and application of their technologies. In particular in the region there are companies (even Big Companies) dealing with: equipment for training in no-gravity conditions (sport & wellness), research on innovative food to be brought or produced in orbit to feed astronauts and future space tourists (space-food), materials for space application, telemedicine and new biomedical materials and drugs for space, etc. Growing trends in E-R are "In-Orbit servicing" and "Miniaturization of satellites" that, even less represented at the moment (3% and 4% respectively) are increasing significantly at a global scale and in the region (with many spin-offs or start-ups that are growing).

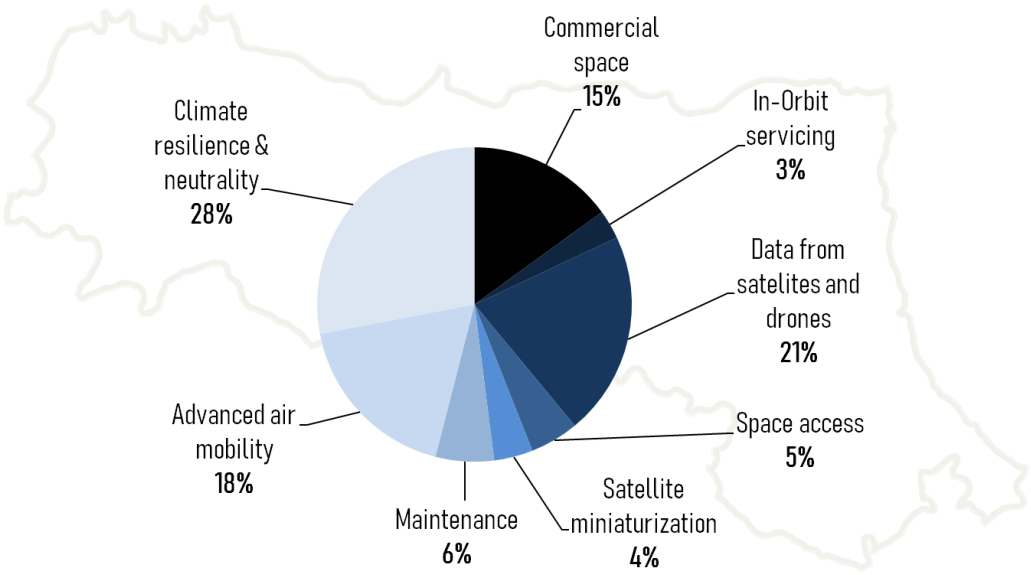

Figure 6. most important activities of the aeronautic sector of E-R region.

For the AD-ASTRA project, among the plethora of stakeholders of the regional territory, only the most significant and relevant have been selected and reported in Annex A1. In the following list a further selection of stakeholders coming from research and industrial fields are reported as an example.

Relevant Institutions:

- ***ART-ER Attractiveness Research Territory:*** is the Emilia-Romagna Joint Stock Consortium born with the purpose of fostering the region's sustainable growth by developing innovation and knowledge, attractiveness and internationalisation of the territory. It is now coordinating together with the Regional government the Strategic Forum for the promotion of the regional aerospace value chain (section 3.4) and it is also the coordinator of this HE project AD-ASTRA.

Universities and research institutes:

- ***Alma Mater Studiorum*** **– University of Bologna (UNIBO):** accommodates lots of departments (e.g., Departments of Industrial Engineering – Electrical, electronic and Information – Civil, Chemical and Materials Engineering – Computer Science – Physics and Astronomy – Chemistry, Biological, Geological and Environmental Sciences; Legal Studies; Interdepartmental Centres: CIRI (interdepartmental Centre for Industrial Research) Aerospace, CIRI ICT) that offer their support and expertise for several application fields on aerospace such as: *a)* aerodynamics and plasma: focused on the aerodynamic design of aeronautical and industrial components, the study of high Reynolds number turbulent flows and the applications related to cold atmospheric pressure plasmas for fluid dynamics control; *b)* mechanics of materials: focused on the development of innovative metallic, polymeric and composite materials, starting from the chemical

formulation up to the mechanical characterization of actual components; *c)* aeronautical design: focused on the development of advanced design techniques, such as multidisciplinary optimization and Time Compression, and their application in the fields of guidance, control and navigation, propulsion and human-machine interface; *d)* life science: focused on the geological and chemical characterization of extraterrestrial bodies and space environment with particular interest in organic and prebiotic molecules, the search for extraterrestrial life biosignatures and the study of the effects of space conditions on lifeforms; *e)* Space science and Universe observation: includes several areas of Space Science, Astrophysics and Cosmology, as well as the development, testing and use of detectors in space and for space-based activities; *f)* Astronautics, space systems and planetary exploration: this research area covers several topics concerning both the space and ground segments for satellite missions, such as navigation, attitude control, and mission control. The planetary exploration activities encompass mission analysis, ground control, radio tracking science experiments and deep space navigation, both based on traditional, large satellites and on CubeSat platforms; *g)* GNSS and Earth observation: this area covers all topics related to the remote sensing and GNSS technologies. All topics are useful for Earth Observation research and for monitoring and mapping the planet or parts of it. GNSS technology instead takes care of positioning both for monitoring and navigation aspects. GNSS signals can be suitable not only for positioning but also, using signal crossing the atmosphere continuously to perform analysis for the atmospheric studies (both of the upper layer or the lowest one); *h)* telecommunication systems: this area covers a broad spectrum of systems and techniques for space, satellite, non-terrestrial, and terrestrial wireless communication systems, covering the physical, medium access control, and network layers; i) Navigation and Air Law: this department offer curricula on Navigation, Air and Space Laws and the International Treaties which govern the sectors.

- **University of Modena and Reggio Emilia (UNIMORE):** accommodates lots of departments (e.g., Departments of Physical, Computer and Mathematical Sciences, Engineering, Engineering Sciences, Methods and Law) whose activities are strongly linked with aerospace sector such as: artificial intelligence, electric vehicles, electronics engineering for intelligent vehicles, materials informatics and study of aviation laws related to aspects of private and public laws and its multiple dimensions. Moreover, starting from 2019, UNIMORE devotes part of its resources to the Project RED whose aim is to design and build a prototype rover for extraterrestrial exploration with which to compete in the European Rover Challenge. Recently there is also an activity, connected with UniMoRe, related to space food, with experiments developed by university students within the framework of the laboratory G-Astronomica.

- **University of Ferrara**: accommodates lots of departments (e.g., Department of Engineering, Department of Physics and Earth Sciences, Department of Translational Medicine and for Romagna, Department of Mathematics, Informatics, Methods and Law) whose activities are strongly linked with air navigation laws and the aerospace sector. Specifically, in recent years UNIFE has devoted part of its resources to EU and national projects such as MASCOT (its aim is to set up a three-level-parameter cost estimation method that allows the determination of the final cost for the fuselage design under analysis. The tree structure of the procedure allows a quick, easy and friendly-user inclusion of the main parameters determining the final cost of a fuselage both at the raw material level and at the component level and the fuselage level) and GLITTERY (Germanium anode lithium Ion battery – its aim is the development of advanced Li-ion batteries with nanoporous germanium anode characterized by enhanced performances with respect to existing ones both in terms of the amount of charge accumulated and the number of charge and discharge cycles). At UniFe there are also strong competencies in the field of X-Ray diffraction with the big infrastructure LARIX[4], funded by ASI, for application on the lens technology (Laue lens) for space applications (in particular for satellites application). Other important competencies of UniFe are related more to Commercial Spaceflight application in the field of Health, in particular with the projects Drain Brain and Drain Brain 2.0, that have been (and will be) tested within the ISS to measure blood flow from the brain, to help researchers understand which physical processes in the body can compensate for the lack of gravity to ensure blood flows properly.
- **University of Parma**: accommodates lots of departments (e.g., Department of Engineering and Architecture, Department of Mathematical, Physical and Computer Sciences, Technical Physics, Satellite telecommunications) whose activities are strongly linked with the aerospace sector. Specifically, in recent years the Department of Technical Physics obtained approval for funding from the European Space Agency (ESA) for the Topdess project. The project aims to investigate the application and assembly of two technologies: Pulsating Heat Pipes (PHP), i.e., micro-heat exchangers required for thermal regulation (conductors that allow heat to be dissipated very efficiently in any device), and deployable systems, foldable devices used for their practicality as they are easy to transport. Moreover, UNIPR participated in Cygnus NG-17's journey to the International Space Station to study the physics of foams and emulsions in weightlessness.
- **ENEA**: is an Italian public research organisation that works in the fields of energy, the environment and new technologies to support competitiveness and sustainable development policies. It is present in Faenza with the Laboratory of

[4] http://fst.unife.it/it/ricerca/aree-di-ricerca-1/astrofisica/attivita-sperimentale

Material Technologies Faenza (TEMAF), with competences on ceramics and composites material also for applications in the aerospace sector.

- **National Institute of Astrophysics (INAF)**: is Italy's leading public research organization for astronomy and astrophysics. It is present in the region with the Astronomical Observatory of Medicina-Bologna, with the Observatory of Astrophysics and Space Sciences (OAS) of Bologna, involved in various scientific missions (Planck, Gaia, …) and with the Institute of Radio Astronomy (IRA). INAF Bologna is one of the main center in Italy and internationally for competences on Space observation. In the center there very strong competencies in particular for infra-red mirrors for space observation and characterization and on cryogenic technologies.
- **National Research Council (CNR)**: it is Italy's leading public research organisation. Various institutes are involved in the region, including IMEM (Institute of Materials for Electronics and Magnetism) with activity on microgravity testing for material science, ISTEC (Institute of Science and Technology of Ceramic Materials) with strong competences on high performance ceramic materials for aerospace applications, IMAA (Institute of Methodologies for Environmental Analysis), ISAC (Institute of Atmospheric Sciences and Climate), ISOF (Institute for Organic Synthesis and Photoreactivity) involved in the Graphene flagship, with application also in the aerospace sector.
- **National Institute for Nuclear Physics (INFN)**: is present in the region with the Bologna, Modena and CNAF sections (AMS2, Euclid, LiteBird missions).
- **Euro-Mediterranean Center on Climate Change (CMCC)**: is a scientific research facility that operates in the field of climate science and aims to deepen our knowledge of climate variability, its causes and consequences, through the development of high-resolution simulations with global models of the Earth system and with regional models, with a focus on the Mediterranean area. It is present in the region with an office that deals mainly with Climate Simulation and Predictions, Ocean modeling and Data Assimilation, Ocean Predictions and Applications.
- **National Institute of Geophysics and Vulcanology (INGV)**: is an independent organization working under the supervision of the Italian Ministry of Education, University and Research (MIUR). It is present in the region with various laboratories, among which the Centre for Earth Space Observations (COS) is of particular note in relation to Space Observation for monitoring, surveillance, and services.

Private companies:

- ***Earth Observation:*** deals with the observation (mainly done by satellites) and the modeling of different processes on the Earth surface and their interaction with the atmosphere by obtaining quantitative measurements and estimations of

geo-bio-physical variables and permit to detect extremes changes and anomalies.

Table 1. Stakeholders from "Earth Observation" sector

Name	Description
GECOsistema	Is a specialist environmental consulting engineering and research company providing advanced consulting, scientific research, innovation, product developments, data science and modeling services in the fields of environmental, climate risk and geospatial intelligence. GECOsistema operates at both global, national and local levels in collaboration with highly qualified partners. They combine advanced data science and machine learning, environmental modelling, GIS and Geospatial Analysis tools, remote sensing, predictive analytics, to provide critical insight about environmental, climate and geospatial issues.
STUDIO MAPP	The company commits to accelerate the transition to a sustainable and safer future on Earth by providing information superiority to tackle climate, environmental and security challenges. It combine science, geospatial data and artificial intelligence to empower organizations to make the best-informed decisions so as to have a positive impact on the world.
MEEO	MEEO activities aim at facilitating geospatial data access with focus on satellite-based products. Since 2006, MEEO is a consolidated partner of the European Space Agency and provides services to public and private entities. In 2009, SISTEMA GmbH was founded in Vienna (Austria), to enforce the Research and Development activities and to enlarge the market to Central and Eastern Europe.

- ***Satellites, in orbit systems:*** is a wide sector which deal with communication relay, weather forecasting, navigation (GPS), broadcasting, scientific research, and Earth observation from the Upstream point of view. In this category companies involved in the satellites industry (including components and sub-systems) are collected.

Table 2. Stakeholders from "Satellites, in orbit systems" sector

Name	Description
Highftech Engineering	The company is mainly involved in mechanical design, structural/thermal analysis, manufacturing, testing and integration of mechanical system or subsystem for: Space Station Structure; Landing Module; Scientific payload for Space Station (ISS); Facility for Space Station (ISS) MGSE. HFT offers to large aerospace companies (Airbus, Thales Alenia Space, Leonardo, OHB, and Ruag) the developing of complex subsystems for space structures programs.

NPC SPACEMIND	The company provides nanosatellite platforms and ground equipment for civil and defense applications. Their mission focuses to become a leader in nanosatellite platform procurement and space-related applications offering complete package solutions thanks to specially designed facilities such as cleanroom for satellite integration and a lab complaint to the ECSS standards. They operate also in the ground equipment business sector by designing and producing a class of tracking mounts for telescopes for electro-optical applications and SSA.
Cshark	It is a leading provider for IoT devices management and machine-to-machine satellite communication fully integrated into PONGO®, a unique software in the market. They developed any subsystem of PILOT-1®, a miniaturized picosatellite, launching the first test in Jan 2022. The ground infrastructure have been made also internally and they produced an innovative gateway for the data gathering of the IoT devices and the transmission to the control room. The two products, both patented, are the basics of the service that they are implementing. They propose to the market the use of the bandwidth for machine-to-machine communications available with the satellite constellation that will be launched in the next two years and the expertise for the implementation of IoT devices on ground and satellite connections.
SITAEL	SITAEL space activities are vertically integrated to cover the Design, Development and Production of Small Satellites, Advanced Electric and Chemical Propulsion Systems, Earth Observation and Science Payloads, Platform and Payload Avionics from equipment down to complex component level. Sitael is a national company with several operational sites, one of these is in the region.
Adaptronics	Adaptronics is a startup that provides solutions for sensorized gripper end-effectors, robotic grasping and handling of objects, based on thin-layer electroactive technologies and soft-robotic mechanisms with capacitive sensors for proximity, contact and contact force embedded, for Space logistics applications, Agritech, Industry; and Flexible electronics.
Nautilus – Navigation in Space	The company is specialized in deep space applications. In particular Nautilus provides deep space services and infrastructures to enable world's transition from terrestrial to interplanetary markets, in order to start having deep-space missions to be fully managed and performed by private enterprises.
DTM	The company is a specialised high performance-engineering group offering mechanical design and analysis (structural, thermal, CFD) capabilities as well as testing and integration facilities. The main areas of development for aerospace sector are: design, integration and testing of mechanical and fluidic systems for flight hardware/structures and mechanical/fluidic ground support equipments (M-GSE, F-GSE).

HYPERTEC SOLUTION	The company, active since 2000, is an innovative engineering SME in mechanical design and mechatronics with crucial competencies in these sectors: Aerospace and Aeronautics, Machine tools and automation, Automotive/Motorsport, Virtual Commissioning, Oil & Gas/Soil Drilling. They can design complex systems for space missions and components to be installed on orbiting stations and structural parts for satellites.

- ***Drones***: are aircraft without a pilot on board, controlled from a ground station and capable of highly automated missions. Created several years ago for military applications, they are now also gaining a foothold in the civil sector, combining the background of dynamic modeling with new professional applications. Particularly relevant are now the uses in the production of photos and videos from unusual (or otherwise unreachable) observation points for applications ranging from photogrammetry to precision agriculture, to video filming of events or cultural promotion.

Table 3. Stakeholders from "Drones" sector

Name	Description
Zephyr	Zephyr was born as a spin-off of the University of Bologna in 2006, when the Flight Mechanics Laboratory stood out for being at the forefront in the field of highly automated aerial vehicles. At a time when the word 'drone' was still unknown to many, the team of professors and researchers that makes up Zephyr today was already developing aerial systems and ground stations for scientific institutes and research organisations.
CURTI	CURTI is a leader in the supply of aeronautical systems and services, thanks to recognized reliability and high-quality levels. The mastery ability to optimize processes combined with specific skills for these processes and the related non-destructive tests have allowed Curti to move from a traditional third-party account to co-engineering activities. They participate and proactively supports the design of machines and complex systems for all its customers, using advanced design software such as CREAO, CATIA, PRO-E, and others.
L3HARRIS	L3HARRIS is a big multi-national company dealing with many application within the Defense and Aerospace industry. In the region the company (former Calzoni) has solid experience in the development and production of Maritime Unmanned and Autonomous vehicles and systems, applied also to Aerospace and Defence systems, handling systems for submarines and surface ships, and docking aids and autonomous robotic naval vehicles.

- ***Materials for aerospace***: relates mainly to the lightweight design which consists in using less material with lower density while ensuring the same or enhanced technical performance. A typical approach to achieve lightweight design for aerospace components is to apply advanced lightweight materials on

numerically optimized structures, which can be fabricated with appropriate manufacturing methods.

Table 4. Stakeholders from "Materials for aerospace " sector

Name	Description
DALLARA	The company was founded in 1972 and operates in the automotive and aerospace & defense sectors. It has three distinctive capabilities: design, production & integration (using carbon fiber composite materials), and aerodynamics and vehicle dynamics (simulation and testing). The company also has opened a Dallara Advances Research Center (DARC) on thermoplastic composite materials, pooling skills and expertise.
BERCELLA	Bercella's core is first and foremost represented by Composite Materials. Carbon Fiber, Fiberglass, Kevlar, Zylon, Quartz, PrePregs, Honeycomb, Nomex, Rohacell, Epoxy resins, Cyanoesters resins and Structural Adhesives are a daily occurrence at Bercella. Composites manufacturing represents their origins and what they have been doing for the past 25 years.
NANOPROM	The company is a pioneer in the research and industrial applications of nanomaterials able to design funcionalized coatings to specific customer needs.
BEAMIT	Is one the most integrated and advanced additive manufacturing service providers in the world to serve the most demanding industries. Based in Fornovo di Taro (Parma, Italy), BEAMIT has been operating in the field of additive manufacturing with metal powders for nearly 25 years.

- ***Components***: this sector covers a wide list of elements characterized by complex and intricate metrics that need to be extremely precise to make them function correctly.

Table 5. Stakeholders from "Components" sector

Name	Description
POGGIPOLINI	Founded in 1950 in Bologna, Italy, POGGPOLINI is a leading company specializing in the design, engineering, and high precision manufacturing of critical and standard fasteners and precision components, for aero-engine, transmission, landing gear, and aerostructure applications. They provide highly innovative technical solutions from weight reduction to complex assembly, from additive manufacturing to the Internet of Fasteners.

WamBlee	The company design and manufacture radio equipment in the maritime and aeronautical sector such as EPIRB, ELT, MSLD (MOB), Radio Buoys HF and satellite for surveillance and professional fishing. Over the years the company has promoted its own registered brand and has expanded its network of distributors and direct customers worldwide
MW.FEP	The company provide state-of-the-art technology solutions: from the design and production of high-tech electronic equipment, to after-sales.
Pradelli	The company is specialized in precision machining for special applications, on the track, in orbit, in the sky and in water.
Novac	It is a startup dealing with energy storage system based on supercapacitors for electric vehicles/aircrafts that does not occupy space because it can be shaped directly into the structure of the vehicle/aircraft itself. Unlike most of the other energy storage systems the product is made of safe and affordable materials.
Motridal	It is an Italian company based in Piacenza Italy. It is divided into two clear departments, that of Bulk Material Handling and the Drilling and Augers division, which specialises in the production of metal spirals and augers over the last 40 years. In 2015 Motridal Middle East LLc. was established for support to clients of the MENA region and in 2017 a new sister company, Motridal America Inc., with offices and manufacturing facilities in Houston, Texas, U.S.A was founded to enhance the growing presence of the Company in the Americas region.

3.3 Capabilities

In the E-R Region there is a variety of prominent capabilities in the aerospace sector, due the the widespread network of stakeholders, which is characteristic of the territory, fragmented, but also dense of excellences coming from the public or private areas. Among these, some distinctive features related to the aerospace sector are reported below.

Technical & Innovation Capabilities:

- **Tecnopolo Manifattura - Data Valley Hub**[5] – Figure 7: it is located in Bologna and hosts some of the most powerful High Performance Computers (HPC) in the world (i.e. pre-exascale HPC Leonardo). This makes this infrastructure an international reference for Supercomputing, Big Data, and Artificial Intelligence covering 80% of Italian computing power and 20 % of European computing power. Actually, Leonardo, which will play a key role in many applications related to

[5] https://www.tecnopolomanifattura.it/

aerospace, including meteorology and earth observation, was classified as the fourth supercomputer most powerful in the world (Top 500 ranking).

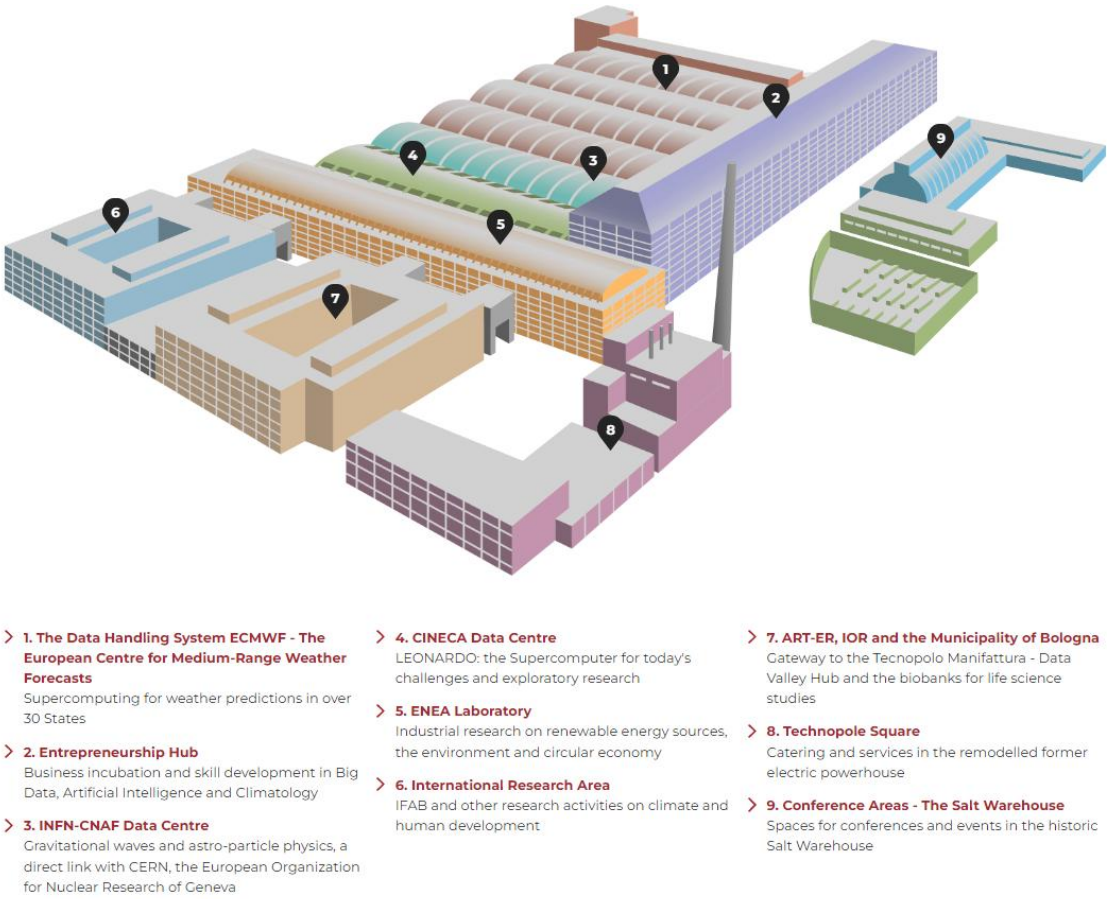

Figure 7. Image of the Tecnopolo Manifattura - Data Valley Hub[6]

- **Center for International Cooperation in Long Pipe Experiments (CICLoPE)** – Figure 8: it is a research infrastructure of the Alma Mater Studiorum - University of Bologna for the study of aerodynamics and fluid dynamics phenomena. It allows the worldwide best space and time-resolved measurements in turbulent pipe flows. This wind tunnel is located inside the 'Ex Industrie Caproni' tunnels, with constant environmental characteristics and a complete absence of external disturbances; it allows experiments to be carried out with extremely high measurement accuracy. The wind tunnel has a test chamber consisting of a circular tube with mirrored walls 110 metres long with a diameter of 1 metre, inside of which the boundary layer is formed (i.e., 50 cm thick). In the large tube, made of carbon fibre, air is passed through at high speed in a controlled

[6] https://www.tecnopolomanifattura.it/en/map

environment free of external disturbances, to recreate the conditions found in nature.

Figure 8. Images of the wind tunnel and infrastructures of CICLoPE[7]

- **SKA Observatory** (SKAO) – Figure 9: is a radio astronomy infrastructure that includes two radio telescopes, under construction, situated in South Africa (SKA-MID) and in Australia (SKA-LOW). Nowadays, it could be defined as a next-generation radio astronomy-driven Big Data facility that will revolutionise our understanding of the Universe and the laws of fundamental physics. The SKA, a global project with thirteen member states (Australia, Canada, China, India, Italy, New Zealand, South Africa, Sweden, The Netherlands, United Kingdom, Spain, France and Germany), aims to answer some fundamental questions concerning the origin and evolution of the Universe. One of the SKA Regional Centre is going to be located in Bologna, under the coordination of the National Institute of Astrophysics (INAF).

Figure 9. SKA infrastructures that will be realised in South Africa (SKA-MID) and in Australia (SKA-LOW)[8]

[7] https://site.unibo.it/ciclope/en
[8] https://www.skao.int/

- **Cherenkov Telescope Array** (CTA) – Figure 10: is a large-scale global project to build a new generation of Cherenkov telescopes dedicated to the study of the Universe in very high-energy gamma-ray. It will be the largest, most sensitive and most advanced instrument ever built for gamma-ray astronomy and moreover, the first ground-based observatory of its kind open to the world-wide astronomical and particle physics community. The observatory will be located on two sites, each in a hemisphere: on the island of La Palma (Spain), at the Observatorio del Roque de los Muchachos, of the Instituto de Astrofísica de Canarias (IAC) and in the Atacama Desert (Chile), at the Paranal Observatory of the European Southern Observatory (ESO). CTA will host three types of telescopes: Large-Sized Telescopes (LSTs), Medium-Sized Telescopes (MSTs) and Small-Sized Telescopes (SSTs) to cover a wide range of gamma radiation. Overall, CTA will have unprecedented accuracy and will be 10 times more sensitive than existing instruments. The headquarter of CTA is located in Bologna, hosted by INAF.

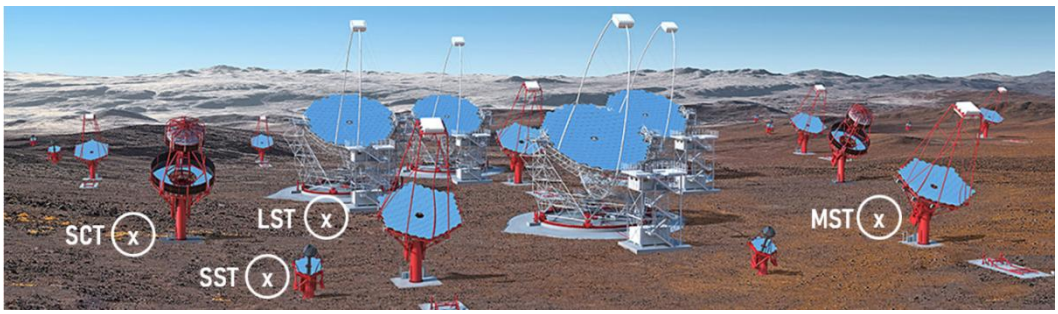

Figure 10. CTA infrastructure composed by different types of telescopes[9].

- **Astrophysics and Space Science Observatory** (INAF/OAS - Bologna)- Figure 11: OAS researchers use large ground- and space-based telescopes that operate across the entire electromagnetic spectrum to study astrophysical problems ranging from the evolution of the Universe to the observation of quasars, black holes and galaxies, to stellar evolution and - using the Loiano telescope near Bologna - the search for space debris.

[9] https://www.cta-observatory.org/

Figure 11. Loiano astronomical park[10].

- **LARIX Facility** (UNIFE, INAF, ASI - Ferrara): The LARIX is a multi-project facility designed to meet requirements that span data engineering, X-ray diagnostics, detector calibration, crystallography test and mainly for astronomical applications. Three main research groups work together in the facility: the Medical Physics group, the Archeometry section and the High Energy Astrophysics (HEA) group. In particular, most of the activity of the HEA group is devoted to the development and test of the X and Gamma-ray astronomy instrumentation. All the structures present in the laboratories are supported by the Physics and Earth Science Department of the Ferrara University, the Istituto Nazionale di Fisica Nucleare (INFN) and the Italian Space Agency (ASI).

Business Innovation Capabilities:

- **Primo Space Fund**: is the first national venture capital fund, one of the few in the world, specializing in the space industry. The aim of this fund is to invest in those solutions constituting the space infrastructure, the ground applications enabled by space technologies and those technologies enabling the space industry as a whole. This fund is not directly located in the region, but it is looking with interest at the growing regional aerospace ecosystem.

3.4 Programmes and Policies

The Space Economy is the value chain that, starting from the research, development and implementation of enabling space infrastructures, leads to the generation of innovative 'enabled' products and services (telecommunication, navigation and positioning services, environmental monitoring, weather forecasting, etc.). It represents one of the most promising development trajectories for the world economy in the coming decades. In this context, Italy has a long tradition in space activities: among the first nations in the world to launch and operate satellites in orbit, it is one of the founding members of the European Space Agency, of which it is now

[10] https://www.oas.inaf.it/en/

the third largest contributor. In this wide context, E-R region has become increasingly interested in aerospace-related activities and, as a result, at the end of 2021 the **"Strategic Forum for the promotion of the regional aerospace value chain"** has been conceived and launched by the regional authority with the aim to improve the collaboration among the institutions, the universities, the specialized research centres and the most representative companies located in the region. The Forum activated specific working groups with the involvement of experts, as well as the Italian Air Force, the Italian Space Agency (ASI) and the National Aerospace Technology Cluster (CTNA). In addition, in May 2021 an agreement between the Region, the Ministry of Defence and the Italian Air Force was also signed with the aim to facilitate the participation of E-R ecosystem (companies, universities and research centres) in the uptake of the growing Commercial Spaceflight, that is particularly relevant in the US, and in the Houston area.

To support the growth and the development of this sector, in the last years E-R has defined and supported several regional and national programmes, including:

- Regional **Intelligent Specialisation Strategy 2021-2027 (S3)**: it represents for the E-R region an extraordinary opportunity to outline the new strategic framework for innovative development and to strengthen the set of intervention tools through integrated and coordinated actions capable of directing regional policies for research and innovation, in order to meet the major challenges that the system faces and seize the opportunities associated with them, involving in an increasingly widespread involvement of the enterprise system and, in particular, of small enterprises. The new strategic development framework must be linked to the principles of ecological sustainability, understood as an essential objective and requirement for the economy of the future[11]. In particular, in the E-R S3 strategy, aerospace is explicitly reported as a sector with high growth potential.
- **EXPERIMENTAL R&D PROJECTS for enterprises**: the aim of this Regional Programme is to support a revitalization process that combines quality of work, increased productivity and added value, technological, environmental and social innovation, attractiveness and international openness. Thus, it helps the regional system on its path towards green transition and digital transformation, helping to reduce economic, social, gender, generational and territorial inequalities[12]. This is not fully devoted to aerospace but, according to the regional S3, the topic is included.
- **EXPERIMENTAL R&D PROJECTS for Laboratories**: this call supports collaborative strategic industrial research projects led by subjects accredited to the High Technology Network, in close collaboration with companies interested in the

[11] https://fesr.regione.emilia-romagna.it/s3/2021-2027

[12] https://fesr.regione.emilia-romagna.it/opportunita/2022/progetti-di-ricerca-e-sviluppo-sperimentale

exploitation and industrialization of the project results[13]. Again is not fully devoted to aerospace but, according to the regional S3, the topic is included.

- **National Strategic Plan Space Economy:** it envisages a country investment of around 4.7 billion euro, of which about 50% will be covered by public resources, including national and regional ones, in addition to those ordinarily allocated to space policies. The Plan is divided into five programme lines, in line with the initiatives conducted at European level and with the aim of maximising their impact at national level: 1) Satellite telecommunications (Mirror GovSatCom), 2) Support for national participation in Galileo (Galileo Mirror), 3) Galileo PRS infrastructure, 4) Support to Copernicus (Mirror Copernicus) and 5) Space exploration and related technological developments[14]. The Region supported (also with dedicated funds) this national plan.
- **Recovery and Resilience Plan: Next Generation Italy (PNRR)**:this plan defines the strategic lines of action that will enable Italy to transform the national space sector into one of the driving forces behind the country's new growth. The Plan is also proposed as the first example of a plan implementing the National Strategy for Smart Specialisation, responding to the European Commission's request to programme structural funds on the basis of a single integrated strategy, from research to production[15].

3.5 Connections

The expression 'industrial ecosystem' indicates a set of subjects whose activities are integrated by close relations in a situation of synergy resulting in a constitution of an industrial reality endowed with the essential resources for its development. These actors may belong to the same production chain, even though they belong to different sectors, or they may be radically different *e.g.* public administration bodies, public or private research and training centres, private actors. The model is also well suited to industries that by their very nature require the contribution and influx of skills and instruments from numerous, individually distinct sectors. The aerospace industry has always been an example of a sector that needs the connection between different industries, disciplines and professions. Indeed, the aerospace sector is the precipitate research field of all the key-enabling technologies (micro/nanoelectronics, nanotechnology, photonics, advanced materials, industrial biotechnology and advanced manufacturing technologies). In the following, some examples of intra-, inter- and European connections are reported, considering those that, in some way, involve E-R stakeholders.

Intraregional Connections (E-R):

[13] https://fesr.regione.emilia-romagna.it/opportunita/2022/progetti-di-ricerca-industriale-rivolti-agli-ambiti-prioritari-della-strategia-di-specializzazione-intelligente-2023-2024
[14] https://www.mise.gov.it/it/impresa/competitivita-e-nuove-imprese/space-economy
[15] https://www.mef.gov.it/focus/Il-Piano-Nazionale-di-Ripresa-e-Resilienza-PNRR

- **Innovation & Research for Industry Consortium (IR4I)**: it brings together 26 small and medium-sized companies of different types, but all with applications in the aerospace sector, with a total turnover of around EUR 500 million[16].
- **ANSER**: is a group of 23 companies providing "Made in Italy" integrated technologies & products for the aeronautics and aerospace sectors with a total turnover of EUR 800 million[17].
- **CLUST-ER MECH**: it works to introduce product and process innovations in E-R's leading industrial sectors, so that they develop towards a new generation manufacturing system, capable of strengthening its market position and increasing employment. This cluster is backed by the regional government[18].

Interregional Connections (Italy):

- **AIAD**: it is the Federation, member of Confindustria, representing Italian companies for Aerospace, Defence and Security. It includes almost all the national high-technology companies that carry out design, production, research and service activities in the civil and military aerospace, naval and military ground sectors and related electronic systems. The AIAD maintains close and constant relations with national, international and NATO bodies and institutions to promote, represent and guarantee the interests of the industry it represents[19].
- **AIPAS**: it is a non-profit association founded in 1998 with the aim of protecting the interests of Italian space SMEs. Since 2007, AIPAS has also given large companies the opportunity to participate in the association's life, becoming an example of good cooperation between SMEs and large companies for developing a favourable ecosystem for all companies in the sector regardless of their size. AIPAS associates are active in the main technology domains, including earth observation, navigation, telecommunications, space transportation, science and exploration, integrated applications, services, and ground segment[20].
- **ASAS**: it was set up in 2004 by some of the most significant companies in the space sector to valorise applications and services based on space technologies and the capacity they have to bring the potential of this sector from Space to Earth and to contribute to the country's technological innovation[21].

European Connections:

- **AD-ASTRA**: the present project, that aims to develop an inter-regional innovation ecosystem connected between five EU regions (Emilia-Romagna, Madrid, Occitania, Puglia and South Holland) with different levels of innovative performance but a common interest in fostering innovations in the aerospace

[16] http://www.ir4i.it/index.aspx?lng=eng
[17] https://www.anser-it.it/
[18] https://mech.clust-er.it/value-chain/fly-er/
[19] https://aiad.it/
[20] https://aipas.it/en/
[21] https://www.asaspazio.it/

sector. The overall objective of the project is to build an interconnected and inclusive innovation ecosystem across Europe, with a shared focus on the aerospace innovation sector and cross-contamination to and from other innovative sectors (*e.g.* automotive, biomedical, agri-food, big data)[22].

- **Network of European Regions Using Space Technologies** (**NEREUS**): it represents the interests of European regions that use space technologies whilst simultaneously highlighting the regional dimension of European space policy and programmes. The key mission of NEREUS, as a unique thematic network, is to explore the benefits of space technologies for European Regions and their citizens and promote the use of space and its applications[23].
- **PEGASUS**: is the partnership of the best European aerospace universities and currently has 30 members in 12 different European countries (including Universities of Bologna in E-R). Today more than 3000 aerospace engineers graduate at Master level from the member institutions of PEGASUS each year. The objective of PEGASUS is to offer highly relevant educational and research programmes and thereby attracting the best students and scientists[24].

[22] https://aerospacedistricts.eu/
[23] https://www.nereus-regions.eu/
[24] https://www.pegasus-europe.org/

4. Madrid

4.1 Introduction

The Community of Madrid (Comunidad Autónoma de Madrid) is one of the seventeen regions in which Spain is politically and administratively organized. It is uniprovincial and its capital, the city of Madrid, is also the capital of Spain. The population amounts to 6,751,251 inhabitants (INE 2021) and is mostly concentrated in the metropolitan area of Madrid.
It is the third autonomous community in population and the most densely populated with a central position in the transport network in Spain. In 2018, Madrid's GDP represented 19.2% of the national GDP.
Madrid is the autonomous community with the highest GDP per capita, with €35,041 (2018), clearly exceeding the European average (established at €30,960). In addition, it is the second autonomous community with the highest percentage of spending on R&D activities over GDP, with 1.66%. The Community of Madrid is the fourth autonomous community with the highest percentage of innovative companies with ten or more employees, with 21.2% of the total in the 2016-2018 period, above the national average. In 2021 it was distinguished by the European Committee of the Regions (CoR) with the European Entrepreneurial Region (REE) award in the 2021-22 edition.
Presently, Madrid concentrates some 25% of all aerospace companies in Spain, a figure that raises up to 90% if only the space sector is considered.

4.2 Stakeholders

Taking into account the research field of Madrid territory, there are six public universities and twelve private universities. Three of them, **Universidad Politécnica de Madrid** (UPM), **Universidad Carlos III de Madrid** (UC3M) and **Universidad Rey Juan Carlos I** offer *curricula* in aeronautics and space. **University of ALcala** (UAH) offers *curricula* in space sciences. Among these, UPM is the largest technical university in Spanish language. Moreover, regarding aerospace international cooperation, UPM is a founding member of PEGASUS, the European association of aeronautics and space universities.

Madrid hosts the largest public RTO in the aerospace sector in Spain, namely **National Institute of Aerospace Technology** (Instituto Nacional de Técnica Aeroespacial - **INTA**). It is a Public Research Organisation that depends on the Spanish Ministry of Defence. INTA is responsible for performing scientific research activities and prototypes in its field of knowledge, as well as for providing technological services to companies in the industry, universities and other institutions. INTA specializes dually in technological research and development in aerospace, aeronautics and hydrodinamics in security and defence technologies. Among the main tasks that INTA is responsible for, it is worth mentioning:

- the performance of various types of tests for checking and certifying materials, components, equipment, systems and subsystems;
- the provision of technical advice and services to official entities and organisations, as well as to industrial and technological based companies;
- its role as the technological centre for the Ministry of Defence.

Regarding the industrial field, one of the largest sites of **Airbus** is in the city of Getafe, in Madrid, where the different activities of this OEM are present (R&I, design, manufacturing and assembly) for commercial aircraft, military aircraft, space and defence. The region also hosts a wide range of companies in the supply chain of Airbus. As one of the company's three founding nations, Spain is home to major production facilities for commercial aircraft, helicopter, space and defence activities, not least final assembly lines for all Airbus Defence and Space military aircraft. The company has also established dedicated Research and Development Centres where projects at the leading edge of science and technology are researched.
Integrated in the global Airbus industrial set-up and feeding into the company's major aircraft, defence and space programmes, approximately 12,300 highly qualified employees work on design, development, manufacture and support of aircraft and major components across eight sites located in three of Spain's main regions (autonomous communities) of Madrid, Castile-La Mancha and Andalusia.
The company's site at Getafe, in Madrid, is Airbus' third largest site and where the national headquarters are located. It is also home to Campus Futura, an advanced and efficient location designed to encourage collaboration, diversity and new ways of working among employees.
Today Airbus is Spain's aerospace and defence champion, leading the bulk of Spain's national and cooperative aerospace and defence programmes. Driving the national industry, Airbus Spain spends approximately €2,200 million annually on the national supply chain, while generating exports worth more than €4.3 billion per year (60% of Spain's A&D exports) and providing a GDP contribution of €3.57 billion (2019 figures).
Airbus is the leading supplier of aircraft to the Spanish Air Force, the country's prime for national and ESA-led space programmes and, as the largest helicopter company and provider, supports our helicopters in operations with the National Police Force, the Guardia Civil and emergency services, helping to save lives on a daily basis.
Through more than 50 agreements with 8 different universities, Airbus Spain has provided a total of 453 scholarships in 2019, exceeding the record annual average of the 2,200 scholarships offered between 2017-2019. Airbus is also working to define a structure in the field of Vocational Training for the aerospace sector in Spain by leading the identification of future competencies, the development of training programmes and the implementation of Vocational Training degrees. This is a crucial aspect to foster the talent ecosystem in Spain.

The other large OEM, **Boeing**, with the Boeing Research & Technology-Europe (BR&T-Europe)is headquartered in Madrid, close to Adolfo Suárez Barajas Airport, and also has a fully integrated presence in the UK and Germany; it was the first research center that Boeing established outside the United States (in 2002). Its mission is to

collaborate with partners across Europe in the research and development of technologies to promote innovation, excellence and competitiveness in R&D in Europe. BR&T-Europe has about 70 employees, most of them engineers and scientists from all over Europe, and has become a major technology integrator in collaboration with universities, research centers, airlines and other industrial partners. BR&T-Europe focuses its activity in Madrid on model-based systems engineering, technological solutions for data management and development of services that improve the operational efficiency of airlines and solutions for the integration of unmanned aerial systems in non-segregated airspace.
The Spanish space sector is largely concentrated in Madrid, where in addition to Airbus, Thales Alenia Space is present, and also a number of Spanish leading companies like **GMV**, **Sener** and several others. In addition to this, the telecommunications satellite operator **Hispasat** is located in the area and also the **European Space Agency** is present, with one of its centres: the **European Space Astronomy Centre** (ESAC).

The Spanish branch of **Thales Alenia Space** is located in the Madrid region, and has over 33 years of experience in the design, manufacturing and delivery of innovative solutions for the space market. It has contributed to more than 600 satellites, space probes and space vehicles for all type of space missions spanning telecommunications, navigation, Earth observation, exploration of the Solar System and the Universe, for space agencies and satellite operators all over the world. With a strong commitment for innovation, Thales Alenia Space in Spain offers solutions throughout the satellite value chain: payloads, subsystems, equipment and ground segment systems. It has delivered over 4,000 equipments and subsystems that accumulate 200,000,000 hours of operations in orbit without failure. Thales Alenia Space has 2000 m^2 of clean rooms (ISO 8) with the capacity for the production of more than 250 equipment per year, including an optical detection laboratory (ISO 5) for the integration and test of optical observation systems. Since 2021 it has a 600 m^2 and 12.5 m free height satellite AIT clean room facility equipped for the assembly, integration and test of large satellite payloads and instruments.

European Space Astronomy Centre (ESAC), is the 'home' of ESA's space telescope and planetary missions, the place from where science operations are conducted, and where all of the scientific data produced are archived and made accessible to the world.

ESA-BIC Comunidad de Madrid is the Business Incubation Center of the European Space Agency (ESA) and the Community of Madrid. Coordinated by the madri+d Foundation, its objective is to support start-ups in the space sector or that develop innovative solutions based on space technologies for other sectors. ESA BIC Comunidad de Madrid is co-financed 50% by ESA and 50% by the Community of Madrid, through the Ministry of Education, Universities, Science and Spokesperson.

Centre for the Development of Industrial Technology (CDTI): is the public authority from the Spanish government and also from the regional government of Madrid.

Madrid+d Foundation: is an initiative of the Government of the Community of Madrid created in 2002 to manage the Regional Plan for Scientific Research and Technological Innovation. In 2014, it was designated as the competent body for the evaluation of the Madrid University System in order to guarantee the quality of the training programs of the universities in the region. In addition, it is committed to the dissemination of scientific knowledge, bringing scientific culture closer to society. The Foundation has been contributing to bringing scientific knowledge closer to society for 16 years, promoting scientific vocations among Madrid students without gender barriers, favouring the improvement of higher education in the Community of Madrid, promoting entrepreneurial culture of our region and transferring technology through specialized professional assistance to the research community and Madrid SMEs. Madri+d works with all the universities and public research organizations in the Community of Madrid, as well as with technology-based companies and entrepreneurs in Madrid, with the aim of helping to articulate an innovative regional ecosystem based on efficient knowledge and integrated into the European Union.
The main associations of companies and organisations of the Spanish aerospace sector are established in Madrid. In particular:
The **Association of Defense, Security, Aeronautics and Space Technology Companies (TEDAE)** that integrates Spanish technology industries with a presence in these three areas of activity. This non-profit Association was created in order to assume the representation and promotion of its Associates both nationally and internationally. The data for the last year available in 2021 reflect that this business bills 11,594 million euros, exports 47% of its products and services, contributes 1.4% to the GDP of Spain, generates 49,625 high-employment jobs. technical qualification and dedicates 10% of its turnover to R+D+i.
The **Aerospace Technological Platform (PAE)**: was established to be: a)a meeting forum on Spanish aerospace R+D+i: the more and better members, the more strength it will have. Collaboration in ideas, proposals and projects should come out of the meeting. b)a place to define a Strategic Agenda for Spanish Aerospace Research, c)a place of surveillance and technological foresight and d) a Spanish advisory body and presence in national and international forums for aerospace R+D+i.

4.3 Capabilities

In the area there are several prominent capabilities mainly related to the important private actors located in the region (Airbus, Thales Alenia Space, Boeing, etc.), but also to the leading Universities and Institutes. Among these, some distinctive features related to the aerospace sector are reported below:

- **INTA** (see previous section) has the capabilities to perform all kinds of tests for checking and certifying materials, components, equipment, systems and

subsystems. In particular, their aerospace testing facilities can perform: structural testing, electromagnetic compatibility, mass properties, mechanical and climatic tests, PIM, multipactor, corona, power handling tests, solar cells, coupon and photovoltaic panel tests services, electronic technologies, radiofrequency and Communication, Common/Transversal disciplines: materials & structures, aerodynamics & propulsion, metrology & calibration.

- **Airbus** has in Madrid all capabilities (R&I, design, manufacturing and assembly) for commercial aircraft, military aircraft, space and defence. Moreover, Spain is home to major production facilities for commercial aircraft, helicopter, space and defence activities, not least final assembly lines for all Airbus Defence and Space military aircraft. The company has also established dedicated Research and Development Centres where projects at the leading edge of science and technology are conducted.

- **Thales Alenia Space** has 2000 m^2 of clean rooms (ISO 8) with the capacity for the production of more than 250 equipment per year, including an optical detection laboratory (ISO 5) for the integration and test of optical observation systems. Since 2021 it has a 600 m^2 and 12.5 m free height satellite AIT clean room facility equipped for the assembly, integration and test of large satellite payloads and instruments.

- **Universidad Politecnica de Madrid** (**UPM**), the Insituto de Microgravedad Ignacio Da Riva (IDR/UPM) has a Concurrent Design Facility (CDF) and a complete laboratory of space environmental tests (thermal vacuum chamber, shakers, attitude and orbit control simulator, clean room).

From the point of view of innovation capabilities, **ESA BIC Comunidad de Madrid** is the Business Incubation Center of the European Space Agency (ESA) and the Community of Madrid. Coordinated by the madri+d Foundation, its objective is to support start-ups in the space sector or that develop innovative solutions based on space technologies for other sectors. ESA BIC Comunidad de Madrid is co-financed 50% by ESA and 50% by the Community of Madrid.

4.4 Programmes and Policies

The Spanish government has developed important programmes and policies to support and allow the development of the aeronautical sector. Among other, we report:

- **PERTE Aeroespacial** - The Recovery and Resilience Plan: Next Generation in Spain National funding programme, based on EU funds. PERTE will accompany the sector in the decarbonization of air transport, digitization of manufacturing

environments; aerospace R+D+I for new services and new technologies; It will promote and accompany new actors in the space field[25].

- **Aeronautical Technological Program (PTA)** aims to finance intensive strategic initiatives in R&D carried out by a group of companies, whose objective is to contribute to the development of relevant technologies for application in the aeronautical field. More specifically, the aim is to significantly reduce the environmental impact of aeronautical technologies, increasing the efficiency of future aircraft and reducing polluting emissions from air transport; without forgetting other strategic technological challenges such as systems, UAS or intelligent and advanced manufacturing. The PTA is included among the actions planned in the National Recovery, Transformation and Resilience Plan, which will receive financing from the "Next Generation EU" funds, including the Recovery and Resilience Mechanism[26].

- **Plan Estatal de Investigación**: national research programme in space, science oriented[27].

- **Plan Regional de Investigación científica e innovación tecnológica**: it is a regional research programme, open to different sectors.

4.5 Connections

In ANNEX A2, there are reported examples of intra-, inter- and European connections that involve the main actors in the region, in the nation (in particular with reference to the two associations TEDAE and PAE, which involve several organisations located in different regions in Spain) and at European level.
Here some of the main European connections are reported in details:

- **PEGASUS**: is an association of aeronautics and space universities that and currently has 30 members in 12 different European countries. Specifically, Universities from Madrid (UPM), Occitania (ISAE-Supaero, ENAC), Emilia-Romagna (UNIBO) and South Holland (TU Delft) are members of PEGASUS and are connected therefore by means of this association.

- **Erasmus +**: it is an Eu-Project to promote the mobility of University students and staff. The universities in the five regions of AD-ASTRA actively exchange students and staff by means of this mechanism.

[25] https://planderecuperacion.gob.es/como-acceder-a-los-fondos/pertes/perte-aeroespacial
[26] https://www.cdti.es/index.asp?MP=100&MS=924&MN=2
[27] https://www.aei.gob.es/convocatorias/planes-estatales

- **European Aeronautics Science Network** (EASN): it is an association of scientists and engineers in the space sector, that provides another means of connection among the five regions of AD-ASTRA.

- **Council of European Aerospace Societies** (CEAS): it comprises 16 European national aerospace societies (including France, Italy, The Netherlands and Spain), with roughly 35,000 individuals who are professionals in the aerospace industry.

- **Association of European Research Establishments in Aeronautics** (EREA): it includes INTA (Spain), ONERA (France), NLR (The Netherlands) and CIRA (Italy)

- **European Aerospace, Security and Defence Industries** (ASD): it is the voice of European Aerospace, Security and Defence Industries with direct members including 20 major European companies and 22 National Associations headquartered in 18 countries.

- **European Space Agency** (ESA): it has establishments in three of the regions of AD-ASTRA: Madrid, Occitania and South Holland and in Italy (even if not specifically in the 2 regions involved.

- **Airbus**: it has sites in Madrid and Toulouse, with respect to the AD-ASTRA project.

- **Thales Alenia Space:** it has sites in Madrid and Toulouse, with respect to the AD-ASTRA project, and in several locations in Italy.

5. Toulouse Métropole (Occitania)

5.1 Introduction

Occitanie is the second largest French region (in metropolitan area) and has more than 6 million inhabitants. The two largest cities are Toulouse and Montpellier. With a GDP of €169 billion, Occitanie has the fastest percentage growth in France and is the leading European developer and manufacturer of space systems and applications. It is also the only French region to spend more than 3% of its GDP on research and innovation.
Occitanie is a leader in aerospace in France and Europe, employing 90,000 people in the sector and having more than 800 suppliers and subcontractors. A quarter of the European aerospace workforce is located in Occitanie.
Occitanie offers a world-class academic and university environment; almost 2/3 of France's most prestigious engineering schools are located in Occitanie. The research and training potential is high, with 9,000 researchers and 19,000 students.
In the field of space, Occitanie offers a range of skills unique in Europe: satellite construction, science of the universe, defence and security, IT and data, ground segment, telecommunications and navigation, remote sensing, critical components, Earth observation, etc.
As the centre of the aeronautics industry, the Occitanie region offers a unique and fully integrated ecosystem. It is a world leader in civil aviation and the first leading French region for higher education and research in aeronautics. Occitanie is also a leading region in diversification with many sectors linked to aerospace: artificial intelligence (ANITI), 3D printing, electric aircraft, cybersecurity, IoT, hydrogen production and distribution. The ecosystem favours the location in Toulouse of companies that benefit from the technologies used in the space industry. In the health sector, for example, the use of imaging technologies from space contributes to the early detection of cancer thanks to a better quality of cellular imaging (ongoing projects between IRT Saint-Exupéry and the company Therapixel, and between IRT Saint-Exupéry and C.H.U. Toulouse - Hôpital Rangueil).

5.2 Stakeholders

Occitanie is home to three major aircraft manufacturers (**Airbus**, **ATR**, **Daher**) and three European prime space industries (**CNES**, **Airbus Defence and Space**, **Thales Alenia Space**). The annual turnover amounts to 10 billion euros (excluding Airbus).
In Toulouse, the space sector is based on research centres and laboratories: **Centre National D'Etudes Spatiales** (**CNES** - French Space Agency), **Office National D'Etudes et de Recherches Aérospatiales** (**ONERA**), **Technological Research Institute** (**I.R.T.**) of Saint Exupéry, **Observatoire Midi-Pyrénées** (**OMP**), **Cooperative research Laboratory in Telecommunications for Space and Aeronautics** (**TéSA**).

The region is home to two major industrial sites: **Thales Alenia Space**, **Airbus Defence and Space**, and a network of start-ups and SMEs in both infrastructures and space applications.
These players benefit from a melting pot of students trained in space, whether at the University of Toulouse or at five engineering schools:

- **Institut Supérieur de l'Aéronautique et de l'Espace** (ISAE SUPAERO)
- **Institut National des Sciences Appliquées de Toulouse**(INSA)
- **École nationale supérieure d'électrotechnique, d'électronique, d'informatique, d'hydraulique et des télécommunications** (INP-ENSEEIHT)
- **École nationale d'Ingénieurs de Tarbes** (INP-ENIT)
- **École Nationale de l'Aviation Civile** (ENAC)

That institutions offer more than 100 training courses in the aeronautical field each year. Toulouse also welcomes the chair of **Space Institute for Research on Innovative Uses of Satellites** (SIRIUS); this is a public-private partnership between three major players in the space sector (CNES, Airbus Defence and Space, and Thales Alenia Space) and two prestigious higher education institutions: **Toulouse University 1 Capitole** and **Toulouse Business School**.
To reinforce this innovation link from higher education to industry through research, the new Toulouse Aerospace district has been dedicated to technological innovation in aerospace and drones. Located in the southeast of Toulouse, where the pioneers of civil aeronautics took off, it benefits from an investment of around 1 billion euros. It is not only a place to live, work, culture and leisure, but also an activity and research centre with the innovation campus symbolised by the B612 building (named after the asteroid from which the Little Prince comes).
To reinforce the interest of professionals and the public in space in Toulouse, the Air and Space Academy or the Cité de l'espace, which has existed for more than 20 years on a surface of five hectares and attracts more than 6 million visitors, is Europe's leading place for the dissemination of the culture of space and astronomy to the public.
Toulouse is equipped with centres of expertise capable of making the most of space data in three major thematic areas:

- Meteorology and Climate, with Météo France, the official weather and climate service of France, and OMP, a group of laboratories ranked top in the Shanghai ranking.
- Geolocation, with ESSP, operator of the European Geostationary Navigation Overlay Service (EGNOS) for the European Union, which improves the accuracy and reliability of positioning across Europe for critical applications such as landing aircraft or navigating ships in narrow channels.
- Oceanography, with Mercator Ocean International, a French operator of ocean information services that develops global models for all the world's oceans that can describe the physical and biogeochemical state of the ocean at any point in time, both at the surface and at depth, on a global or regional scale (temperature, salinity, sea surface height, ice thickness, state of currents, nutrients).

Recently, the **Ministry of Arms** decided to establish its French Space Command in Toulouse. In parallel, Toulouse was chosen as the site for the **NATO space Centre of Excellence**.
Toulouse also hosts the **Aerospace Valley competitive cluster**. It brings together the regions of New Aquitaine and Occitanie to form Europe's leading employment pool in aerospace, drones and embedded systems. It brings together more than 800 members (companies, research laboratories, universities), organises more than 130 events per year and has already supported 580 R&T projects that enable companies to become leaders in France and internationally.
Finally, the **Galaxie Club** has been working on the development and promotion of the space sector for more than 20 years. Since its creation, the Club has participated in the development of a space ecosystem that fosters innovation, cross-sector synergies and entrepreneurship. It brings together around a hundred leaders from the Occitanie region, from large corporations, SMEs, start-ups and research institutions in the space sector to the various related services.

5.3 Capabilities

The space industry in Occitanie covers the entire value chain, from conception to integration, from infrastructure to applications and uses. The **Toulouse Space Center** is responsible for the preparation, development and operation of vehicles and orbital systems under the responsibility of CNES. Toulouse is also home to world leaders **Airbus Defence** and **Space and Thales Alenia Space**. Airbus is Europe's leading space company and the world's second largest space company. Thales Alenia Space develops and delivers high-technology solutions for telecommunications, navigation, Earth observation, environmental management, exploration, science and orbital infrastructures.
Numerous engineering companies are present in the environment of these leading companies. **Anywaves** manufactures a new generation of miniature and high-performance antennas designed to space standards to meet the requirements of the satellite constellation market. **VorteX-io** has developed hydrological micro-stations that guarantee centimeter-level accuracy of measured hydrological parameters. **ShareMySpace**, winner of the 2022 EDA Innovation Award, has developed a modular optical system that enables the detection, tracking and characterization of all space objects in sight in all orbits.
As for the use of Earth observation data, Toulouse has also seen the emergence of numerous companies developing applications based on Copernicus data in the fields of agriculture, climate, environment, etc. Several companies offer innovative space-based solutions, such as **CLS Group**, **Telespazio**, **Mercator Ocean** (Wekeo), **TerraNIS**, etc. **Gisaia** has developed the Arlas exploration tool, which filters and visualizes both historical and real-time space data and the distribution of views over time and space, as well as other numerical indicators. **MEOSS** provides operational decision support for managing and upgrading areas.

Toulouse also has a unique environment for high performance computing with test facilities and clean rooms with the **Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique** (**CERFACS**), **National Computer Center for Higher Education** (**CINES**), universities. Regarding Galileo, **GUIDE GNSS** is a test laboratory with ISO17025 accreditation based on the European standards EN 16803 that evaluates positioning systems in real environments or similar conditions.
The ecosystem also has a strong attraction for the major players in the New Space Economy. For example, **Exotrail** (space mobility solutions), **Loft Orbital** (cockpit/payload hub), **Infinite Orbits** (GEO life extension/space surveillance) or **Pangea Aerospace** have set up shop in Toulouse. Pangea Aerospace recently developed the first aerospike engine in Toulouse, using liquid methane and liquid oxygen as propellant.
The Occitanie region plays a prominent role in satellites of all sizes. Occitanie is also the region where the industrialization of small constellations began. The constellation of nanosatellites produced by Kinéis was developed in collaboration with strategic partners for the Internet of Things. Kineis has also developed a high-frequency chip that enables satellite connectivity to any cell phone. Toulouse is also home to the first assembly line for Oneweb satellites in an Airbus plant.
Occitanie offers a concentration of aeronautical industry players unique in Europe, covering the entire supply chain from the design to the disassembly of an aircraft.
The largest companies are based in Occitanie: **Airbus**, **Altran**, **ATR**, **Collins Aerospace**, **Daher**, **Honeywell Aerospace**, **Liebherr Aerospace**, **Nexeya**, **Safran**, **Thalès**, etc. Airbus offers the most comprehensive range of passenger aircraft from 100 to over 600 seats. Airbus is also a leading European supplier of tanker, fighter, transport and mission aircraft. In helicopters, Airbus offers the world's most efficient civil and military rotary-wing solutions. Liebherr Aerospace is developing a hydrogen fuel cell energy source to generate sufficient electrical power in the range of 400 kW to power all next-generation aircraft non-propulsion systems. To test and evaluate this solution in a representative environment, **Liebherr** recently installed a hydrogen test stand at its test centre. **Satys**, a company active in aircraft painting and sealing, engineering and manufacturing of interiors for the aerospace and railroad sectors, offers a unique training centre for painters. **Sabena Technics** is the leading independent French provider of maintenance (MRO) and modification services for civil and military aircraft operators.
With Occitanie set to become the testing ground for green aviation, several start-ups have set up shop in Occitanie: **Beyond Aero**, **Blue Spirit Aero** (Dragonfly), **Ascendance Flight Technologies** (Atea), **Aura Aéro**, **H3 Dynamics**. They are all key players in the MAELE initiative led by Aerospace Valley. Occitanie is also a pioneer in the field of electric aircraft with the **Fuel Cell Power Unit** developed by Safran.
Numerous initiatives have been launched to support this ecosystem. In terms of incubation, **Nubbo**, **Toulouse Aerospace** and **Tech The Moon** offer various solutions. The last initiative is particularly focused on Moon projects.
The acceleration phase is mainly supported by programmes of the Aerospace Valley cluster. **Booster Nova** helps create, develop and accelerate companies by using data

generated by satellites in orbit for a high value-added business. "B612 Accélération" offers two tools: District and Cockpit. District focuses in particular on innovative companies developing an aerospace activity with a strong digital technology component. Aerospace Valley also operates **ESA BIC Sud France** (at B612), a European Space Agency (ESA)-funded incubator that hosts nearly 110 startups and promotes the transfer of technologies and related services from space to other sectors, allowing these technologies to expand their fields of application.
On a global scale, **Toulouse Tech Transfer** creates added value from academic research in Toulouse by bringing laboratories and companies together.
In terms of private financing, **Irdi Capital Investissement** has been supporting companies in the southwest of France for more than 40 years. More recently, **Aerospace Angels** was created as a network of business angels specialised in aerospace.

5.4 Programmes and Policies

All local and national funding opportunities available in Occitanie are listed on the **Hub Entreprendre Occitanie** portal[28]. **France 2030** is an investment plan launched in 2020. It is partially funded by NextGeneration EU.
Regional calls for proposals have been launched with the regions. The Occitanie region has launched several programmes in recent years to support the aerospace sector:

- **Plan ADER 4** is the fourth regional plan launched jointly with the central government since 2001.
- **100-million-euro M€ recovery plan** has been set up in July 2020 during the COVID -19 crisis.
- **Green Plan for Aviation**: adopted in 2022, it aims to decarbonize the aviation sector, e.g., through innovations in SAF (Sustainable Aviation Fuel).
- Aviation is eligible for the "**green youth allowance**", a monthly income for young people under 29 who commit to a green career project.

At the intersection of research and innovation, the Occitanie region has selected key challenges, including "Earth observation and territories". These are intended to help the region become a leader in these fields. Moreover, all financial instruments of the Occitanie Region are currently on hold as new regional regulations have been adopted in November 2022. These will be available in 2023.

[28] https://hubentreprendre.laregion.fr

5.5 Connections

Occitanie region hosts several clusters, including Aerospace Valley and PRIMUS. **Aerospace Valley** is the leading European competitiveness cluster in the aerospace sector, serving three strategic sectors (aerospace, drones, and defense) in the Occitanie/Pyrénées-Méditerranée and Nouvelle-Aquitaine regions. It leads the **MAELE** initiative, which brings together a community of innovative regional players in the field of light, low-carbon air mobility.

Some Aerospace Valley members have created the **NewSpace Factory**, which brings together French SMEs with complementary skills and extensive experience in the space sector to offer a complete, flexible and easily accessible portfolio of solutions for international markets.

PRIMUS Defense & Security promotes the growth of companies' turnover and workforce through the conquest of new markets and international development. It draws on the industrial pool of the Occitanie region, particularly in aerospace, and contributes to the region's development.

Several associations are active in this ecosystem. The **ASTRE** (Toulouse Space Association for Student Research) gathers students from the University of Toulouse and three engineering schools (INSA, ENSEEIHT, ENAC). It helps students learn about space engineering through technical and concrete projects.

The "**Friends of the Cité de l'espace**" are associated with the Cité de l'espace and aim to promote science, technology and space applications among all target groups, especially the youngest.

Finally, the "**Campus des métiers et des qualifications d'excellence**" brings together partners, training bodies, companies, research centers and institutions serving the aerospace industry.

Interregional

In 2021, Toulouse and Montreal signed a cooperation agreement covering several areas of common interest, including aerospace. The memorandum aims to exchange best practices and innovative solutions to promote economic development.

Toulouse regularly hosts the **Aeromart Business Convention**. It brings together original equipment manufacturers and their Tier 1 and Tier 2 suppliers with commercial and military aerospace manufacturers and service providers through B2B meetings.

Toulouse is also home to the **Académie de l'Air et de l'Espace**, the only national academy not based in Paris, which contributes greatly to the promotion of the national and European space industry through its publications and the organisation of forums and conferences. It is made up of members who hold or have held major responsibilities in their respective fields related to aerospace. They form a pool of knowledge, unique in Europe, with the aim of promoting and encouraging the development of high-quality scientific, technical, cultural and human activities in the fields of aeronautics and space.

European

At the EU level, Toulouse Metropole participates in the **Eurocities** network. Eurocities is a network of more than 200 cities representing the interests of 130 million citizens. Toulouse Metropole is particularly active in WG related to mobility, culture, homelessness, culture, environment. The Metropole is also an active member of Occitanie Europe, the Brussels representation of Occitanie.

For several years, Toulouse has been involved in several European projects, mainly in the framework of Horizon 2020/Horizon Europe. For example, as a Core member of the **EIT Urban Mobility**, Toulouse participates in several calls for proposals and initiatives aimed at the deployment of innovative mobility solutions.

Toulouse Metropole in partnership with Aerospace Valley is leading the **European UAM Plazza Accelerator programme**, which aims to take selected start-ups to the next level by helping them to develop their activities in Europe.

With the support of the EIT Urban Mobility, 10 European start-ups wishing to move into the urban air mobility market were selected and started the programme at the beginning of July with a week in Toulouse at the B612.

Other actors such as the Aerospace Valley cluster are involved in EIT initiatives. Aerospace Valley, for example, coordinates the **Gazelle Accelerator project**, which aims to support existing technology-based companies, SMEs, start-ups and scale-ups by accelerating their international business, innovation and financial capabilities in Industry 4.0.

Aerospace Valley is also coordinating the **ECARE** (Developing a European Clean Aviation Regional Ecosystem) project, selected by the Clean Aviation Partnership. The project aims to facilitate the emergence of synergies between regional/local funding and the European level around aviation.

Several stakeholders from Occitanie (Occitanie Region, Aerospace Valley, Safran…) are signatories of **AZEA** (Alliance for Zero Emission Aviation), which is part of the EU industrial strategy.

Region Occitanie is a founding member of the **NEREUS** network (Network of European Regions Using Space Technologies). NEREUS provides a platform for all regions seeking to better use space applications to implement efficient public policies for the benefit of citizens.

Finally, the University of Toulouse is coordinating **UNIVERSEH**, the first European university to bring together five universities from all over Europe in the field of space.

6. Puglia

6.1 Introduction

Apulia is a hub for aerospace manufacturing and innovation with 1.5B € of turnover and employing more than 7,500 people in various sectors of the aerospace supply chain and R&D. It is supported by an extensive network of private and public research laboratories and four major universities, two of which (the University of Salento and Politecnico di Bari) offer postgraduate courses in aerospace systems engineering.
The **Aerospace Technology Cluster - DTA**, which is the hub of the more general Apulia Aerospace Cluster - is a key player in the aerospace sector in Apulia and can support companies in developing highly specialised R&D programmes and training activities. Meanwhile, through the regional agency Puglia Sviluppo, the Puglia regional government offers potential investors a wide range of flexible incentive schemes designed to facilitate and reduce the cost of investing in Puglia and support business growth and innovation. Based on cooperation and trust, it acts as a decision-making tool for the institutional players committed to its growth. It supports the production system by defining the sector's territorial policies and development plans. Its activity is conceived in a systemic logic that focuses on the territory and its components as an integrated growth engine. The Apulia Aerospace District, recognised by a regional law of the Apulia Region, therefore works for the competitiveness of Apulia's aerospace production and for the recognition of research and training skills and specialisations at national and international levels. It implements integration and cooperation policies between large companies and SMEs, promotes joint participation in regional, national and European programmes to support investments and projects, and updates its industrial, scientific and training strategy with the support of public institutions. The district identifies projects and partners crucial to the development and success of the cluster by participating in regional, national or international public programmes and monitoring their implementation and effectiveness. To implement these policies, the cluster collects and presents to the institutions the demands of its members, which are aimed at implementing the cluster's competitiveness. For the success of this activity, the willingness to establish links and relationships with other national and international clusters is crucial. The district has built its network, defined its strategy and started implementing it, focusing on increasing knowledge, innovation, trust and cooperation, which are essential for its competitiveness. The district's strategy has been developed around this simple but powerful principle. From its first recognition to the present day, it has worked by contributing to achieving a series of results. In general terms, 'the need for change' has become a cultural and strategic imperative for the district, which is called upon to compete in a global context moving towards the knowledge economy.
The breakdown of enterprises by size class shows a predominance of small enterprises and an equal presence of medium and large enterprises. The number of micro-enterprises, i.e. those with less than ten employees, is marginal.

Aerospace enterprises are spread throughout the Region (Figure 12), with a clear concentration in the province of Brindisi. The distribution of employees among the Region's provinces is, of course, influenced by the location of the large companies.

Figure 12. Aerospace enterprises in Apulia.

6.2 Stakeholders

The Polytechnic of Bari, the University of Salento, and the University of Bari, together with ENEA, CNR, and the CETMA consortia represent the aerospace research in Apulia, developed with partnerships with large, small, medium enterprises, and within national and international public projects. Their engagement concentrates on ther study of the materials and structures, of sensors, of mechanic and fluid dynamics, and of managerial and production space technologies. Beside that, the universities all play a fundamental role in the vocational training of highly qualified human resources, needed by the companies of the aerospace industry operating in the Region. More in detail:

- **Polytechnic of Bari**: three departments of Polytechnic are engaged in aerospace engineering research carring out designing of light and ultra-light structures, experimental analysis of stress on real components of static mechanical characterization, and fatigue characterization of traditional and innovative materias at room/cold/warm temperature, measurements of residual tensions, with different techniques on both welded and non-welded componentes, development of augmented reality systems for maintenance, buckling analysis of composite. Other esearch activities are in the field of electronics, microelectronics, and telecommunication.
- **University of Bari**: almost all projects at the University of Bari are focused on space technology issues.
- **University of Salento:** it is committed to aerospace research with its department of innovation engineering (which has a degree course in Aerospace Engineering). With projects aimed at designing instruments for space probes, the Department

of Mathematics, the Department of Physics and the Department of Biological Sciences are also involved in research in the sector. The main areas of study and development are: aerostructures and materials, aeronautical and space engines, sensors, new processing and production technologies, and new composite and ceramic materials.

- **ENEA**: it is a public agency with research and innovation tasks in the fields of energy, environment and new technologies. ENEA is present in Puglia with the Brindisi Research Centre with over 25 laboratories for the Synthesis and Characterisation of New Materials. The research lines can be summarised as follows: innovative metallic materials, development of process technologies for the realisation of nanocomposite materials for the aeronautical sector, ceramic matrix composites and ceramic coatings for applications in corrosive and erosive high-temperature environments.
- **Centro Nazionale delle Ricerche** (**CNR**): it is involved in the aerospace sector in Apulia, especially with activities in the fields of sensors, micro-systems and micro-electronics. In addition, activities are recognised in the fields of numerical calculation and signal and image processing, observation from aerial and/or satellite platforms.
- **CETMA**: it is a research organisation in the form of a consortium between public research organisations and private companies. It is one of the largest private research centres in terms of number of employees. It has developed expertise in three disciplinary clusters (materials engineering, computer engineering and industrial design). In the fields of interest of the aeronautical sector, CETMA has developed specific competences concerning composite materials processing technologies, the development of advanced materials, the development of applications for Augmented Reality-based education, training and maintenance, and the development of computer and information systems. The site covers an area of 4600 square metres and is equipped with a well-equipped Materials Technology Laboratory, a Prototyping Laboratory and a Virtual Reality Centre.

From the higher technical education and training system the Apulia Region can account for the **ITS Aerospazio Puglia**. The ITS was set up on 29 July 2010 in accordance with Law 296/2007 on the reorganisation of the higher technical education and training system and the Apulia Regional Plan. The Foundation was created to respond to the demand of companies for new and high technical and technological skills. Our aim is to train higher technicians in strategic technological areas for economic development and competitiveness.

The Istituto Tecnico Superiore (ITS) is a new post-baccalaureate training pathway, a special school of technology that aims to train higher technicians in strategic technological areas for economic development and competitiveness. ITS courses are closely linked to the professional needs of companies, which are actively involved in the design and implementation of the training pathway. The mission of the ITS is to:

- ensure the continuity of the supply of higher technicians at post-secondary level, in terms of numbers, in order to respond to the needs of the public and private labour world in relation to the aerospace sector;

- support the integration between education, training and work systems, with particular reference to technical-professional poles, in order to disseminate technical and scientific culture;
- support measures for innovation and technology transfer to small and medium-sized enterprises;
- disseminate technical and scientific culture and promote the orientation of young people and their families towards technical professions;
- establish organic relations with interprofessional funds for the continuous training of workers.

The private Companies group of the Apulia aerospace sector can be listed as following:

- **Leonardo Helicopters**: it is a leading manufacturer of helicopters for commercial and defence use. The Brindisi unit is today engaged in the production of the AW109, AW139, NH90 and AW101 aero structures. As part of the organisation, the Brindisi Centre of Excellence for Helicopter Structures has autonomous competences for the design, production of components and systems both in metal and composite materials, and for the technical/production coordination of all the structures that are manufactured through the supply chain.
- **Leonardo Electronics Avionics**: it is present in Puglia through Leonardo Electronics company, based in Taranto, which is active in the areas of on-board and embedded SW, mission planning, monitoring and control, virtual world and simulation, and the development of "swarm intelligence" applications, and collaborates with other companies and public bodies for research activities. The future evolution of its business could envisage possible synergies with other companies currently operating in the information systems, electronics and space sectors.
- **Leonardo Aerostrutture**: Leonardo Aerostrutture's Grottaglie facility was set up to manage the industrial process for the production of carbon fibre fuselage sections for the Boing 787. With an innovative production process and the use of 'one piece barrel' technology, entire primary structures of the B787 are manufactured from the composite materials. The Foggia plant is the centre of excellence for the production of composite and carbon fibre structures.
- **Telespazio**: it provides services that include the design and development of space systems, the management of launch services and in-orbit satellite control, Earth observation services, integrated communications, satellite navigation and localization and scientific programmes. The company manages space infrastructure, such as the Fucino Space Centre and is involved in programmes including Galileo, EGNOS, Copernicus, COSMO-SkyMed, SICRAL and Göktürk.
- **Vitrociset**: it mainly operates electronic and information systems in the civil and military fields for companies, public administrations, government agencies and organisations. It also deals with defence systems, air traffic control

systems, satellite technologies and telecommunications, transport and infomobility, ICT and integrated logistics.

- **Salver**: it develops and produces advanced composite and hybrid composite-metal amterial products, which are subsequently assembled as structural components of aircraft. The components manufactured are destined for Leonardo Helicopters, Eurocopter, Airbus, Boeing, Piaggio, for both commercial and military programmes. The company's activities include: research and development in the field of aeronautical artefacts; design and production of composite material ducting for civil aircraft air conditioning systems; production of composite material artefacts.
- **Avio Aero**: it designs and manufactures modules and components for propulsion systems for airplanes and helicopters, is the Italian engine manufacturer of reference for aeronautical engines of the Italian armed forces and is a world leader in mechanical transmissions. The company also carries out the maintenance and repair of aircraft engines and management services for propulsion systems for aircraft and helicopters. In Puglia the company has an important production activity in Brindisi equipped with machinery and plants for the production of engine modules, for the assembly, overhaul and maintenance of complete military engines.
- **Enginsoft**: it is characterized by a multidisciplinary nature of technical skills, which allows it to present itself as a single partner for companies for all problems relating to CAE, and to virtual experimentation, both in relation to the use of commercial software and with respect to the development of tailor-made solutions, with particular attention to the optimization of integrated problems. These are all skills that take the form of simulation activities (structural, fluid dynamics, and process), numerical modeling and multidisciplinary and multi-objective optimization.
- **Unmanned Aero Systems** (**UAS** srl): it has developed a programme that includes the design, production, integration, testing and marketing of various types of UAVs. These integrated technological solutions have been designed to be extremely versatile and reliable, and have proven to be the most suitable resources for the numerous intervention possibilities in critical situations and for numerous other civil applications, including real-time reconnaissance and surveillance and precision detection. A wind tunnel completes the production scenario, providing space for specific tests and a range of services to support other companies in the sector, including the design and construction of aerodynamic models, experimentation and data analysis.
- **Planetek**: it works in the field of Geographical Information Systems and the processing of satellite remote sensing images, developing solutions for the archiving, updating and sharing of territorial data for planning, design, management and monitoring of the territory. The company is known for its expertise in GIS systems, earth observation data management, satellite positioning system management and cartographic publishing. Planetek is involved in research and development of open source standard products to

make its systems for distributing maps and images over the Internet more competitive.

- **Sitael**: it is the result of the merger of five main companies. They have four main areas of expertise: we operate in the field of space systems (new generation of small satellites), advance propulsion (mainly electrical propulsion), avionics for platform and payloads, and downstream (innovative services and applications). Currently they have less than 400 people operating in aerospace, making Sitael the largest Italian privately-owned space company.
- **DEMA**: it operates in the aerospace sector as an innovative company of great importance thanks to its interpretation of the most complete form of development: verticalisation. This process allows it to offer a product that integrates: design capabilities, production engineering, sheet metal working, machining, production of composite parts, development, research and experimentation on new materials, related processing technologies (e.g. titanium), heat treatments and special processes, assemblies. This makes it a first level supplier/partner for aerospace companies. The company is certified AS/EN 9100, UNI EN ISO 14000; is accredited Nadcap AC/7102, Nadcap AC7101/5, Nadcap AC7118. The company is a partner of Leonardo Aerostructures and participates in the most important international aeronautical programmes, extending its collaborations to companies and institutions on a global scale.
- **Blackshape Aircraft**: it is an Italian civil aircraft manufacturing company based in Monopoli, Puglia, where it operates within the Apulian Aerospace District. The company is dedicated to the production of ultra-light touring aircraft made entirely of carbon fibre. Blackshape became the fifth Italian aeronautical company in terms of capitalisation in 2011, while the Monopoli plant is the second investment in the Apulian aeronautical district, after the Alenia Boeing plant in Grottaglie.
- **Manta Group**: it is active in the aeronautical, automotive and industrial maintenance sectors: ***a)*** the most advanced technologies in the field of composite materials production, ***b)*** the design, ***c)*** production and management of verticalised aeronautical segments, d) the best professionals in manual and automated painting and ***d)*** industrial maintenance and tool management services. Its main objective is to be a centre of excellence in the production of reliable and competitive products and services that enable its customers to achieve the best performance. Today, Manta Group is the only company that carries out the protective treatments required for the overseas transport of engines produced by FPT Foggia, the exclusive supplier of key components for civil helicopters (e.g. AW109, AW139, AW169, AW189) and the only company in the world that assembles structural control surfaces for the Boeing 767 and KC-46 tanker programmes.
- **HB Technology**: it is an aerospace company founded and run by professionals with a wealth of experience. Specialised in the supply of engineering projects and services, production and assembly of parts, systems and assemblies, it

counts among its customers some of the most important players in the aerospace industry worldwide. It's one of the first Italian manufacturers of complex metal parts using additive manufacturing technology (3D printing).

- **Sysman Progetti & Servizi**: it is an Italian company that has been working in the ICT sector for over twenty years. Thanks to its long experience, it is able to offer its customers a wide range of IT services, from Verical Software Development of "custom" solutions to software maintenance, both on-site and remote, system integration, IT consultancy and much more. In addition, thanks to the innovative spirit that has always characterised our company, SYSMAN now also has a Research and Development department that has participated in and designed numerous national and European projects. Thanks to the Projects Department, it has been possible to create innovative IT solutions for sectors that are very different in nature and needs, such as Digital Farming, Civil Protection, E-Health, Industry 4.0, etc...
- **IMT Srl**: it is a forward-looking company focused on three main types of activities: ***a)*** Space: design and development of Nano/Microsatellites and relevant On-board Units for Space Commercial, Scientific and Defense applications. ***b)*** Parts Engineering: Characterization and Testing of Electrical, Electronic and Electro-Mechanical components. ***c)*** Satellite IoT solutions: design and development of IoT Solutions for Smart Cities, Environmental Monitoring, Infrastructure Monitoring and Agriculture. IMT Srl can offer to the market very innovative and competitive solutions that meets the performance required for a wide range of applications: ***i)*** Earth Observation and Remote Sensing, ***ii)*** Deep Space Exploration Missions, ***iii)*** Satellite Internet of Things, ***iv)*** Environmental Monitoring, ***v)*** Custom Payloads & Subsystems and ***vi)*** EEE Parts Engineering.
- **Novotech**: it is a key partner for many industries in the aerospace and other high technology sectors. The company was founded in 1992 as an engineering consultancy spin-off from the Department of Aerospace Engineering at the University of Naples "Federico II". In order to maintain a high level of competitiveness in the market, NOVOTECH has developed a well consolidated know-how on aircraft and aircraft components: design/certification; automated composite manufacturing processes; advanced FEA; static/dynamic experimental testing. Novotech has produced several demonstrators using the AFP process, such as the tail cone part of the Next Generation Turboprop Regional Aircraft (NGTP) or a part of the lower skin of the M-346 aircraft, as well as test activities for the qualification and validation of the design methodologies implemented. The company is currently involved in research projects aimed at the study and characterisation of innovative configurations and the processing of multi-functional CFRP multi-layer materials for manufacturing with automated technology. In this context, since the end of 2014, NOVOTECH has been identified by the Cytec Solvay Group as a qualified laboratory for the development and testing of new materials for the Automated Fibre Placement (AFP) and Resin Transfer Moulding (RTM) processes.

- **Exprivia**: it is an international group specialising in information and communication technologies, capable of responding to its clients' business change drivers through digital technologies. Exprivia stands out for its reliability in managing complex projects by combining and integrating vertical and horizontal skills, and for its ability to create solutions that are easy to use and update, based on continuous research and innovation. Thanks to the know-how and experience gained in over 30 years of constant presence on the market, Exprivia dis has a team of experts specialised in various technological fields and domains, from capital markets and credit & risk management to IT governance, from BPO to IT security, from big data to cloud, from IoT to mobile, to the SAP world, distributed among its various offices in Italy and abroad (Europe, America and Asia). Listed on the Italian Stock Exchange since 2000 in the STAR MTA segment (XPR), Exprivia supports its customers in the Banking, Finance & Insurance, Telco&Media, Energy & Utilities, Aerospace & Defence, Manufacturing & Distribution, Healthcare and Public Sector sectors.
- **Giannuzzi srl**: it is a company specialising in the creative design of aircraft interiors, with over 50 years of experience. Today, the latest technologies and aeronautical certifications complement the traditional craftsmanship and the company is recognised in the design, manufacture and installation of cabin interiors and equipment for civil and military aircraft.
- **Salentec**: it produces high-quality ceramic cores and delivering them on time. It knows process investment casting, and how important it is to have dependable cores that perform as designed. Salentec specializes in the process injection molding of metallic and ceramic polymeric materials. In particular, it excels in the development of components in technical ceramic material for injection (CIM). The experience developed starts from the composition of injectable ceramic feedstocks, to the dewaxing and sintering phases. Various ceramic compositions have been developed for the aerospace, jewerly porcelain, zirconia and alumina components.
- **IDS Ingegneria Dei Sistemi SpA** (Fincantieri NexTech company): it is an engineering and systems technologies company providing research, innovation and products in Electromagnetic Engineering, Satellite Communications, Robotics and Unmanned Systems, and Radar based safety and protection systems for civil and defense applications. Since the outset in 1980, IDS has specialized in providing consulting services for high-tech engineering projects and in developing integrated hardware and software solutions. IDS has a strong customer focus and is committed to meeting customer requirements with high quality innovative solutions. IDS is an international company with 250 professional employees worldwide, mostly electronic, telecommunications and aerospace engineers.

Other apulian companies which are aerospace stakeholders:

- **Avioman s.r.l** (Manta Group)
- **GAP srl**
- **I.A.P. Industrial & Aeronautical Painting S.r.l.**

- **OMA Arseni**
- **PRO.MECC Group**
- **TSM - Trattamenti Superficiali dei Metalli S.r.l.**

Public Administration stakeholders:

- **City of Bari**
- **City of Taranto**
- **Province of Brindisi**

National stakeholders are:

- **ASI - Italian Space Agency**
- **ENAC - Italian Civil Aviation Authority**
- **ENAV - Italian Air Navigation Service Provider**
- **D-FLIGHT - Italian U-Space provider**

International stakeholders are:

- **European Space Agency** (ESA)

6.3 Capabilities

Capabilities of apulian aerospace ecosystem, with research labs, field labs, incubators and different hotspots are listed below:

- **Grottaglie Airport Test-Bed (GATB**, Figure 13): it is an initiative generating interesting investment opportunities for key industry players, SMEs and innovative start-ups involved in business sectors such as UAV systems, software systems and cybersecurity who want to be located in or around a strategic airport infrastructure. The Taranto-Grottaglie Airport is a fully-serviced strategic airport infrastructure, authorised for UAV simulation and flight trials, designated as Italy's first and only spaceport, ready for operating suborbital flights in the near future.

Figure 13. Grottaglie Airport Test Bed (GATB)

- **Drone Living Lab** (DLL, Figure 14): it is located in the "Fiera del Levante" district of Bari, simulates urban environments with many people, buildings, roads and utilities on site, combined with scientific expertise in various disciplines, dedicated experimental facilities and high-speed communication networks. In particular, the DLL focuses on solutions and ideas to develop monitoring and delivery systems using UAS.

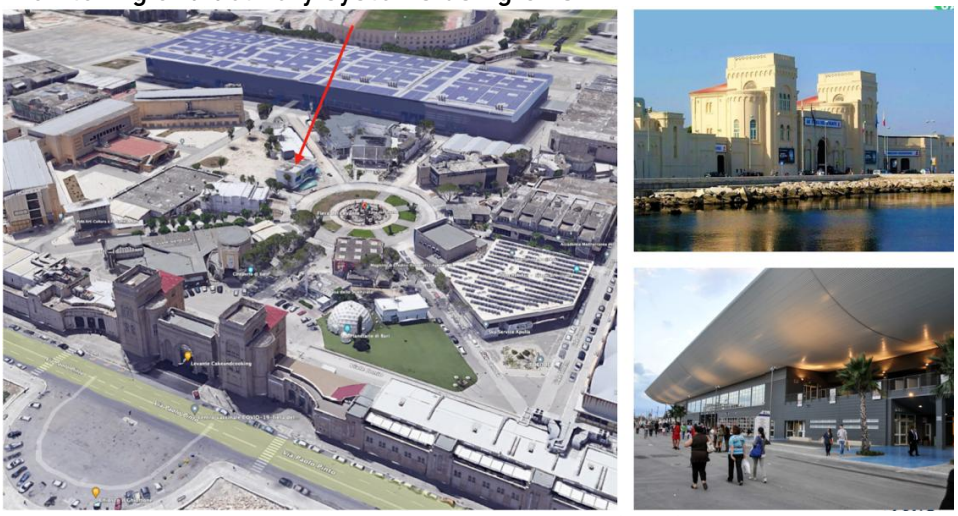

Figure 14. Drone Living Lab (DLL)

- **Bari Urban Drone Range** (Figure 15): it is a UAM experimental infrastructure for smart cities, built by the Municipality of Bari in collaboration with DTA as part of the Bari Open Innovation Hub (BOIH) project, co-funded by the Ministry of Economic Development.

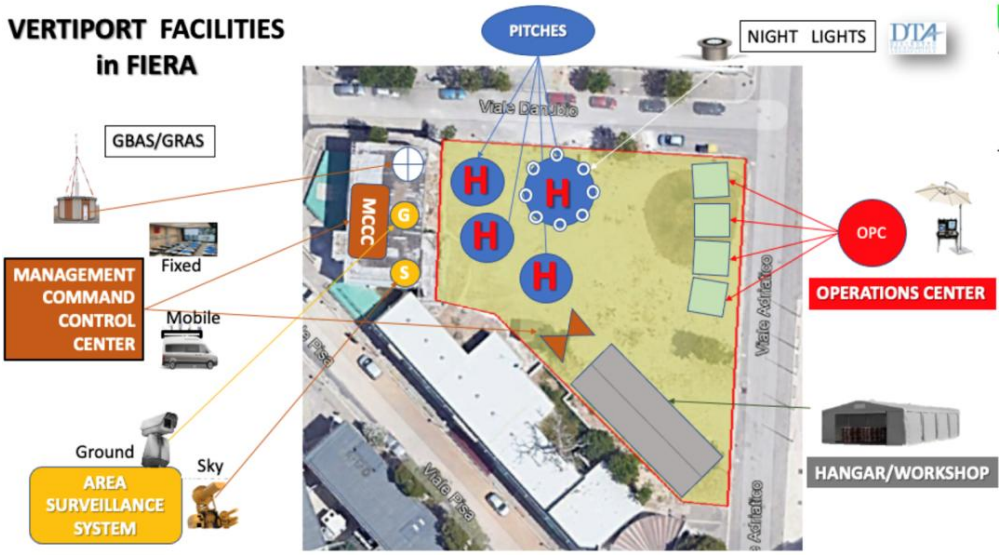

Figure 15. Bari Urban Drone Range

- **Bari ReCaS Data Centre**: it was built by the University of Bari "Aldo Moro" and the National Institute for Nuclear Physics (INFN) as part of the ReCaS project.The computing power provided by the ReCaS project consisted of 128 servers, each with 64 cores and 256 GB of RAM, for a total of more than 8000 cores and 3500 TB of disk storage.
- Italy is the only European country with **OPB (One Piece Barrel) technology** at Leonardo's Grottaglie plant (Figure 16). The know-how developed by Leonardo (Aerostructures Division) contributed to Boeing's decision to develop the One Piece Barrel. The concept is based on a complete fuselage shell, consisting of skin and stringers, consolidated and cured in a single autoclave cycle. Leonardo's pre-existing specific know-how enabled it to support Boeing in the development of this process and to rapidly implement the technology at Leonardo's Grottaglie plant (in the province of Taranto), which has been producing fuselage sections 44 and 46 for the Boeing 787 since 2006.

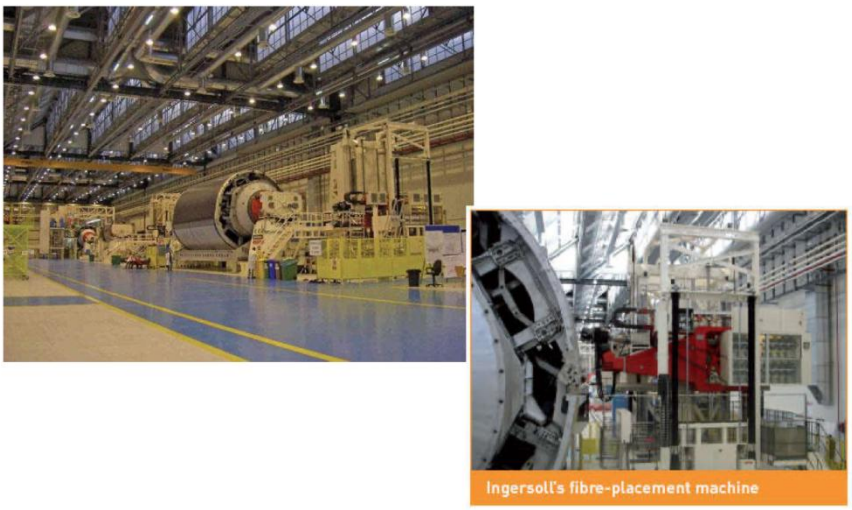

Figure 16. Bari ReCaS Data Centre

- Italy is the only country in the world to have **multi-spar (i.e. rib-less) technology for tail assembly** at Leonardo's Foggia plant (Aerostructure Division). This tailplane comprises longitudinal members (spars) and not transverse members (ribs). This configuration, without the ribs, makes it possible to produce the right or left half of the tailplane, complete with structure and skin (cured box), in a single autoclave cycle, with significant advantages in terms of time and cost savings in manufacturing and assembly, without compromising on weight. The CMB technology was developed at the Foggia plant and is protected by national and international patents.
- The **Umanned Aero Systems' (the company) wind tunnel** (reported in Figure 17) is one of Italy's most modern open subsonic wind tunnels. It is a valuable tool for UAS to analyse the aerodynamic characteristics of different aircraft over a wide range of speeds, allowing different flight conditions to be simulated. There are two test chambers: one for high-speed tests and one for low-speed

tests. A 250 kW fan generates the airflow. The UAS's open-circuit tunnel allows tests to be carried out in the presence of combustion engines, as the exhaust gases are vented to the outside.

Figure 17. Umanned Aero Systems

- **European Space Agency's Business Incubation Centre** (Apulia Node) - **ESA BIC** - helps entrepreneurs and start-ups to turn their space-related projects into successful businesses. The ESA-BIC is looking for entrepreneurial ventures that develop innovative products and services in the upstream or downstream sectors.
- **CTE - Bari Open Innovation Hub**: the project aims to create an innovation hub in the metropolitan area of Bari that can test new technologies and operating protocols, focusing on autonomous and semi-autonomous driving, using 5G as an enabling technology and the use of AI, next-generation IoT and drones.
- **Puglia Sviluppo (Puglia Development Agency)**: it is the Puglia Region's in-house company that acts as an intermediary body for managing business incentives, has a network of business incubators throughout the region and the Sprint Desk to promote the internationalisation of Puglia companies. The services offered by the incubator in the Bari-Modugno industrial area are particularly interesting for companies operating in the ICT sector. Puglia Sviluppo also serves as a financial company for managing the microcredit, counter-guarantee and tranched cover funds for companies set up by the Region of Puglia.

6.4 Programmes and Policies

The Apulia Aerospace Cluster aims at:

- supporting small OEMs and SME networks in international programmes by developing the capacity to design and manufacture complex products such as aeronautical and space systems, subsystems, and innovative integrated service offerings;
- strengthening research and training capabilities in developing new products and services in line with the needs of new industrial initiatives;
- completion, through regional action in collaboration with the authorities (Aeronautica Militare and Enac), of the analysis of the safe operation (test areas and entry/exit corridors) of the different classes of UAV platforms for

the Grottaglie test bed to guarantee the wide use of the site and its competitiveness at European level;
- improving the Taranto-Grottaglie infrastructure for the development of suborbital activities;
- activating a stable system for acquiring and disseminating timely information on the potential world market (and its evolution in the short and long term) and the needs of end users;
- carring out targeted actions to promote the Puglia space system and its opportunities;
- promoting a National Aerospace Steering Committee;
- strengthening the proactive role in the National Space Steering Committee;
- simplifying the procedure for attracting investment;
- participating actively in international networks such as Nereus (Network of European Regions Using Space Technologies).

All the above can be achievied by using properly regional, national and international programmes and policies. For instance using the **Recovery and Resilience Plan: Next Generation Italia**, the DTA has been funded for a hydrogen research project for the general aviation sector. In **Apulia S3 programme**, Aerospace is addressed as a key priority since its high development potential for the Region. While, the national **Strategic Plan Space Economy** is divided into 5 programmatic lines as the initiatives carried out at European level. The aim is to maximizing the impact at national level of:

- Satellite Telecommunications
- Support for national participation in GALILEO
- Galileo PRS infrastructure
- Support for Copernicus
- Space exploration and related technological developments.

The regioanl Call "**Progetti di potenziamento dell'infrastruttura di ricerca di rilevanza regionale (Airport Test Bed) di Taranto-Grottaglie**" aims to support the development of a research infrastructure to be built at the Taranto-Grottaglie Airport for the development of the Grottaglie Airport Test Bed (GATB), and to strengthen the capacity of the Apulian research system to offer research, development and innovation services by enhancing the GATB research infrastructure with state-of-the-art technologies and laboratories at the international level, also with a view to enhancing the capacity to compete at the national and European level, due to the still small number of reported Research Infrastructures (RIIs), compared to other Italian regions.

6.5 Connections

The Apulia Aerospace sector is a system of relationships between the various public and private players in the aerospace sector. All the companies, public entities and research centers above mentioned are all coordinated by strategies of the DTA Cluster. Moreover, there are other connections to be mentioned such as:

Intraregional Connections into the Apulia Region:

- **Ap-EDIH** is a working group that aims to create a single European Digital Innovation Hub (EDIH) structure in the Apulian region, with the necessary critical mass to support Apulian SMEs and public bodies operating in sectors that have a significant impact on the competitiveness, recovery and resilience of the region, such as Manufacturing, Agro-Food, Energy/Climate/Smart Mobility, Healthcare (devices and systems), Blue Economy and Smart City.

Interregional Connections (Italy):

- The **CTNA** is the point of synthesis and convergence of the needs and priorities that the various stakeholders of the national aerospace system have developed in recent years in light of global market trends and sectoral policies at the European and international levels.
- Associazione italiana di aeronautica e astronautica (AIDAA) aims to bring together people, industries and institutions interested in scientific and technical activities in the aerospace sector and to disseminate knowledge about the sector.
- **APRE - Agency for the Promotion of European Research** aims to support and facilitate Italian participation in the European Union's Research and Innovation (R&I) funding programmes by providing information, training and assistance.

European Connections:

- The **ASSURED-UAM** is a H2020 project aiming to ensure excellence in the safety, sustainability and acceptance of UAM. In addition, it will promote aviation best practices, standards, recommendations and organisational solutions to administrative and legislative bodies[29].
- **AD-ASTRA** - the present project, that aims to develop an inter-regional innovation ecosystem connected between 5 EU regions (Occitania, South Holland, Madrid, Apulia and Emilia-Romagna) with different levels of innovative performance but a common interest in fostering innovations in the aerospace sector. The overall objective of the project is to build an interconnected and inclusive innovation ecosystem across Europe, with a shared focus on the aerospace innovation sector and cross-contamination to and from other innovative sectors (e.g. automotive, biomedical, agri-food, big data)[30].
- **Network of European Regions Using Space Technologies (NEREUS)**: it represents the interests of European regions that use space technologies whilst simultaneously highlighting the regional dimension of European space policy and programmes. The key mission of NEREUS, as a unique thematic

[29] https://assured-uam.eu
[30] https://aerospacedistricts.eu

network, is to explore the benefits of space technologies for European Regions and their citizens and promote the use of space and its applications[31].

- The **EACP** is a permanent partnership of collaborating European aerospace clusters. The consortium currently comprises 45 aerospace clusters from 18 different countries and was initiated in 2009 by the City of Hamburg and co-funded by the European Commission.
- **UIC2 – Urban Air Mobility Initiative City Communities** fosters collaboration across disciplines and sectors pertinent to UAM with the aim to jointly shape the future of UAM.

[31] https://www.nereus-regions.eu

South Holland

7.1 Introduction

The South Holland region is one of the twelve provinces of the Netherlands. It is the most densely populated area of the country with 3.6 million inhabitants with Rotterdam and The Hague as the largest cities. As reported in Figure 18, important industrial sectors are the maritime and offshore industry, greenhouse horticulture, life science & health and of course the high tech systems industry. Aerospace is a separate part of the latter sector and is a relatively small compared to other sectors, with approximately 350 companies, institutes and other organizations.

Figure 18. Main six industrial verticals and three horizontals in the Zuid-Holland region.

The number of companies in South Holland amounts to almost 600,000. It is striking that a very large share (18%) of these companies are in business services (advice, research and other specialist services). Only 3% are industrial companies and 4% are ICT companies. As reported in Figure 19, the number of jobs in South Holland amounts to almost 2 million (20% of the Netherlands), GDP 162 billion euros (21% of the Netherlands), spending on R&D 3.1 billion euros and exports from the region amount to 74.7 billion (23% of the Netherlands). The number of direct jobs in the aerospace sector is approximately 7.500; Indirectly, some 12.500 jobs are linked to the sector.

Figure 19. Zuid-Holland in numbers: the Netherlands benefits from investing in Zuid-Holland, Economic Board Zuid-Holland, 2019.

As reported in Figure 20, the Zuid-Holland region has many higher educational opportunities with 3 research universities with a total of more than 100,000 students and 4,000 PhD students. In addition, there are 6 universities of applied sciences and colleges with more than 95,000 students. Two of the universities have specific courses and research centers for aerospace. These are the University of Delft with the Faculty of Aerospace Engineering and Leiden University with the Faculty of Astronomy and the Institute of Air & Space Law. The universities of applied sciences all have courses in electronics, mechatronics and precision engineering. A special college is the Leiden Instrument Making School, specifically aimed at training students the ability to make precision (research) instruments.

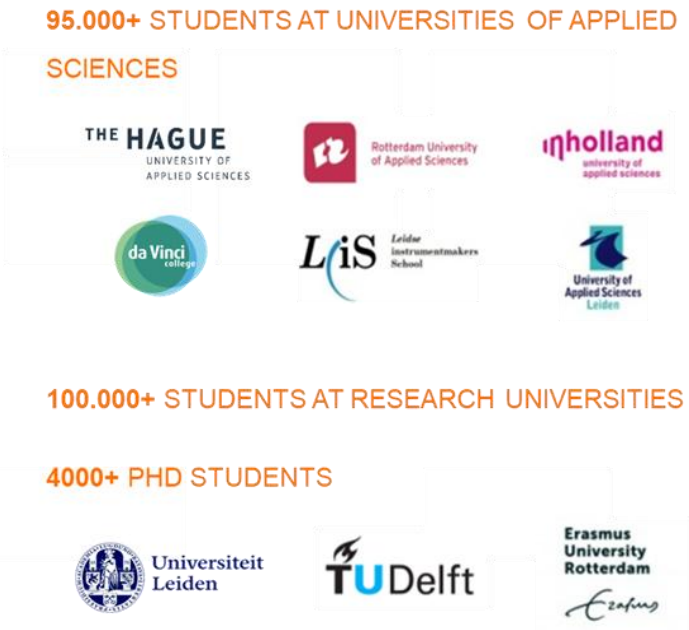

Figure 20. Education and research.

Despite its modest size with 257 stakeholders, the aerospace sector in Zuid-Holland is very diverse and of a very high level in specific niches (Figure 21). The sector has subclusters in airport technology and services, the aeronautics industry, the drone industry and the space upstream and downstream industry.

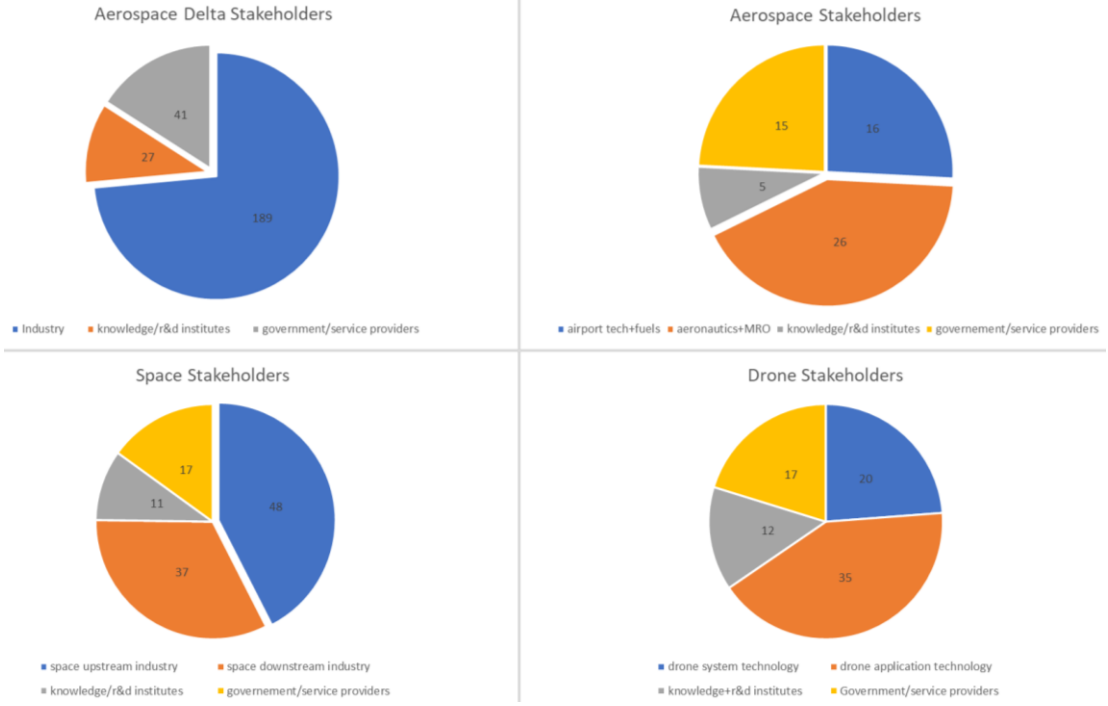

Figure 21. Characteristics of aerospace sector in Zuid-Holland.

7.2 Stakeholders

In this list of the most important stakeholders in the region, we distinguish between universities and research institutes, schools, private companies and other organizations.

Universities and research institutes

- **Technical University of Delft**: The Faculty of Aerospace Engineering at Delft University of Technology (TU Delft) is one of the world's largest faculties devoted entirely to aerospace engineering. It is the only research and education institute in the Netherlands engaged in research and teaching that is directly related to the aerospace engineering sector. It covers the whole spectrum of aerospace engineering subjects, and explores vital related fields such as wind energy, in close cooperation with other faculties like Electrical Engineering, Mathematics and Computer Science, Mechanical, Maritime and Materials Engineering and Applied Sciences.
- **University of Leiden** (Figure 22): The research carried out at the Faculty of Science is very diverse, ranging from mathematics, computer science, astronomy, physics, chemistry and bio-pharmaceutical sciences to biology and environmental sciences. The research activities are organised in eight

institutes. Leiden Observatory is the astronomical institute of the Faculty of Science of Leiden University. Established in 1633, it is the oldest university observatory in operation today, with a very rich tradition. Leiden Observatory carries out world class research in the formation of structures in the universe and the origin and evolution of galaxies, the detection and characterization of exoplanets, and the formation of stars and planetary systems. The International Institute of Air and Space Law at Leiden University of Law is one of the leading international academic research and teaching institutes in the world, specializing in legal and policy issues regarding aeronautics and space.

Figure 22. Leiden Observatory

- **TNO Space & Scientific instrumentation**: Ever since its foundation, TNO has been active in the field of advanced optical instruments, and for over 50 years has been developing instruments for use in space, astronomy, scientific research and manufacturing industry. Examples of this work include the development of instruments for measuring the ozone layer (GOME and TROPOMI) and a space telescope (GAIA). The measuring instruments contribute to dealing with important social issues, spur on science and form the basis for industry and job opportunities in the Netherlands. TNO has a long legacy in developing instruments that monitor our planet's atmosphere and allow us to mitigate the harmful impact of greenhouse gases and air pollution. In addition to this, we work on systems that monitor land and water and the calibration of a wider range of optical satellite instruments. For Laser Satellite Communication, TNO builds the optical part through which the satellites communicate with ground stations and optical terminals for inter-satellite communication. TNO is also developing the key technologies needed for the future, more advanced terminals. Some examples are high-precision mechanisms, optical components, the production of mirrors, and components for photonics. An important task for us is to make the components smaller, cheaper, and, therefore, more commercially interesting.
- **SRON Netherlands Institute for Space Research**: SRON is the Dutch national expertise institute for scientific space research. Since the foundation of the institute by university groups, in the early 1960s, we have, often in a leading role, provided key contributions to instruments of missions of the major space agencies, ESA, NASA, and JAXA. These contributions have enabled the national and international space-research communities to explore the universe and to

investigate the Earth's atmosphere and climate. As a national expertise institute, we stimulate collaboration between the science community, technological institutes, and industry.

- **ESA-ESTEC** (Figure 23): it has sites in several European countries, but the European Space Research and Technology Centre (ESTEC) in Noordwijk, the Netherlands, is the largest. ESTEC is the technical heart of ESA- the incubator of the European space effort - where most ESA projects are born and where they are guided through the various phases of development. ESTEC in short is:
  - Developing and managing all types of ESA missions: science, exploration, telecommunications, human spaceflight, satellite navigation and Earth observation.
  - Providing all the managerial and technical competences and facilities needed to initiate and manage the development of space systems and technologies.
  - Operating an environmental test centre for spacecraft, with supporting engineering laboratories specialized in systems engineering, components and materials, and working within a network of other facilities and laboratories.
  - Supporting European space industry and working closely with other organisations, such as universities, research institutes and national agencies from ESA Member States, and cooperating with space agencies all over the world.

Figure 23. ESA-ESTEC facilities in Noordwijk.

Relevant Educational institutes (non research)

- **University of Applied Science InHolland**: The Aeronautical Engineering bachelor's degree program of InHolland University of Applied Science educates in the broad field of the aircraft and space industry. The focus of this four-year program is on designing and constructing aircraft and aircraft components. Special project is Dragonfly, the modification of a regular powertrain to an electric one. Part of the Precision Engineering bachelor is the New Space Minor which trains students to become future space engineers. The Aeronautical Engineering department of InHolland Delft works closely with TU Delft.
- **Leidse Instrument maker School** (**LiS**): The LiS is a high level vocational school. Students are trained to become a (research) instrument maker. They learn to device, design and make precision instruments from hard materials, such as metal and plastic. These are prototypes that are necessary for scientific research and in the high-tech industry and aerospace and that are not (yet) for sale in the

store. As a graduated (research) instrument maker, the students therefore contribute greatly to new discoveries and inventions! The LiS has set up the Lifelong Optics Learning platform together with The Hague University of Applied Sciences and the Dutch Optics Centre, a collaboration between TU Delft and TNO. This education platform in optics and photonics provides further and further training in optics and photonics for professionals.

Private companies: As described above, the aerospace ecosystem in Zuid-Holland knows different subsectors: aeronautics, airport technology, drone systems and application development, space up and downstream. Below a selection of private companies with their main capability.

- **Aeronautics** (Table 1): the aeronautical industry has a strong link with the TU Delft and is mainly focused on the development and production of light weight composites components and structures but also on the development of assembly technology and manufacturing technology (automation and digitization). Relative new is the search for biobased and recyclable composite materials, primers and bonding. New developments focus on battery-electric and hydrogen propulsion technology with the intention to modify an turboprop aircraft into a green solution.

Table 6. Stakeholders involved in aeronautical industry

Name	Segment	Specify	Sub-segment
GKN/Fokker Aerostructures multi technology center	Aeronautics	R&D/ manufacturing	Electrical wiring systems, metal bonding, assembly automation of large substructures and landing gear.
Airborne Composites	Aeronautics/ space	R&D/ manufacturing	Substrates solar panels, aircraft structural parts, automation and digitization solutions for manufacturing.
KVE (part of Daher) composites	Aeronautics/ space/ drones	R&D/ manufacturing	Thermoplastic composite assembly, radar structures, uav rotor blades, satellite structures.
Marshall Aerospace Netherlands	Aerospace	Engineering/ maintenance	Conversion, modification and maintenance of military and civil aircraft.
Conscious Aerospace	Aerospace	R&D	LH2 powertrain modification/new build regional aircraft 50-80 seats.
Meave Aerospace	Aerospace	R&D	Battery-electric powertrain/40 seat regional aircraft development.

- **Airport technology** (Table 2): that companies are engaged in the development of the further digitization of the airport, both with regard to passenger and

baggage handling processes and the other processes at the airside. There is also a strong development towards the introduction of more autonomous processes. An important topic for airports, not mentioned below, is the development of technology, infrastructure and procedures necessary for the use of new energy carriers such as electric batteries and hydrogen. Furthermore studies take place to encounter the problems with noise pollution.

Table 7. Stakeholders involved airport technology

Name	Segment	Specify	Sub-segment
SITA	Airport IT solutions	R&D/ implementation	Bagage management, passenger processing; airport operations, communication & data exchange
ADECS	Airport IT/database solutions	R&D/ IT implementation	Open Airport IT system; data exchange management.
CGI	Airport operations/security	consultancy	Passenger experience; airport operation; (cyber) security
To70	Airport consultancy	consultancy	Safety; environment; efficiency; airport planning
NACO	Airport Design& engineering	Design& engineering	Masterplanning; design and engineering of infrastructure and buildings; airport sustainability
Deerns	Airport systems	Design and engineering	installation design and integration of airport-specific systems.
Robin Radar	Airport safety	R&D/ manufacturing of Radar systems	Radar system for bird & drone detection on airports

- **Drones** (system development): due to the presence of the port of Rotterdam and the large-scale off-shore industry, system developers focus on being able to fly for a long time under difficult conditions at an object for an accurate inspection. In addition, the ability to operate fully autonomously from a drone inspection or monitoring system is an important development.

Table 8. Stakeholders involved in drones tecnology

Name	Segment	Specify	Sub-segment
Aerialtronics	Multi copter drones	R&D/ manufacturing	Drone platform & sensor (camara's); applications for windturbine inspection, safety&security, search&rescue.
Atmos UAV	Fixed wing drones	R&D/ manufacturing	Applications for surveying&GIS, construction&infrastructure, mining&aggregates, environment and precision agriculture
Delft Dynamics	Helicopter drone, multi copter	R&D; engineering; manufacturing	Inspection, monitoring, communication, drone-catcher
High Eye	Unmanned helicopter systems	R&D/ manufacturing	Applications in maritime, safety&security, research&inspection
Mapture	Autonomous system	R&D/ manufacturing	Autonomous drone in a box system
Shore Systems	Drones	R&D/ manufacturing	Drones with extended hover endurance and cruise range, enabling remote industrial asset inspection
Airhub	drones	R&D/ software development	Ground control software for drone operations; consultancy
Birds.ai	drones	R&D/ software development	Artificial Intelligence, Machine Learning, and Predictive Analytics with drone data
Fusion Engineering	drones	software	Flight control technology

- **Drone application development**: the application developers and services providers also focus on technology solutions for monitoring and inspecting assets in difficult conditions.

Table 9. Stakeholders involved in drone application development

Name	Segment	Specify	Sub-segment
Applus RVIS	Drone application	inspection	Inspection of assets in harsh environments; training inspection methodes
Bavak Security Group	Drone application	Security inspection	Autonomous Surveillance Drone
Dutch Drone Company	Drone application	Inspection	Inspections of on- and offshore installations; using digital twin and live streaming
Falcker Innovation	Drone application	Inspection	Mapping and inspection of vital infrastructure and the most complex industrial assets
Mainblades Inspections	Drone application	Inspection	Automated aircraft drone inspections

- **Space upstream**: the up-stream space industry mainly focuses on the market of small satellites and the necessary components, systems and test and integration services. In addition, with TNO's knowledge, a lot of attention is paid to the development of optical instruments for space applications, such as atmospheric research and laser satellite communication.

Table 10. Stakeholders involved in space upstream

Name	Segment	Specify	Sub-segment
Airbus Defence and Space NL	Space	R&D/ manufacturing	Solar arrays; instruments; launcher structures (Ariane); earth observation data for climate monitoring
Demcon	Space	R&D/ optomechatronic engineering	Laser satellite communication; thermal systems&control
ISISpace	Space	Manufacturing; launch services	Turn-key cube sat and nano sat solutions; components and platform integration; services
Dawn Aerospace	Space	Propulsion; reusable launch vehicle	Green propulsion solutios for small and cube sats; spaceplane development
T-minus	Space	Engineering; Suborbital launcher	Space and rocket engineering; scientific suborbital flights; propellant munufacturing
GTM Advanced Structures	Space	Solar arrays for small and cube sats	Material and structural testing; small sat structures; solar arrays; antennas
AAC Clyde Hyperion	Space	R&D/ manufacturing	High performance components; attitude and orbit control technologies and laser communications

- **Space downstream**: many space down stream companies use InSAR data to develop applications, for example to monitor shift in assets or soil. Many other companies use the data from hyperspectral cameras for the development of applications for the agricultural sector such as drought measurements, crop growth and disease recognition. Relatively new are the applications to visualize climate-disrupting emissions.

Table 11. Stakeholders involved in space downstream

Name	Segment	Specify	Sub-segment
Groundstation Dotspace	Space data	Network activities	Supports potential end-users of satellite applications with its network to make experience and expertise available
Science&Technology	Space data	Software/AI solution for big data	software solutions for a deeper understanding of valuable earth observation and GNSS data
SkyGeo	Space data	InSAR data applications	Mapping soil and assets deformation for mining, energy, civil constructutions, underground gasstorage
Orbital Eye	Space data	InSAR data applications	Oil&gas/water pipeline monitoring; deformation monitoring
Sensar	Space data	InSAR data applications	reduce ground deformation risks with satellite change monitoring solutions
Space4Good	Space data	Remote Sensing Data analyses	focuses on sectors in which our services, expertise and motivation can contribute the most to the UN Sustainable Development Goals
Geronimo.AI	Space data	Remote Sensing Data analyses	Monitoring of the Common Agricultural Policy (CAP) and crop(rotations) voor governments and farmers

7.3 Capabilities

The separate capabilities of all stakeholders are described above in the chapter 7.2 entirely dedicated to stakeholders. Thus, we will limit this part to the special capabilities of our aerospace ecosystem, with research labs, fieldlabs, incubators and different hotspots (Figure 24).

Figure 24. Laboratories distribution in Zuid-Holland.

- ***TU Delft Campus***[32]: Various facilities are located on the TU Delft campus that have an important relationship with the Aerospace Delta ecosystem[33]. *The TU Delft Aerospace Faculty Labs are*[34]*: 1)* The Aerospace Structures and Materials Laboratory that carries out research on manufacturing, testing and inspection techniques on new materials; *2)* The Micro Arial Vehicle Lab, leading research on miniaturisation of UAV structures, autonomous operation and swarming; *3)* Wind tunnel, propulsion and aerospace design lab, leading research on aerodynamics, an aircraft power and propulsion lab and design tools; *4)* Flight Simulation lab, the Simona Research Simulator, that can realistically simulate all types of aircraft, helicopters and even cars; *5)* Space Cleanroom, enables assembly, integration and testing of small satellites, including propulsion test stands. *TNO Space&Science Instruments* has specific capabilities: TNO has

[32] https://www.tudelftcampus.nl/
[33] www.aerospacedelta.nl
[34] *Virtual Lab Tours (tudelft.nl)* - https://www.tudelft.nl/en/ae/organisation/virtual-lab-tours

unique expertise in manufacturing high-precision optical components, so called high-end optics manufacturing. TNO manufactures customer-specific components – mirrors and lenses – that are integrated into innovative and compact systems, leading to new products such as space instruments. *SAM|XL stands for* Smart Advanced Manufacturing | Nederland XL[35] *(Figure 25)*. Is a collaborative research centre at TU Delft Campus, that develops, demonstrates and de-risks smart manufacturing solutions. Focusing on automated production processes of large-size, lightweight/composite structures for the high-tech aerospace sector. Specific capabilities are: Robotic Filament Winding, Automated Fibre Placement, Pick & Place of sheet materials, Ultrasonic Welding, AR/VR assisted assembly, Laser Line Scanning, Phase Array Ultrasonic Inspection, metrology equipment like 3D cameras, Laser tracker, Indoor GPS, Mechanical testing, Chemical analysis, Microscopy, software like RoboDK professional, SolidWorks, InspectionWare, LabVIEW.

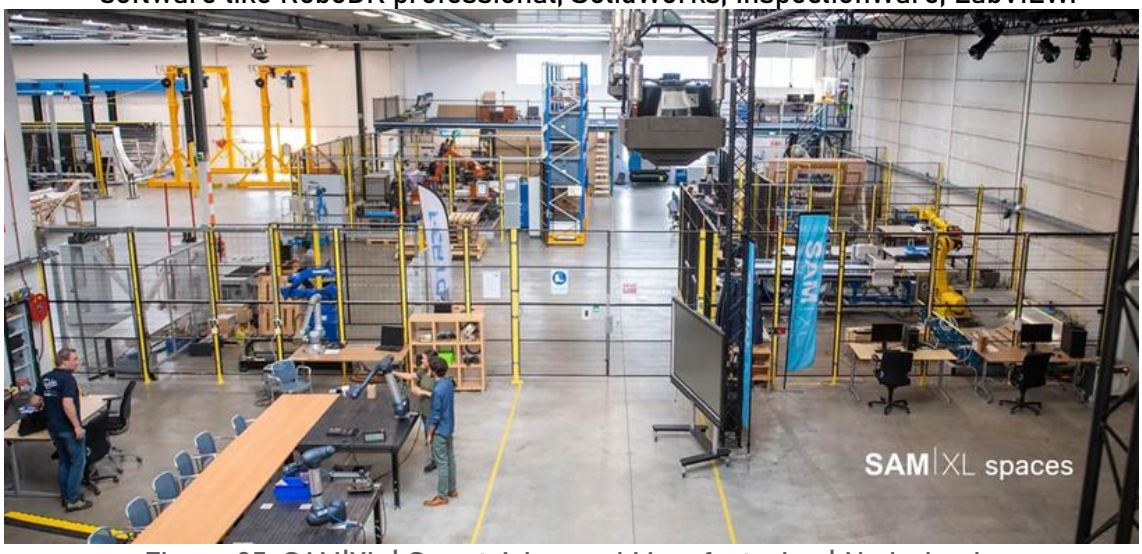

Figure 25. SAM|XL | Smart Advanced Manufacturing | Nederland

- ***The Aerospace Innovation Hub*** *@TU Delft:* is a community of aerospace related startups, academics, students, corporates, and industry professionals. Their mission is to accelerate content driven innovation in aerospace in a community by facilitating the early entrepreneurial journey, offering a vast aerospace network, and access to a rich aerospace talent pool. We are attaining our mission by offering our members an active community through which they can develop their ideas into viable and scalable products. The community room and offices are situated on the top four floors of the Aerospace Engineering Faculty at Delft University of Technology. This location enables the community members to have a close connection with the faculty's students, researchers, and facilities. On top of that, it is a vibrant environment full of likeminded people who elevate each other's work. The Aerospace Innovation Hub supports

[35] https://www.samxl.com/

the faculty's Start Up Voucher program by offering an entry into our community and coaching sessions with industry professionals. There is no better way to kick off your entrepreneurial journey in aerospace! The focus is supporting innovations in space technology, in solutions enabling the long term sustainability of aviation, and in novel drone technology.

- ***NL Space Campus***[36]*:* NL Space Campus offers an inspiring, open and dynamic environment where people and organizations can feel at home, excel and are facilitated in their growth and development. Start-ups are facilitated in their journey to scale-up. Grow-up and larger companies or organizations find their current and future talent pool on campus. NL Space Campus stimulates cooperation and interaction during which the curious can connect and share knowledge. The various groups – space and non-space, upstream and downstream, companies and institutions, national and international authorities – are stimulated to think cross-sectoral, to challenge each other and connect on existing and rising challenges. Technical facilities to support businesses: Clean rooms (with ESD-safe working places); CNC machining (up to 5 axis); World-class test facilities at ESA/ESTEC for:

    - Vibration (mechanical and acoustic) testing
    - Thermal cycling
    - Thermal shock
    - Thermal vacuum cycling
    - Noise
    - Electro-Magnetic Compatibility
    - Electro-Magnetic Interference
    - Weight and Centre of Gravity measurement
    - Propulsion/thruster testing
    - Solar simulator

    Part of the NL Space Campus is the incubator ESA-BIC Noordwijk[37]. ESA BIC Noordwijk offers technical, business and financial support to startups that use space technology for terrestrial applications. ESA BIC Noordwijk is part of a network of 26 (and counting) ESA BICs across Europe, which were established to empower entrepreneurship and to allow local economies to benefit from space data and technologies. The 2-year programme is managed by a local partner: Space Business Innovation Centre Noordwijk. Incubetees get up to 80 hours of technical support (from the European Space Agency and/or partners); Up to €50,000 Incentive Funding for product development and patents; Business development support and advice; Access to the international ESA Commercialisation Gateway community and SBIC alumni network; Exclusive access to (international) events; Door opener to international investors via

[36] https://www.nlspacecampus.eu/
[37] https://www.sbicnoordwijk.nl/esa-bic/

EBAN; Workshops, seminars and training courses; Use the ESA BIC brand to boost the business.
Located on NL Space Campus is the field lab SCN AVATAR. This field lab is an VR/AR development center for the space industry poviding state-of-the-art AR/VR infrastructure, workspaces and a network of knowledge to our participants. The AVATAR center focuses on improving space engineering processes and data visualization using immersive technologies. The Avatar is an open innovation workplace that allows its participants to jointly develop tools, services and products by providing the infrastructure, the workspace, the network and the access to market. It is a collaboration between industrial and institutional parties in the Netherlands, who aim to optimize processes and procedures using their knowledge of VR and AR. Co-founding partners are TU Delft, NLR, RHEA and ATG Europe.
Also located at the NL Space Campus is the Galileo Reference Center (GRC). Galileo is operated and maintained under the aegis of the European GNSS Agency (GSA). One of the GSA's most vital tasks is to work to keep end-user needs at the center of the Galileo Programme, and the GRC is an important part of that process, monitoring the additional accuracy and availability delivered by Galileo and disseminating this information free of charge. GRC is responsible for performing independent monitoring and assessment of Galileo service provision; Assessing, when feasible, the compatibility and interoperability of Galileo vis-a-vis other GNSS; Providing service performance expertise to the Programme; Supporting investigations of service performance and service degradations; Providing an archiving service for performance data over the nominal operational lifetime of the system; and Integrating data and products from EU Member States, and Norway and Switzerland. CGI Netherlands is with S&T and NLR the founders of the GNSS Centre of Excellence. This initiative helps users, government and industry to raise the awareness on GNSS usage and improve the resilience of GNSS-based applications.

- ***Unmanned Valley Valkenburg***[38] *(Figure 26):* Unmanned Valley aims to bring together know-how from across the chain and help innovations in unmanned technology, autonomous systems and sensors to accelerate, grow and lead the European industry. Unmanned Valley is unique. The airspace can be used continuously and flexibly and a corridor to the sea makes BVLOS-flying possible (over land and sea). Unmanned Valley, located on the former naval airbase of Valkenburg, is in the heart of the area for the companies and knowledge institutions that together form the UAV industry and offers the space it seeks. Unmanned Valley supports entrepreneurship. Its ambition is to give a positive impulse to the innovative power and high-quality technical

[38] https://unmannedvalley.nl/en/

employment in the region. Unmanned Valley initiates research projects with a strong innovative character. Knowledge development and transfer is paramount, as well as the connection between training, research and knowledge institutions, companies and authorities. Unmanned Valley offers test facilities for indoor and outdoor, outside a controlled airspace (CTR) of active airports. A corridor to the sea makes BVLOS flights (over land and sea) possible. Unmanned Valley offers a modern working, learning and meeting environment that is tailored to the needs of the target group. The location should provide space for high-quality activity in a future-proof manner. Which type of communication technology is best for an application depends on the amount of data, the energy consumption and the frequency with which data is sent. Various networks are therefore available at Unmanned Valley, commercial and (soon) experimental. KPN has made various IoT-networks available for Unmanned Valley; LoRa, LTE-M, 4G and 5G (including their unique 5G services such as application priority, guaranteed bandwidth, and coverage on demand). Through this collaboration, companies can easily test and demonstrate all kinds of sensor-related applications that use the commercially available KPN networks.

Figure 26. (upper) Unmanned Valley Valkenburg and (lower) Drone center Unmanned Valley Valkenburg.

- ***Technology Park Ypenburg***[39] *(Figure 27):* Technology Park Ypenburg (TPY) is a high tech business park focused on businesses in sustainable aviation, space, medtech and light weight composite materials. The park offers an open community. The community members focus on developing innovative solutions in the field of high-tech manufacturing. Through collaboration and co-creation, innovative solutions have been developed in the TPY community. The Technology Park is located in the old Fokker Aircraft Factories in The Hague. After the aircraft company pulled out, there was a lot of high end production space available for starting companies that could use the left behind equipment. The 50.000 m2 facility was taken over bit by bit by companies like Aiborne Composites, KVE Composites, GTM Advaced Structures, Promolding and Aeroworkx amongst others. TPY has its own facilitating organization. It offers the following programs and activities. **Campus**: TPY is located near educational institutions such as TU Delft, InHolland, and The Hague University of Applied Sciences. At TPY, students have the ability to cooperate and co-create with fellow students from different schools, whilst networking with companies at our Production Center. This way, TPY offers a unique experience for students. Students have worked on various projects in the past at the TPY Scale-up & Innovation Center. Teams such as the DragonFly Team by InHolland Delft and the Formula- and EcoRunner Team by TU Delft have been welcomed at TPY. **Academy**: For tech students, TPY is the place to grab the opportunity to enhance their ability and increase their career possibilities. Alongside gaining multiple or single company experience from the TPY companies. TPY wants to encourage the development of talent no matter the stage of education or career. TPY student programmes vary from thesis writing and internships to training and summer school. Companies have the need to attract new talent and grow current talent. TPY companies benefit from the knowledge and talent of interns and graduated engineers, active in all contemporary fields of composites research. **Soft Landing**: TPY offers a solution to help people set up their business in the Netherlands with the softlanding programme to access the Netherlands and European markets. TPY helps people connecting with innovative peers from the high tech manufacturing industry, including lightweight composites, plastics- and metal materials, assemblies design and production, mechatronics, and automation solutions. TPY also has an extensive network in the aviation, space and medical markets. **Co-creation**: Co-creation is a big pillar within the TPY EcoSystem. TPY facilitates in various dimensions to make sure the members have everything they need to improve and achieve common goals. TPY drives events which are educational in content or challenging through events like “Hackathons” and “Makethons”. In addition, innovation projects are set up for products and processes and help find the appropriate local, regional, national and european funding initiatives to help accelerate your development. The community members focus on developing

[39] https://www.technologyparkypenburg.nl/

innovative solutions in the field of high-tech manufacturing through collaboration. **Machine portal**[40]: Technology Park Ypenburg and its members offer a wide range of machinery and facilities for prototypes, products or testing. These machines can be rented and booked through a machine portal. Cost includes use of the machine, operators and/or programming staff, and if applicable materials. Most of the machines and facilities are focussed on composites and high-tech manufacturing and include an automation & digitalisation lab, large autoclaves, CNC milling machines and various testing equipment.

Figure 27. Technology Park Ypenburg

- ***Rotterdam The Hague (Innovation) Airport***[41] *(Figure 28):* Rotterdam The Hague Airport (RTHA) is a small regional airport within the Rotterdam-The Hague region with around 2 million passager annually. The airport aims to be one of the first zero emission airports in the world and has therefor set up an innovation program. This program is run by an independent foundation: Rotterdam The Hague Innovation Airport (RHIA). The organization offers different programmes to the network partners. In close cooperation with the airport operational organization it is possible to perform different research and demonstrations projects. Of course daily operations and safety regulations are always a priority. But because of the limited use as a commercial airport the availability of open time slots makes it possible to perform these projects. Focus is mainly on digitization developments and sustainability of airport operations and sustainable flight operations. Some of the programs/capabilities are: **Airport Technology Lab (ATL)** which is a

[40] https://www.technologyparkypenburg.nl/machines
[41] https://stichtingrhia.nl/en/home-en/

development, testing and demonstration environment for innovative products and services for airports. The digitization of everything that happens at airports and the application of Artificial Intelligence is increasing exponentially and making applications at the airport more important. An open Operational Data Base of the airport processes is present at RTHA. This allows partners to test new digital or physical products in a simulated environment. **RTHA Campus**: The RTHA College is an initiative of the Albeda College in collaboration with RTHA and RHIA. In order to organize the service sector of the future and to train its people, collaborations have been entered into with companies and Albeda College in order to make a better connection between practice and theory for students and professionals. The focus is on the aviation sector and, among other things, experience places are realized at companies and internships. In this center for Hospitality, companies and other partners work together to join the next professional. The location of the college provides a unique connection between the education and the working environment at the airport. Albeda College takes the lead in developing a future-proof curriculum in the field of hospitality with new innovative learning-working method and learning-work arrangements. **Field Lab Next Aviation**: Under the Field lab Next Aviation program, various projects are being carried out, all of which aim to make the airport and flight operations more sustainable. For example, projects focus on the development of airport infrastructure and procedures for flying electric and hydrogen aircraft in the future. The first projects have been started to prepare the airport for handling aircraft with new energy carriers. **PHLAB**: The PHLAB is the test aircraft of TU Delft and NLR and is located at RTHA (https://cs.lr.tudelft.nl/citation/facility/). The Cessna Citation II "PH-LAB" has been converted into a flexible facility for advanced aviation research. Thanks to the installed instrumentation, and modifications to the aircraft, several classes of project are possible with this flying laboratory: a) Testing of new flight displays. The standard EFIS instrumentation for the right pilot station can be replaced by experimental screens, either one large screen in landscape mode, or two smaller screens in portrait mode. The experimental data acquisition system gives a developer access to a wide range of aircraft data that can be used to generate the screen's new image. b) Testing of flight control laws. The data acquisition system can be extended to a fly-by-wire configuration, in which the aircraft can be controlled in three axes with the autopilot actuators. Optionally pilot inputs can be included from a side stick mounted at the right-hand pilot station. c) Experiments with additional sensors and equipment. These require additional effort, but due to the flexible set-up of the data acquisition system and the availability of a WiFi link on-board for communication with additional displays and devices, as well as the possibility to use wired network links, truly customized experiments are possible. The backbone of the flying laboratory is an experimental control and data acquisition computer installed in a rack in the back of the airplane.

Figure 28. a) Rotterdam The Hague Airport and b) RTHA campus

7.4 Programmes and Policies

The Netherlands does not have a specific aerospace policy with funding programs. But there are different regional and national funding schemes for R&D activities in place where aerospace industry and research institutes can take part. For the aeronautics sector a large support program became available last year (385 mln euro). The program supports different projects that focus on developing technology for sustainable aircraft design. Research institutes and private companies are also active in European programs like Clean Aviation, Horizon Europe and ESA.

Table 7. List of programmes and policies

Name	Type	Segment	Description	Link
MIT-R&D	Regionaal program	R&D financial support	Not specific aerospace	MIT R&D-Samenwerkingsprojecten - Provincie Zuid-Holland
Kansen voor West (EFRD)	Regional program funded by EU	R&D financial support; specific support field labs	Not specific aerospace	Kansen voor West - Ontdek wat Europees geld aan kansen biedt!
RNIZ	Regional program	Financial support for network/cluster organisations	Not specific aerospace	Regionale Netwerken voor Innovatie Zuid-Holland, subsidie - Provincie Zuid-Holland
Regiodeal	Regional/National program	Financial support for specific regional challanges	Not specific aerospace	Regio Deals | Rijksoverheid.nl
Mobility Fund (2021)	National program (150 mln euro)	R&D financial post-covid support	For mobility sectors (automotive; maritime; aviation)	Subsidieregeling R&D Mobiliteitssectoren (RDM) (rvo.nl)
National Growth Fund	National program (20 bln euro)	R&D support for large innovation programs stimulation new economy;	Not specific aerospace; funding for laser sat com, aviation in transition program	Home | Nationaal Groeifonds

7.5 Connections

The region of Zuid-Holland is a relatively small area. Nevertheless every vertical has its own cluster organisation. In most cluster organisations InnovationQuarter plays a role and is the link between these organisations. Occasionally workshops and seminars are organised to stimulate cross-sectoral cooperation

Table 8. Intra-regional connections

Name	Type	Description	Link
Aerospace Delta	Network/cluster	International marketing and stimulation cooperation between different subclusters	www.aerospacedelta.nl
HI-Delta	Network	Network activities for high tech industry in the region	https://hidelta.nl/
Maritime Delta	Network/cluster	Network activities for Martime industry	https://www.maritimedelta.nl/
The Hague Security Delta	Network/cluster	Network activities for (Cyber)security cluster in The Hague	https://securitydelta.nl/

Because there is only a limited internal aerospace market in the Netherlands, institutes and companies are used to working internationally. They are supported by the national government with specific programmes for internationalisation and by their own industry associations. These programs are globally oriented. There are therefore only limited initiatives to cooperate from one region with another region in Europe. One of the few collaborations in this area is that between Zuid-Holland and the Stadt Bremen in Germany in the field of space.

Table 9. Inter-regional connection

Name	Type	Description	Link
Cooperation Zuid-Holland - Bremen	Action Agenda with working groups; including regional funding schemes	Stimulation of cooperation between the space clusters in Zuid-Holland and Bremen	https://www.zuid-holland.nl/politiek-bestuur/bestuur-zh/gedeputeerde-staten/besluiten/besluit/vaststelling-action-agenda-2019-2022-cooperation-in-the-space-sector-between-bre

8. Conclusions

The relevant stakeholders (public authorities, industry, RTOs, universities, investors, etc.) and their innovation and technical capabilities, as well as any already existing innovation programmes and policies, have been identified in each region.

Then the already established inter- and intra-regional connections, and possibly any relevant international connection, are identified.

Both for the identification of the capabilities and pre-existing networks and connections, an exhaustive screening of existing databases and directories has been performed.

As task result, an inventory has been created, containing stakeholders' relevant innovation and technical capabilities of each region, already established inter- and intra-regional connections, and possibly any established international connection.

The inventory that has been shown proves the richness and variety of the innovative ecosystem of the five regions that participate in the project. All segments and subsegments of the aerospace sector are well represented: leading universities and research centres, industry (both OEMs and their supply chains), space agencies, etc.

There are as well multiple connections already among the five regions through industry associations, university associations, multinational companies and even ESA, with sites in three out of the five regions.

From the point of view of programmes and policies, there are also some links, as a core on which build further connections and links between regional and national programmes and transnational programmes.

The results of the inventory prove that the consortium of AD-ASTRA can provide valuable inputs to the extension of the connections and links among the five paticipant regions, and others to come, contributing to consolidating the leadership of the European aerospace industry.

This activity and this inventory are clearly a first step in the common understanding of the five ecosystems and further improvement of this inventory will be managed during the project, in particular after the co-creation events. In this way the five ecosystems will be even better described and can be used as best practices to draw a joint action plan that will help each ecosystem to grow up.

Annex. Inventory

A1. Emilia-Romagna

Table A1.1. Stakeholders

Name	Type	Segment	Specify	Sub-segment	Web-site
ART-ER	Consortium	Other	Innovation	Aerospace (with a division)	https://www.art-er.it/
CINECA	RTO	Other	HPC	Big Data Management	https://www.cineca.it/
Clust-ER Innovate	Cluster	Other	Tech Transfer	downstream application	https://innovate.clust-er.it/
Clust-ER Meccatronica e Motoristica	Cluster	Other	Tech Transfer	Aerospace (with a division)	https://mech.clust-er.it/
Centro Euro-Mediterraneo per i Cambiamenti Climatici (CMCC)	RTO	Space	R&D	data modeling	https://www.cmcc.it/it
Consiglio Nazionale delle Ricerche (CNR)	RTO	Other	R&D	materials	https://www.imem.cnr.it/; https://www.istec.cnr.it/
Confindustria Emilia-Romagna	Association	Other	other	aerospace (with some associate)	https://www.confind.emr.it/

Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile (ENEA)	RTO	Other	R&D	materials	http://www.enea.it/
Istituto Nazionale di Astrofisica (INAF)	RTO	Space	R&D	Astrophysics	https://www.oas.inaf.it/it/
Istituto Nazionale di Fisica Nucleare (INFN)	RTO	Other	R&D	deep tech physiscs	https://www.bo.infn.it/
Istituto Nazionale di Geofisica e Vulcanologia (INGV)	RTO	Other	R&D	Geophysics	https://www.bo.ingv.it/
Università di Bologna	University	Other	R&D	Aerospace (with a department)	https://www.unibo.it/it
CIRI Aerospace	RTO	Aerospac e	Industrial R&D	Aerospace	https://centri.unibo.it/aerospace/en
Università di Ferrara	University	Other	R&D	Aerospace (with a department)	https://www.unife.it/it
Università di Modena e Reggio Emilia	University	Other	R&D	Aerospace (with a department)	https://www.unimore.it/
Università di Parma	University	Other	R&D	Aerospace (with a department)	https://www.unipr.it/
Curti	Industry	Aviation	Production	Helycopters (with a department)	https://www.curti.com/

ECMWF	RTO	Space	R&D	data modeling	https://www.ecmwf.int/en/about/location/ecmwf-bologna
GECO Sistema	Industry	Space	Service	Earth Observation	https://gecosistema.com/
HIGHFTECH	Industry	Space	R&D and production	Satellites and payload	https://www.highftech.com/
NPC-Spacemind	Industry	Space	Production and services	Satellites	https://www.npcspacemind.com/store/
Studio Mapp	Industry	Space	Service	Earth Observation	https://www.studiomapp.com/
ISTEC	RTO	Aerospace	R&D	materials	https://www.istec.cnr.it/
Jacobacci	Industry	Other	Service	intellectual property	https://www.jacobacci.com/
DALLARA	Industry	Aerospace	production	materials	https://www.dallara.it/it
NANOPROMM	Industry	Aerospace	production	coatings	https://nanoprom.it/
MEEO	Industry	Aerospace	Service	Earth Observation	https://www.meeo.it/
PRADELLI GIANCARLO SRL	Industry	Aerospace	production	Components	https://pradelligiancarlo.it/
ANSER	cluster	Aerospace	Service	/	https://www.anser-it.it/

Nautilus	Industry	Space	Service	Deep Space	https://www.spacenautilus.com
Cshark	Industry	Space	Production and services	Satellites	https://cshark.it/
Zephyr	Industry	Aviation	Production and services	Drones	https://www.zephyraerospace.com/
Wamblee s.r.l.	Industry	Aviation	Production	Avionics	https://www.wamblee.it/
mw.fep spa	Industry	Aviation	Production	Avionics	https://www.mwfep.com/
L3Harris Calzoni	Industry	Aerospace	Production	Systems and products	https://www.l3harris.com/
DTM srl	Industry	Aerospace	Production and services	Components	http://www.dtm.it
Poggipolini	Industry	Aviation	Production	Fastners	https://poggipolini.it/
AdapTronics	Industry	Space	Service	Space Logistic and Robotics	https://www.adaptronics.it/
Bercella	Industry	Aerospace	production	materials	https://bercella.it/
SITAEL	Industry	Space	production	Satellites	https://www.sitael.com/
beam-it	Industry	Aerospace	Service providers	Metal 3D printing	https://www.beam-it.eu/
IR4I	Cluster	Aerospace	Service	/	http://www.ir4i.it/
Motridal	Industry	Space	Production		https://www.motridal.com/
Hypertec Solution	Industry	Aerospace	Service	Designing services for systems and components	https://hypertec.it/

Novac	Industry	Aerospac e	Production	Components for energy storage (capacitors)	https://www.novacsupercap.com/
ICSC National Research Centre for High Performance Computing, Big Data and Quantum Computing	RTO	Space	R&D	HPC	https://www.supercomputing-icsc.it/

Table A1.2. Capabilities

Technical & Innovation				
Name	**Owner**	**Type**	**Description**	**Website**
CICLoPE (Centre for International Cooperation in Long Pipe Experiments)	Alma Mater Studiorum - Università di Bologna	R&D	The Centre for International Cooperation in Long Pipe Experiments (CICLoPE) is a research laboratory which allows the worldwide best space and time resolved measurements in turbulent pipe flows.	https://site.unibo.it/ciclope/en
Laboratory for Assembly Integration and Verifications of	INAF - Istituto Nazionale di Astrofisica	R&D	In this room, integration and assembly activities of large space equipment and qualification tests of	https://www.oas.inaf.it/en/

optical/infrared instruments (INAF/OAS-Bologna)			scientific equipment are carried out, as well as simulation activities in a space environment with the use of a thermobaric chamber and the use of overhead cranes for handling loads.	
Square Kilometre Array Observatory (SKAO)	INAF - Istituto Nazionale di Astrofisica	R&D	Radio astronomy infrastructure which includes two radio telescopes under construction in South Africa (SKA-MID) and in Australia (SKA-LOW). Bologna is a candidate to host important structures, including one of the poles of the worldwide network of SKA Regional Centres.	https://www.skao.int/en/partners/skao-members/292/italy
CTA - Cherenkov Telescope Array	INAF - Istituto Nazionale di Astrofisica	R&D	International infrastructure for the construction of two large astronomical observatories, one in the northern hemisphere on the island of La Palma, Canary Islands, and one in the southern hemisphere at Cerro Paranal in the Atacama desert in Chile. CTA will study the Universe through high energy range (TeraElectronVolt) revealed by the Cherenkov effect. The CTA Headquarters are currently in Bologna.	https://www.oas.inaf.it/en/projects/cta-en/

Tecnopolo Manifattura - Data Valley Hub	Public	R&D	The Technopole hosts some of the most powerful High Performance Computers (HPC) in the world and is the international reference for Supercomputing, Big Data and Artificial Intelligence.	https://www.tecnopolomanifattura.it/en
LARIX Facility	Public	R&D	The LARIX is a multi-project facility designed to meet requirements that span data engineering, X-ray diagnostics, detector calibration, crystallography test and mainly for astronomical applications.	https://larixfacility.unife.it/

Business innovation			
Name	**Type**	**Description**	**website**
Primo Space Fund (national)	Private funding	Primo Space Fund is a seed and early stage venture capital fund focused on skyrocketing the potential of space tech projects developed by brilliant teams.	https://www.primo.vc/primospace

Table A1.3. Programme and Policies

Name	**Type**	**Segment**	**Description**	**Link**
CALL FOR RESEARCH AND EXPERIMENTAL DEVELOPMENT PROJECTS	Regional programme	Industrial innovation	Not specifically devoted to aerospace, but this could be an instrument also for enterprises in the aerospace sector	https://fesr.regione.emilia-romagna.it/opportunita/2022/progetti-di-ricerca-e-sviluppo-

for enterprises			willing to innovate.	sperimentale
CALL FOR RESEARCH AND EXPERIMENTAL DEVELOPMENT PROJECTS for Laboratories	Regional programme	Industrial innovation	Not specifically devoted to aerospace, but this could an instrument also for laboratories in the aerospace sector willing to innovate.	https://fesr.regione.emilia-romagna.it/opportunita/2022/progetti-di-ricerca-industriale-rivolti-agli-ambiti-prioritari-della-strategia-di-specializzazione-intelligente-2023-2024
Regional S3	Regional programme	Innovation	In E-R S3 programme Aerospace is recorded as a key priority for the next activities, being a sector with an High development potential for the region.	https://fesr.regione.emilia-romagna.it/s3/2021-2027
Strategic Plan Space Economy	National programme	Innovation in Space Economy	The Plan is divided into 5 programmatic lines, in line with the initiatives carried out at European level and with the aim of maximizing their impact at national level: Satellite Telecommunications (Mirror GovSatCom) Support for national participation in GALILEO (Mirror Galileo) Galileo PRS infrastructure Support for Copernicus (Mirror Copernicus) Space exploration and related technological developments.	https://www.mise.gov.it/it/impresa/competitivita-e-nuove-imprese/space-economy

PNRR -The Recovery and Resilience Plan: Next Generation Italia	National programme	Recovery and Resilience Plan	The National Recovery and Resilience Plan (PNRR) applied to space projects (Investment M1C2.4) is aimed at enhancing satellite communication and Earth observation systems for monitoring territories and outer space and strengthening national skills in space economy and in space access assets: satellite technologies and space economy. The strategy envisages 4 investment lines whose overall plan amounts to over 2.3 billion euros (1.5 billion euros from the PNRR and 0.8 billion euros from the Complementary Fund): SATCOM (INVESTIMENTO M1C2.4.1) OSSERVAZIONE DELLA TERRA (INVESTIMENTO M1C2.4.2) SPACE FACTORY (INVESTIMENTO M1C2.4.3) IN-ORBIT ECONOMY (INVESTIMENTO M1C2.4.4)	https://www.governo.it/sites/governo.it/files/PNRR.pdf

Table A1.4. Connections

Intra-regional			
Name	**Type**	**Description**	**web-site**
Strategic forum for the promotion of the regional aerospace supply chain	working group	A strategic regional asset to promote the regional supply chain of the aerospace sector, allowing manufacturing companies and services in the sector to contribute to national development.	https://www.breakinglatest.news/business/aerospace-emilia-obtains-funds-for-the-first-five-hi-tech-projects/
Clust-er mech - VC Fly.er	cluster	Regional cluster on mechatronics and motoristic with a specific working group on aerospace.	https://mech.clust-er.it/value-chain/fly-er/
ANSER	cluster	Regional cluster of companies on aerospace topics	https://www.anser-it.it/
IR4I	cluster	Regional cluster of companies on aerospace topics	http://www.ir4i.it/index.aspx?lng=eng

Inter-regional			
Name	**Type**	**Description**	**web-site**
CTNA (National Technological Cluster on Aerospace)	cluster	This is a national cluster for regions, specifically dedicated to Aerospace	https://www.ctna.it/
AIAD	association	Italian Industries Federation for Aerospace, Defence and Security	https://aiad.it/

AIPAS	association	Association Of Italian Space Enterprises	https://aipas.it/en/
ASAS	association	Association for Space-based Applications and Services	https://www.asaspazio.it/

European			
Name	**Type**	**Description**	**web-site**
AD-ASTRA	Eu-Project	Aerospace Districts: Acceleration of the Strategic Transfer of Regional Advancements	https://aerospacedistricts.eu/
Nereus	association	Network of European Regions Using Space Technologies	https://www.nereus-regions.eu/
Pegasus	association	PEGASUS is the partnership of the best European aerospace universities and currently has 30 members in 12 different European countries.	https://www.pegasus-europe.org/

A2. Madrid

Table A2.1. Stakeholders

Name	**Type**	**Segment**	**Specify**	**Sub-segment**	**website**
Universidad Politécnica de Madrid (UPM)	University	Other	Innovation, Tech transfer	Several	www.upm.es

Universidad Carlos III (UC3M)	University	Other	Innovation, Tech transfer	Electric propulsion	https://www.uc3m.es
Universidad de Alcalá de Henares (UAH)	University	Other	Innovation	Astrophysics	https://www.uah.es/es
Instituto Nacional de Técnica Aeroespacial (INTA)	RTO	Aerospac e	Innovation, Tech transfer	Several	https://www.inta.es/INTA
ESA-ESAC	RTO	Space	Innovation	Astrophysics	https://www.esa.int/About_Us/ESAC
CDTI	Public authority	Aerospac e	Funding industry	Ministry of Science	https://www.cdti.es
Fundación Madri+d	Public authority	Aerospac e	Funding science	Madrid regional government (CAM)	https://www.madrimasd.org
DGAC	Public authority	Aviation	Civil aviation authority	Ministry of Transport	https://www.mitma.gob.es/aviacion-civil/organizacion-y-funciones/secretaria-general-de-transporte-y-movilidad/direccion-general-aviacion-civil
AESA	Public authority	Aviation	Inspection authority	Safety	https://www.seguridadaerea.gob.es
Airbus	Industry	Aerospac e	Design, product and services	Aircraft OEM, Space prime	https://www.airbus.com/en/our-worldwide-presence/airbus-in-europe/airbus-in-spain
Thales Alenia Space	Industry	Space	Electronic equipment	Space prime	https://www.thalesgroup.com/es/espana/espacio
GMV	Industry	Space	Design, product and services	Mission analysis, ground segment	https://www.gmv.com/es-es
Deimos	Industry	Space	Design, product and services	Mission analysis	https://elecnor-deimos.com/es/inicio-es

SENER	Industry	Space	Design, product and services	Mechanisms	https://www.group.sener
Tecnobit	Industry	Space	Components	Electronic, optical	https://grupooesia.com/tecnobit
Arquimea	Industry	Space	Components	Electronic, optical	https://www.arquimea.com/es
Lidax	Industry	Space	Components	Electronic, optical	http://www.lidax.com/en
Iberespacio	Industry	Space	Subsystems	Thermal control	https://iberespacio.es
Indra	Industry	Aerospac e	Design, product and services	Systems	https://www.indracompany.com
Hispasat	Industry	Space	Communication s	Satellite operator	https://www.hispasat.com/es
Hisdesat	Industry	Space	Communication s, Observation	Satellite operator	https://www.hisdesat.es
ITP	Industry	Aviation	Design, product and services	Engines	https://www.itpaero.com/es
Aciturri	Industry	Aviation	Tier 1	Aircraft structures	https://www.aciturri.com/es
TEDAE	Associatio n	Aerospac e			https://www.tedae.org/es
Plataforma Aeroespacial Española	Associatio n	Aerospac e			https://plataforma-aeroespacial.es
Fundación para el Conocimiento madri+d	Public authority	Other	Regional public funding body		http://www.madrimasd.org/
Institutos Madrileños de Estudios Avanzados (IMDEA)	RTO	Other	Research centre in materials	Materials	https://materials.imdea.org/the-center/who-we-are/

Table A2.2. Capabilities

Technical & Innovation				
Name	**Owner**	**Type**	**Description**	**web-site**
Aerospace test facilities	INTA	R&D	Structural Testing, Electromagnetic Compatibility, Mass Properties, Mechanical and climatic Tests, PIM, Multipactor, Corona, Power Handling Tests, solar cells, coupon and photovoltaic panel tests services, Electronic Technologies, Radiofrequency and Communication, Common/Transversal disciplines: materials & structures, aerodynamics & propulsion, metrology & calibration	https://triasrnd.com/en/inta
Concurrent Design Facility (CDF)	Universidad Politecnica de Madrid	R&D	Facility to perform mission analysis by applying systems engineering and concurrent engineering	https://www.idr.upm.es/index.php/es/tecnologia-aeroespacial
Aircraft design, manufacturing and integration	Airbus	Product development		
Satellite design, manufacturing and testing	Airbus	Product development		

Business innovation			
Name	**Type**	**Description**	**web-site**
ESA-BIC	Incubator	Business incubator managed by ESA and the Madrid regional government	http://www.madrimasd.org/emprendedores/esa-bic-comunidad-madrid

Table A2.3. Programme and Policies

Name	Type	Segment	Description	link
PERTE Aeroespacial -The Recovery and Resilience Plan: Next Generation in Spain	National programme with EU funds	Recovery and Resilience Plan	PERTE will accompany the sector in the decarbonization of air transport, digitization of manufacturing environments; aerospace R+D+I for new services and new technologies; It will promote and accompany new actors in the space field.	https://planderecuperacion.gob.es/como-acceder-a-los-fondos/pertes/perte-aeroespacial
Plan Aeronáutico	National programme (partly) with EU funds	Recovery and Resilience Plan and National funds	The Aeronautical Technological Program (PTA) aims to finance intensive strategic initiatives in R&D carried out by a group of companies, whose objective is to contribute to the development of relevant technologies for application in the aeronautical field. More specifically, the aim is to significantly reduce the environmental impact of aeronautical technologies, increasing the efficiency of future aircraft and reducing	https://www.cdti.es/index.asp?MP=100&MS=924&MN=2

			polluting emissions from air transport; without forgetting other strategic technological challenges such as systems, UAS or intelligent and advanced manufacturing. The PTA is included among the actions planned in the National Recovery, Transformation and Resilience Plan, which will receive financing from the "Next Generation EU" funds, including the Recovery and Resilience Mechanism.	
Plan Estatal de Investigación	National research programme	Space	National research programme in space, science oriented	https://www.aei.gob.es/convocatorias/planes-estatales
Plan Regional de Investigación científica e innovación tecnológica	Regional research programme	multi-sectorial	Regional research programme, open to different sectors	https://mcyt.educa.madrid.org/madrid-ciencia-tecnologia/planes-regionales/vi-pricit

Table A2.4. Connections

Inter-regional			
Name	**Type**	**Description**	**web-site**

TEDAE	association	Association of aerospace companies in Spain. It has regional branches, one in Madrid	https://www.tedae.org/es
Plataforma Aeroespacial Española	association	Association of all stakeholders related to aerospace to interface with the public authorities	https://plataforma-aeroespacial.es

European			
Name	**Type**	**Description**	**web-site**
PEGASUS	association	Association of aeronautics and space Universities	https://www.pegasus-europe.org/
Erasmus +	Eu-Project	Mobility of University students and staff	https://erasmus-plus.ec.europa.eu/
EASN	association	European Aeronautics Science Netwrok	https://www.easn.net/
CEAS	association	Council of European Aerospace Societies	https://ceas.org/
EREA	association	Association of European Research Estabishments in Aeronautics	https://erea.org/
ASD	association	European Aerospace, Security and Defence Industries	https://www.asd-europe.org/
ESA	agency	Sites in Madrid, Occitania and South Holland	https://www.esa.int/
Airbus	industry	Aerospace OEM with sites in Madrid and Occitanie	https://www.airbus.com/

A3. Toulouse Métropole (Occitania)

Table A3.1. Stakeholders

Name	Type	Segment	Specify	Sub-segment	website
Académie de l'air et de l'espace	Association	Aerospace			https://academieairespace.com/?lang=en
Aerospace Valley	Cluster	Aerospace			https://www.aerospace-valley.com/
ENAC	University	Aviation			https://www.enac.fr/fr
ISAE SUPAERO	University	Aerospace			https://www.isae-supaero.fr/en/
Région Occitanie	Public authority	Other			https://www.laregion.fr/
IRT Saint Exupéry	RTO	Other	Technological research Institute		https://www.irt-saintexupery.com/
Club Galaxie	Association	Space			https://www.club-galaxie.com/
ONERA	RTO	Aerospace			https://www.onera.fr/fr/centres/toulouse
AIRBUS	Industry	Aviation			https://www.airbus.com/en
Airbus Defense and Space	Industry	Space			https://www.airbus.com/en/products-services/space

Thales alenia Space	Industry	Space			https://www.thalesgroup.com/en/cybersecurity-space
Kineis	Industry	Space		IoT constellation	https://www.kineis.com/
Loft Orbital	Industry	Space		shared satellite (design, build, operations)	https://www.loftorbital.com/
Comat	Industry	Space		Equipment manufacturer	https://comat.space/
Mecano-ID	Industry	Space		Equipment manufacturer	https://www.mecano-id.fr/fr/entreprise/
Telespazio	Industry	Space		Operations	https://www.telespazio.fr/fr/home
Cerfacs	RTO	Space		Laboratory	https://cerfacs.fr/#
OMP	RTO	Space		Laboratory	https://www.omp.eu/
CNES	Public authority	Space		French Space Agency	https://cnes.fr/fr
IRAP	RTO	Space		Laboratory	https://www.irap.omp.eu/
CSUT	Association	Space		University Space center	https://www.csut.cnrs.fr/
Tech The moon	Association	Space		incibator of space projects	https://techthemoon.com/
ESSP	Industry	Space		GNSS	https://www.essp-sas.eu/
IPSA	University	Space		University	https://www.ipsa.fr/

ESA BIC	Industry	Space			https://www.esabicsud.fr/
Anywaves	Industry	space		Equipment manufacturer	https://anywaves.eu/
Space Founders	Association	space		Acceleration program	https://www.spacefounders.eu/
Erems	Industry	space		Equipment manufacturer	https://www.erems.fr/fr/
Ternwaves	Industry	space		Software	https://www.ternwaves.com/About-Us
AOWS - OneWebSatellites	Industry	space		Satellite designer	https://airbusonewebsatellites.com/about-us/
ACTIA	Industry	space		Equipment manufacturer	https://www.actia.com/fr
Syntony	Industry	space		Equipment manufacturer	https://syntony-gnss.com/
Exotrail	Industry	space		Equipment manufacturer	https://www.exotrail.com/
CS-group	Industry	space		Software	https://www.csgroup.eu/fr/
Pangea Aerospace	Industry	space		Equipment manufacturer	https://pangeaaerospace.com/
Infinite Orbits	Industry	space		Constellation	https://www.infiniteorbits.io/
Zephalto	Industry	space		Space Tourism	https://zephalto.com/
uspace	Industry	space		Satellite designer and manufacturer	https://www.u-space.fr/

Hemeria	Industry	space		Satellite designer and manufacturer	https://www.hemeria-group.com/
Prométhée	Industry	space		Constellation	https://www.promethee.earth/en/
Commandement de l'ESPACE	Public authority	space		Constellation	https://air.defense.gouv.fr/cde/le-commandement-de-lespace
BRICKS	Association	space		Bespoke Training for space	
DAHER	Industry	Aviation		Equipment manufacturer	https://www.daher.com/
Safran	Industry	Aviation		Equipment manufacturer	https://www.safran-group.com/fr
ATR	Industry	Aviation		Equipment manufacturer	https://www.atr-aircraft.com/
Cité de l'espace	Association	Space		Museum	https://www.cite-espace.com/
Observatoire Midi-Pyrénées	University	Space		R&D	https://www.omp.eu/
Latecoere	Industry	Aerospace		Equipment manufacturer	https://www.latecoere.aero/en/
Medes Institute for Space Medicine and Physiology / Space Clinic	University	Space		R&D	http://www.medes.fr/en/index.html
Mecachrome	Industry	Aerospace		Equipment manufacturer	https://www.mecachrome.com/
Meteo France	RTO	Space		R&D	https://meteofrance.fr/

SIRIUS	University	Space		R&D	https://chaire-sirius.eu/

Table A3.2. Capabilities

Technical & Innovation				
Name	**Owner**	**Type**	**Description**	**web-site**
CARIOQA-PMP project	Airbus, iXblue, TELETEL, LEONARDO	R&D		
Arlas exploration	Gisaia	Product development	filter and visualise both historical and real-time spatial data and view distribution over time and space, as well as other numerical indicators.	
Multi-telescope observation stations	ShareMySpace	Product development	Modular optical system that enables the detection, tracking and characterization of all space objects in sight, across all orbits.	
vorteX-io hydrological micro-station	vorteX-io	R&D	service is based on the deployment of a network of new generation instruments, micro-stations. Their technology, inherited from space altimetry, guarantees centimeter level accuracy of the measured hydrological parameters.	
Last generation of side by side two seater aircraft	Aura Aéro	Product development	Regional electric aircraft	

Aircraft with hydrogen propulsion	Beyond Aero	Manufacturing	First aircraft designed for hydrogen propulsion	
Hyperloop	Hyperloop Transportation Technologies	Product development	Hyperloop is a vacuum tube-based system that moves people and goods in levitating capsules at airplane speeds on the ground. These speeds are achieved by using passive magnetic levitation technology and a linear electric motor in a tube with minimal pressure, reducing resistance. As a mobility solution with transformative power, hyperloop is potentially cleaner, safer, healthier, and more efficient than existing forms of transportation.	
Mercator System	Mercator Ocean	R&D	ocean science-based services of general interest focused on the conservation and the sustainable use of the ocean and marine resources	
Antennas	Anywaves	Product development	A new generation of miniature and high-performance antennas designed according to space standards as an answer to the satellites constellations market's needs	
Geolocation testing lab	Guide GNSS	R&D	GNSS testing laboratory with ISO17025 accreditation based on European standards EN 16803 to assess positioning systems in real environments or in similar conditions	
Cockpit / Payload Hub	Loft Orbital	R&D	Cockpit is Loft's satellite operations software that empowers end-users with powerful satellite constellation management capabilities while abstracting away the complexity of spacecraft operations he Payload Hub is Loft Orbital's universal interface that enables the rapid integration of payloads without placing any limitations on their development. The Hub also serves as the spacecraft's 'brain' - controlling payloads and managing dataflow and resources between the onboard payloads and the	

			satellite bus.	
GEO Life extension / Space surveillance	Infinite Orbits	Product development	Life Extension Services for GEO satellites. Support in fleet management decisions, in the extension of lifetime of assets and replacement of heavy capital investment by an operational service. Infinite Orbits provides In-Site Intelligence for Space Surveillance, covering SST, SSA and SDA. Thus, responding to a significant need of operating satellites.	
Operations and service provision of EGNOS, the European Geostationary Navigation Overlay Service	ESSP	R&D	EGNOS is a satellite based augmentation system which delivers precise satellite positioning on top of GPS to make it suitable for safety critical applications such as landing aircrafts or navigating ships through narrow channels.	
Next generation satellites	U-Space	Design	U-Space accompanies you through your project, starting as early as the feasibility study, to convert your needs into an operational project.	
Certification programme for astronaut	Space Flight Institute	Product development	THE WORLD'S FIRST COMMERCIAL ASTRONAUT CERTIFICATION PROGRAM	
Training center for	Satys	Product development	Satys is active in aircraft painting and sealing, engineering and manufacturing interiors for the aerospace and railway sectors.	

painters				
Advanced propulsion technology thanks to additive manufacturing	Pangea Aerospace	Product development	In October 2021, Pangea Aerospace fired the first ever aerospike engine using liquid methane and liquid oxygen as propellants. DemoP1 is a 20kN thrust engine, fully additively manufactured in only two pieces.	
CSUT	CSUT	Product development	Organizes the development and the realization of collaborative and innovative projects of space nano-systems using mainly nano-satellites (Cubesats) or stratospheric balloons flights to realize scientific or technological missions. It participates in the training of future actors of the space domain and supports the research actions of its members or partners in the field of miniaturized space systems.	
Solutions combining satellite imagery and local information for local authorities and their delegates	MEOSS	Product development	MEOSS offers operational decision-making tools for the management and enhancement of territories.	
	Honeywell	MRO		

	Aerospace			
Space Mobility solutions	Exotrail	Product development	Exotrail is an end-to-end space mobility operator. Our mission is to enable small satellites to move in space, optimise their deployment, increase their service performance, and reduce space pollution.	
Atea	Ascendance Flight Technologies	Product development	vertical take-off and landing aircraft (VTOL) designed as a clean, quiet and efficient advanced air mobility solution. With a range of 400km+ and a turn-around time of only 10min thanks to our unique hybrid propulsion system, our aircraft meets the operational requirements of aerial mobility providers today for a wide range of missions such as passenger transportation, Emergency Medical Services, sightseeing, or Surveillance and Patrol.	
Unmanned and manned H2 crafts	H3 Dynamics	Product development	New hydrogen electric flight configuration based on distributed hydrogen electric propulsion pods, self-contained, and collaborative - opening to new and radically different aircraft designs.	
Dragonfly	Blue Spirit Aero	Product development	Proprietary electro-propulsive technology optimised for clean performance.	
Multiple services	Collins Aerospace	MRO	Avionics for civil rotary-wing aircraft (Blagnac)	
Kineis chipset IoT Constellation	Kineis	Product development	The Kinéis chipset is a radio frequency chip that provides satellite connectivity to any mobile phone. This constellation of nanosatellites, the basis of Kinéis connectivity, is unprecedented. It has been custom-developed for the Internet of Things with	

			strategic partners.	
MRO and modification services	Sabena Technics	MRO	French leading independent provider of maintenance (MRO) and modification services for civil and military aircraft operators.	

Business innovation			
Name	**Type**	**Description**	**web-site**
Toulouse Tech Transfer	Accelerator	Toulouse Tech Transfer creates value from academic research in Toulouse by bringing together laboratories and companies.	
Booster Nova	Accelerator	Launch, develop and accelerate business by exploiting data produced by satellites in orbit, for a high value-added business.	
Nubbo	Incubator	Support to start ups until 50k€	
French Tech Toulouse	cluster	Help to start ups and scale ups	
B612	Accelerator	« B612 Accélération » proposes two support programs: DISTRICT and Cockpit.	
District by Aerospace Valley	Accelerator	The innovation booster aims to support innovative companies developing an Aerospatial activity with a strong digital technology component.	
ESABIC Sud de France	Accelerator	Business Incubation Center supported by ESA	
Toulouse Aerospace	Incubator	Aerospace campus	

Aerospace Angels	Private funding	Network of business angels specialised in aeronautics and space	
TechtheMoon	Incubator	Dedicated to Moon projects	
Irdi Capital Investissement	Private funding	Funding for innovative projects	

Table A3.3. Programme and Policies

Name	Type	Segment	Description	web-site
France 2030	NextGenerationEU	innovation	Call for proposals	
Défi clé "Observatoire de la Terre et des territoires"	Regional	R&D	The key challenges of Region Occitanie aim at positionning the region as leader in those topics	
Plan ADER 4	Regional	R&D	4th regional plan since 2001 in cooperation with the state	
Recovery plan for the aeronautics and space sectors	Regional	R&D	Recovery plan of 100 M€ launched in July 2020 during COVID-19 crisis	
Plan Aviation Vert	Regional	R&D	Testbed at Francazal, innovation in SAF etc.	
Revenu écologique jeune	Regional	innovation	Monthly income for young people under 29 YO willing to engage in a green professional project.	

All Region Occitanie tools are currently on hold following the adoption of new regional schemes in November 2022. They will be available in 2023.	

Table A3.4. Connections

Intra-regional			
Name	**Type**	**Description**	**web-site**
Hub Entreprendre Occitanie	association	Web portal on funding opportunities in Occitanie	
LIGHT, LOW CARBON AVIATION – MAELE	working group	brings together a community of innovative regional players in the field of light, low-carbon air mobility.	
Aerospace Valley	cluster	Aerospace Valley is the leading European competitiveness cluster in the aerospace sector serving 3 strategic sectors in Occitanie/Pyrénées-Méditerranée & Nouvelle-Aquitaine regions.	
Primus	cluster	PRIMUS Defense & Security's objective is to promote the growth of companies' turnover and workforce by conquering new markets and developing internationally. It relies on the Occitanie region's industrial pool, especially in aeronautics and space, and contributes to the development of the region through its activities.	
Association Spatiale Toulousaine de Recherche Étudiante	association	The ASTRE (Toulouse Space Association for Student Research) was created on the 5th october 2017 by ten students from INSA (National Institute of Applied Sciences). Open to everyone, students from the University of Toulouse and three engineering school (INSA, ENSEEIHT, ENAC) meet in the association.	

		Our main goal is to constitute an organization where students can learn about space engineering thanks to technical and concrete projects. The heart of the association is powered by the experience and by sharing between our members.	
Association les amis de la Cité de l'Espace	association	Recognized as being of general interest, its vocation is to promote science, technology and space applications to all audiences, especially the youngest. It uses the facilities of the Cité de l'espace in Toulouse to illustrate its action in favor of the promotion of SCIENTIFIC CULTURE.	
Campus des métiers et des qualifications d'excellence	association	Brings together partners, training establishments, companies, research centers and institutions at the service of the aeronautics and space sector.	
Newspace Factory	association	Group of French SMEs with complementary skills and extensive experience in the space sector, with the aim of offering a complete, flexible and easily accessible portfolio of solutions geared towards international markets.	

Inter-regional			
Name	**Type**	**Description**	**web-site**
Entente Montréal-Toulouse	working group	Entente de coopération avec la Ville de Toulouse afin de poursuivre leurs objectifs mutuels de croissance et de développement dans des secteurs économiques de pointe, dont l'aérospatiale, l'intelligence artificielle, les industries culturelles créatives et le tourisme. Ces domaines d'intérêt commun seront au cœur de leurs échanges et permettront le partage d'enjeux communs, de pratiques exemplaires et d'initiatives innovantes mises en place pour soutenir le développement économique.	

Académie de l'air et de l'espace	association	AAE is composed of members who hold or have held significant responsibilities in their respective fields related to aeronautics and space. From a wide variety of backgrounds, engineers, industrialists, researchers, managers, pilots, astronauts, doctors, lawyers, economists, journalists, writers and artists all work together. They constitute a pool of knowledge unique in Europe aimed at promoting and furthering the development of high quality scientific, technical, cultural and human activities in the fields of Air and Space.	

European			
Name	**Type**	**Description**	**web-site**
Eurocities	association	multithematic	
EIT Urban	Eu-Project	urban mobility	
Réseau NEREUS	association	As Network of European Regions Using Space Technologies, NEREUS offers a dynamic platform to all Regions aiming at making a better use of space applications for the delivery of efficient public policies benefiting citizens.	
Gazelle Accelerator	Eu-Project	The Gazelle Accelerator programme is an European project created in 2020 and co-funded by the EIT Manufacturing. This activity is coordinated by Aerospace Valley with the help of other European partners involved such as Atos, RoboHouse, LINPRA, LMS, FGB and Fast Track Actions. The Gazelle Accelerator aims at : 1 : identify industrial needs and challenges from manufacturing companies in	

		Europe 2 : find innovative solution to answer these challenges 3 : organise meetings between start-ups and industrials or investors	
AZEA	working group	Alliance for Zero Emission Aviation. Signatories : Aerospace Valley, Occitanie Region, Safran etc.	
ECARE	Eu-Project	Developing a European Clean Aviation Regional Ecosystem (ECARE)	
UNIVERSEH	Eu-Project	UNIVERSEH is an alliance of five young and mature universities from five European countries. It was established in November 2020 to develop a new way of collaboration in the field of Space, within the new "European Universities" initiative promoted by the European Commission.	

A4. Puglia

Table A4.1. Stakeholders

Name	Type	Segment	Specify	Sub-segment	website
Universita del Salento	University	Other	R&D	Aerospace	
Università di Bari	University	Other	R&D	Aerospace	
Politecnico di Bari	University	Other	R&D	Aerospace	
Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile (ENEA)	RTO	Other	R&D	Characterization of materials	
Consiglio Nazionale delle Ricerche (CNR)	RTO	Other	R&D	Downstream applications,	

				Data modeling	
ReCas	Consortium	Other	HPC	Big Data Management	
Leonardo	Industry	Aerospace	Design, production and services	Aerospace	
Salver	Industry	Segment	Production	Aeronautical Components	
Avio Aero	Industry	Aviation	Design, production and services	Aeronautic Engines (for Commercial Aviation)	
CETMA	RTO	Other	Tech Transfer	Composites, Simulations and modeling, Data modeling	
OPTEL	RTO	Segment	Innovation	Optical physics	
Enginsoft	Industry	Other	Service	Simulations and modeling	
International Aviation Supply	Industry	Aviation	Design, production and services	Unmanned systems	
Planetek	Industry	Space	Service	Earth Observation	
CMD	Industry	Aviation	Design, production and	Aeronautic Engines (for General Aviation)	

			services		
SITAEL	Industry	Space	Design, production and services	Satellite, Space engines	
DEMA	Industry	Aviation	Production	Aeronautic Components	
Blackshape	Industry	Aviation	Design, production and services	Aeronautic Components, Aircraft production	
Manta Group	Industry	Aviation	Production	Aeronautical components, Aircraft production	
HB Tecnhology	Industry	Other	Service	Additive manufacturing	
Sysman	Industry	Other	Service	Digital Transformation	
IMT	Industry	Space	Design, production and services	Satellite, Downstream application	
Novotech	Industry	Aviation	Production	Aeronautical components, Aircraft production	
Exprivia	Industry	Other	Service	Digital Transformation	
Giannuzzi	Industry	Aviation	Production	Aeronautical components	

Salentech	Industry	Other	Service	Additive manufacturing	
IDS - Ingegneria dei Sistemi	Industry	Aviation	Design, production and services	Avionics systems	
City of Bari	Public authority	Other	Services	Smart cities	
City of Taranto	Public authority	Other	Services	Smart cities	
Puglia Sviluppo	Public authority	Other			
ITS - Mobilità Sostenibile e Aerospazio	Public authority	Other	Education	Aerospace	
ARTI - Regional Agency for Technology and Innovation	Public authority	Other			
DAP - Distretto Aerospaziale Pugliese (Produttivo)	Cluster	Aerospace			

Table A4.2. Capabilities

Technical & Innovation				
Name	**Owner**	**Type**	**Description**	**web-site**
Grottaglie Airport Test Bed	DTA	Product development	To increase the regional innovation capacity, the DTA is setting up the GATB - a research infrastructure - which is a technological environment able to accompany universities and enterprises in the development of UAS (configuration, avionic components,	

			sensors, …) to test operational capacity and to interact with ground systems (ground control station, ATM, UTM), to develop aerial monitoring and transport services (sensors, data management systems, data processing applications). The GATB consists of a node within the Grottaglie experimental airport and a node at Bari (Bari Urban Drone Range).	
Bari Drone Range	DTA	Product development	The Bari Urban Drone Range is a UAM experimentation infrastructure for smart cities that the Municipality of Bari is building in collaboration with DTA as part of the Bari Open Innovation Hub (BOIH) project co-funded by the Ministry of Economic Development.	
Drone Living Lab	DTA	Design	Living Labs sited in "Fiera del Levante" districit in Bari which effectively simulate urban environments given a large number of staff, buildings, roads and utilities on sites, combined with the scientific expertise in multiple disciplines, dedicated experimental facilities and high-speed communication networks. The DLL particular is focused on solutions and ideas to develop monitoring and delivery system using UAS.	

Business innovation			
Name	**Type**	**Description**	**web-site**
ESA BIC ITALY (Apulia node)	Incubator	The European Space Agency Business Incubation Centre (Apulia node) supports entrepreneurs and start-ups in transforming their space-related projects into successful businesses. We look for entrepreneurial ventures that are developing innovative products	

		and services in the upstream or downstream fields.	
CTE - Bari Open Innovation Hub	Accelerator	The aim of the project is to create an innovation hub in the metropolitan city of Bari that can test new technologies and operating protocols with particular reference to the theme of autonomous and semi-autonomous driving through the use of 5G as an enabling technology and the use of AI, next-generation IOT and drones.	

Table A4.3. Programme and Policies

Name	Type	Segment	Description	link
PNRR -The Recovery and Resilience Plan: Next Generation Italia	National programme	Recovery and Resilience Plan	Space funding programme Hydrogen funding programme *(DTA has been funded for a hydrogen research project for the general aviation sector)*	

Table A4.4. Connections

Intra-regional			
Name	**Type**	**Description**	**web-site**
Ap-EDIH (DTA/DAC)	working group		

Inter-regional			
Name	**Type**	**Description**	**web-site**

Cluster Tecnologico Nazionale Aerospazio (CTNA)	cluster	The CTNA is the point of synthesis and convergence of needs and priorities that the various stakeholders of the national aerospace system have developed in recent years in the light of global market trends and sectoral policies at European and international level.	
AIDAA	association	The association aims to bring together people, industries and institutions interested in scientific and technical activities in the aeronautical and space sector and to disseminate knowledge of the sector.	
Agenzia APRE	cluster	The first and only organization of its kind in Italy, APRE - Agency for the Promotion of European Research has the objective of supporting and facilitating Italian participation in the European Union's research and innovation (R&I) funding programmes, through information, training and assistance.	

European			
Name	**Type**	**Description**	**web-site**
ASSURED-UAM	Eu-Project	The ASSURED-UAM project aims to guarantee outstanding robustness in terms of safety, sustainability and acceptability of UAM. It will promote aviation best practices, standards, recommendations and organizational solutions to the administrative and legislative bodies.	
AD-ASTRA	Eu-Project	Aerospace Districts: Acceleration of the Strategic Transfer of Regional Advancements	
Nereus	association	Network of European Regions Using Space Technologies	
Enterprise Europe Network (ENEA node)	working group	network co-funded by the European Union - COSME 2014-2020 Program to help companies innovate and grow on an international	

		scale. ENEA is a partner of the Enterprise Europe Network in the BridgEconomies consortium which operates in the southern regions (Abruzzo, Basilicata, Calabria, Campania, Molise, Puglia and Sicily), and collaborates with all the other Italian and international EEN nodes.	
European Aerospace Cluster Partnership (EACP)	cluster	EACP is a permanent partnership between collaborating European aerospace clusters. The consortium currently comprises 45 aerospace clusters from 18 different countries and was initiated by the city of Hamburg in 2009 and co-funded by the European Commission.	
SPACEWAVE	Eu-Project		

A5. South Holland

Table A5.1. Stakeholders

Name	Type	Segment	Specify	Sub-segment	website
InnovationQuarter	Public authority	Other	Innovation	Aerospace	https://www.innovationquarter.nl/en/
Technical University of Delft - Faculty of Aerospace Engineering	University	Aerospace	R&D/Education	Aerospace	www.tudelft.nl/en/ae/

ESA-ESTEC	Public authority	Space	R&D	upstream & downstream space	www.esa.int/About_Us/ESTEC
GRC - Galileo Reference Center	Public authority	Space	Innovation	downstream	www.gsa.europa.eu
Netherlands Space Office NSO	Public authority	Space	Government		www.spaceoffice.nl
Leiden Observatory	University	Space	R&D/Educatio n	Astronomy	www.strw.leidenuniv.nl
TNO Space & Scientific Instrumentation	RTO	Space	R&D	space optics	https://www.tno.nl/en/about-tno/organisation/units/industry/space-systems-engineering/
SBIC - Space Business Innovation Centre	Cluster	Space	Hub	Incubator	www.sbicnoordwijk.nl
SpaceNed	Association	Space			https://www.spacened.nl/
Airbus Defence & Space	Industry	Space	R&D Manufacturing	Upstream	https://www.airbusdefenceandspacenetherlands.nl/
Airborne Composites	Industry	Aerospace	Manufacturing		https://www.airborne.com/
International Institute of Air & Space Law	University	Aerospace	R&D / Education	Law	http://www.iiasl.aero/

Aerialtronics	Industry	Aerospace	Manufacturing	Drones	http://www.aerialtronics.com/
Atmos UAV	Industry	Aerospace	Manufacturing	Drones	http://www.atmosuav.com/
Delft Dynamics	Industry	Aerospace	Manufacturing	Drones	http://www.delftdynamics.nl
Demcon	Industry	Aerospace	Manufacturing	Drones	https://demcon.com/press/new-van-oord-order-for-unmanned-autonomously-sailing-offshore-vessel/
Flapper Drones	Industry	Aerospace	Manufacturing	Drones	https://flapper-drones.com/wp/
High Eye	Industry	Aerospace	Manufacturing	Drones	https://www.higheye.com/
Mapture	Industry	Aerospace	Manufacturing	Drones	http://mapture.ai/
Shore Systems	Industry	Aerospace	Manufacturing	Drones	https://www.shoresystems.nl/
AirHub	Industry	Aerospace	Software	Drones	https://www.airhub.app/
Birds AI	Industry	Aerospace	Software	Drones	https://birds.ai/
Fusion Engineering	Industry	Aerospace	Software	Drones	https://fusion.engineering/
Applus RVIS	Industry	Aerospace	Inspection	Drones	https://www.applus.com/nl/nl/what-we-do/solutions/drone-inspection

Bavak Security Group	Industry	Aerospace	Inspection	Drones	https://bavak.com/nl/solutions/integrated-security/autonomous-surveillance-drone/
Dutch Drone Company	Industry	Aerospace	inspection	Drones	https://ddc.works/
Falcker Innovations	Industry	Aerospace	inspection	Drones	https://falcker.com/
Mainblades Inspections	Industry	Aerospace	inspection	Drones	http://mainblades.com/
DJI Europe	Industry	Aerospace	sales	Drones	https://www.dji.com/nl
Robin Radar	Industry	Aerospace	detection	Drones	https://www.robinradar.com/
GKN Fokker	Industry	Aerospace	manufacturing	aircraft parts	http://www.fokker.com/
KVE	Industry	Aerospace	manufacturing	aircraft parts	https://www.kve.nl
Marshall Aerospace Netherlands	Industry	Aerospace	R&D	MRO	https://marshallaerospace.com/
SITA N.V.	Industry	Other	Hardware	Airport Technology	https://www.sita.aero/
ADECS Airsystems	Industry	Other	Software / IT, Environmental Impact	Airport Technology	https://airinfra.eu/

To70	Industry	Other	Software / IT, Environmental Impact	Airport Technology	https://to70.com/
NACO	Industry	Other	Airport Infrastructure	Airport Technology	https://www.naco.nl/
Deerns	Industry	Other	Airport Infrastructure	Airport Technology	https://www.deerns.nl/
CGI	Industry	Other	Consultancy	Airport Technology	https://www.cgi.com/en/transportation-logistics/aviation-services
Conscious Aerospace	Industry	Aviation	manufacturing	Propulsion	https://www.consciousaerospace.com/
Maeve Aerospace	Industry	Aviation	manufacturing	Aircraft	https://maeve.aero/home
InHolland University of Applied Sciences	University	Aerospace	education	aerospace engineering	https://www.inholland.nl/opleidingen/aeronautical-engineering-en-fulltime/
Leiden-Delft-Erasmus Space for Science & Society	University	Space	space R&D of 3 universities	Space	https://www.lde-space.nl/home
SRON Netherlands Institute for Space Research	RTO	Space	Research	Space	https://www.sron.nl/
ISISpace	Industry	Space	manufacturing	nano	https://www.isispace.nl/

				satellites	
NLR Netherlands Aerospace Centre	RTO	Aerospace	R&D	Aerospace	https://www.nlr.nl/
Dawn Aerospace	Industry	Space	manufacturing	Launchers	https://www.dawnaerospace.com/
T-Minus	Industry	Space	manufacturing	Launchers	https://www.t-minus.nl/
GTM Advanced Structures	Industry	Aerospace	manufacturing	satellite parts	https://gtm-as.com/
AAC Clyde Hyperion	Industry	Space	manufacturing	nano satellites	https://www.aac-clyde.space/who-we-are/our-brands/hyperion
Groundstation DotSpace	Cluster	Space	network	downstream	https://www.groundstation.space/
Science & Technology Corp.	Industry	Space	software	downstream	http://www.stcorp.nl/
SkyGeo	Industry	Space	software	downstream	https://skygeo.com/nl/

Table A5.2. Capabilities

Technical & Innovation				
Name	**Owner**	**Type**	**Description**	**website**
Large Space Simulator	ETS-ESA	R&D	Solar simulation (incl. spacecraft motion), Infrared radiation, Vacuum temperature cycling, Deployment	https://www.european-test-services.net/services-thermal-Large-

			testing, Videogrammetry measurements and Dynamic balancin	Space-Simulator.html
Large European Acoustic Facility	ETS-ESA	R&D	acoustic noise tests on spacecrafts and payloads	https://www.european-test-services.net/services-mechanical-Large-Acoustic.html
HYDRA Multi-Axis Shaker	ETS-ESA	R&D	Sine, transient or random testing in the frequency range from 0.1Hz to 100Hz	https://www.european-test-services.net/services-mechanical-Hydra-Vibration.html
Maxwell EMC Facility	ETS-ESA	R&D	electromagnetic compatibility testing and electrostatic discharge testin	https://www.european-test-services.net/services-emc-maxwell.html
MAVLAB Micro Air Vehicle Lab	Technical University of Delft	R&D	fundamental research lab for Micro Air Vehicles to maximize utility and safety	https://mavlab.tudelft.nl/
Institute for Air & Space Law	University of Leiden	R&D	legal and policy issues regarding aviation and space activities	https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law#:~:text=The%20International%20Institute%20of%20Air,broadest%20sense%20of%20the%20word.
Aviation Design Experience Centre	Technical University of Delft	R&D	Industrial Design Engineering experience centre to build, prototype, try out anything that is happening inside an airplane during the fligh	https://www.tudelft.nl/io/onderzoek/research-labs/aviation
Do IoT Fieldland	Technical University	R&D	5G test facility for sensor-based (drone) technology	https://doiotfieldlab.tudelftcampus.nl/

	of Delft			
Smart Advanced Manufacturing XL Facility	Technical University of Delft	R&D	automated production processes of large-size, lightweight structures	https://www.samxl.com/

Business innovation			
Name	**Type**	**Description**	**website**
Aerospace Innovation Hub	Incubator	(pre-)incubator for aerospace spin-offs from TU Delft	https://aerospaceinnovationhub.nl/
The Hague Security Delta	cluster	Cluster of +400 (cyber) security stakeholders	https://securitydelta.nl/
Rotterdam The Hague Innovation Airport	cluster	cluster of aviation and airport technology stakeholders	https://stichtingrhia.nl/en/home-en/
Unmanned Valley	cluster	Multi-tenant test and development centre for drones	https://unmannedvalley.nl/en/
Technology Park Ypenburg	cluster	Multi-tenant facility for aerospace companies	www.technologyparkypenburg.nl
ESA-BIC in SBIC	Incubator	Multi-tenant incubator for space companies	https://www.sbicnoordwijk.nl/
NL Space Campus	cluster	Network organisation for space companies	https://www.nlspacecampus.eu/

Table A5.3. Programme and Policies

Name	Type	Segment	Description	Link
SME Innovation Stimulation Zuid-Holland	Regional programme	innovation	Not specifically devoted to aerospace, but this could be an instrument also for enterprises in the aerospace sector willing to innovate.	https://www.zuid-holland.nl/onderwerpen/economie/innovatief-mkb/mit-subsidie-innovatiestimulering/
National Growth Fund	National programme	innovative consortia	Not specifically devoted to aerospace, but this could be an instrument also for enterprises in the aerospace sector willing to innovate.	https://www.nationaalgroeifonds.nl/english/the-national-growth-fund

Table A5.4. Connections

Intra-regional			
Name	**Type**	**Description**	**web-site**
Aerospace Delta	cluster	International promotion of the regional aerospace cluster	www.aerospacedelta.nl
Holland Instrumentation	cluster	cluster of regional high tech companies	https://hidelta.nl/

Inter-regional

Name	Type	Description	web-site
Cooperation in the Space Sector between Bremen and Zuid-Holland	working group	Cooperation between the space regions of Bremen and Zuid-Holland	https://www.zuid-holland.nl/@25233/vaststelling-action/

European			
Name	**Type**	**Description**	**web-site**
AD-ASTRA	Eu-Project	Aerospace Districts: Acceleration of the Strategic Transfer of Regional Advancements	https://aerospacedistricts.eu/
Galileo Masters Competition	Eu-Project	Annual European competition for solutions using satellite navigation data with participants from 89 regions	https://galileo-masters.eu/