EU – RISE
(European Robotics for Space Ecosystems)

Ref. Ares(2024)2212554 - 24/03/2024

Kick-Off Meeting, 5th of December in Brussels

OIKOPLUS · dfki ai · magellium · Libre Space Foundation · sener · The Exploration Company · AIRBUS

Agenda

- **Introduction**
  - Motivation for the project
  - Project organization
  - Introduction of partners and people
- **Workstream Objectives**
  - Future eco space definition
  - Envisioned testbed presentation
  - Software architecture and elements
  - Hardware architecture and elements
- **Technology building blocks**
- **Action plan**
  - Work breakdown structure
  - Schedule
  - Way of working
  - Dissemination
  - Open source
- **Success criteria and next steps**
- **Presentation HaDEA**
- **Discussion and feedback from the EU**

The purpose of this meeting

I. To get to know the partners, the people, and the vision for the project

II. To share all information with you so that you know what you have to do tomorrow and we can start to work

III. To explain the way we will work and why we have this set-up

IV. To hear the feedback and wishes from the EU representatives

Please collect your questions and use the Q&A at the end. After that, we should all be ready to go. If not, please ask!

- **Introduction**
- Workstream Objectives
- Technology Building Blocks
- Action plan
- Success criteria and next steps
- Presentation HaDEA
- Discussion and feedback from the EU

Motivation for the project

Associated with Workstream I – Future Space Ecosystem:

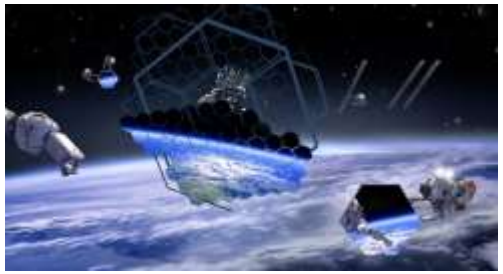
- **Prepare the paradigm shift** to change the way space systems are designed, built and operated, moving from mission-specific solutions to modular spacecraft serviced, manufacture and assembled by robots in space

- I**mprove the capabilities, cost-effectiveness and reliability** of space assets through the use of In-Space Servicing, Assembly and Manufacturing (ISAM)

Associated with Workstream II – Enabling Technologies:

- **Strengthen European capabilities** to build the future orbital infrastructure and be competitive in the On-Orbit Servicing (OOS) markets

- **Harmonize the robotic H/W and S/W building blocks** existing in Europe to enable a realistic robotic system for commercial and institutional missions



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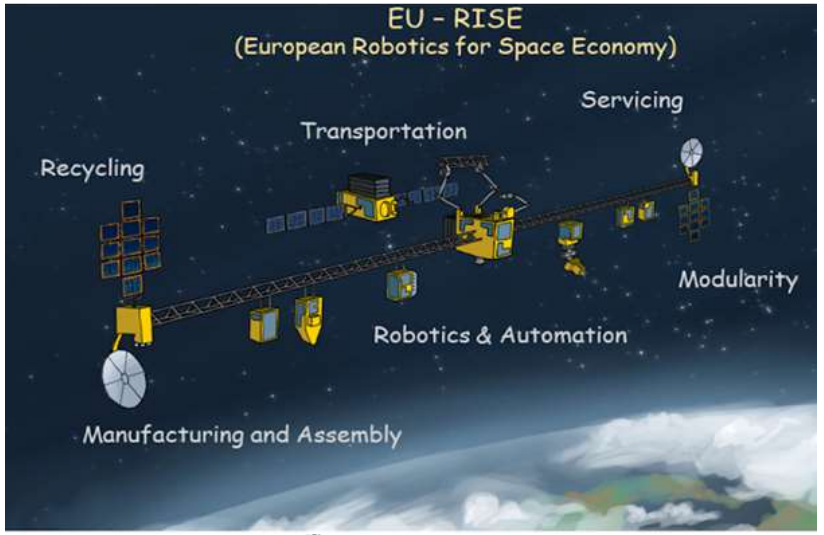
Future Space Ecosystem Definition

Present in-orbit infrastructure is limited by

- Constrained launcher capabilities
- High cost for the launch into the orbit
- Limited reconfiguration and upgrade possibilities
- Restricted autonomy & capabilities of orbital robots

The objectives of this work for the future space ecosystem workstream are:

- Assessment of the markets and potentials (Market survey report, Exploitation Plan)
- Definition of the needed services and the associated capabilities and functions (Market survey)
- Definition of the market and mission requirements (Future Space Ecosystem Requirements)
- Definition of a system concept to be composed of the building blocks
- Development of an open-source strategy



Enabling Technologies for Robotic In-Space Services

Present European space robotics technologies are limited by

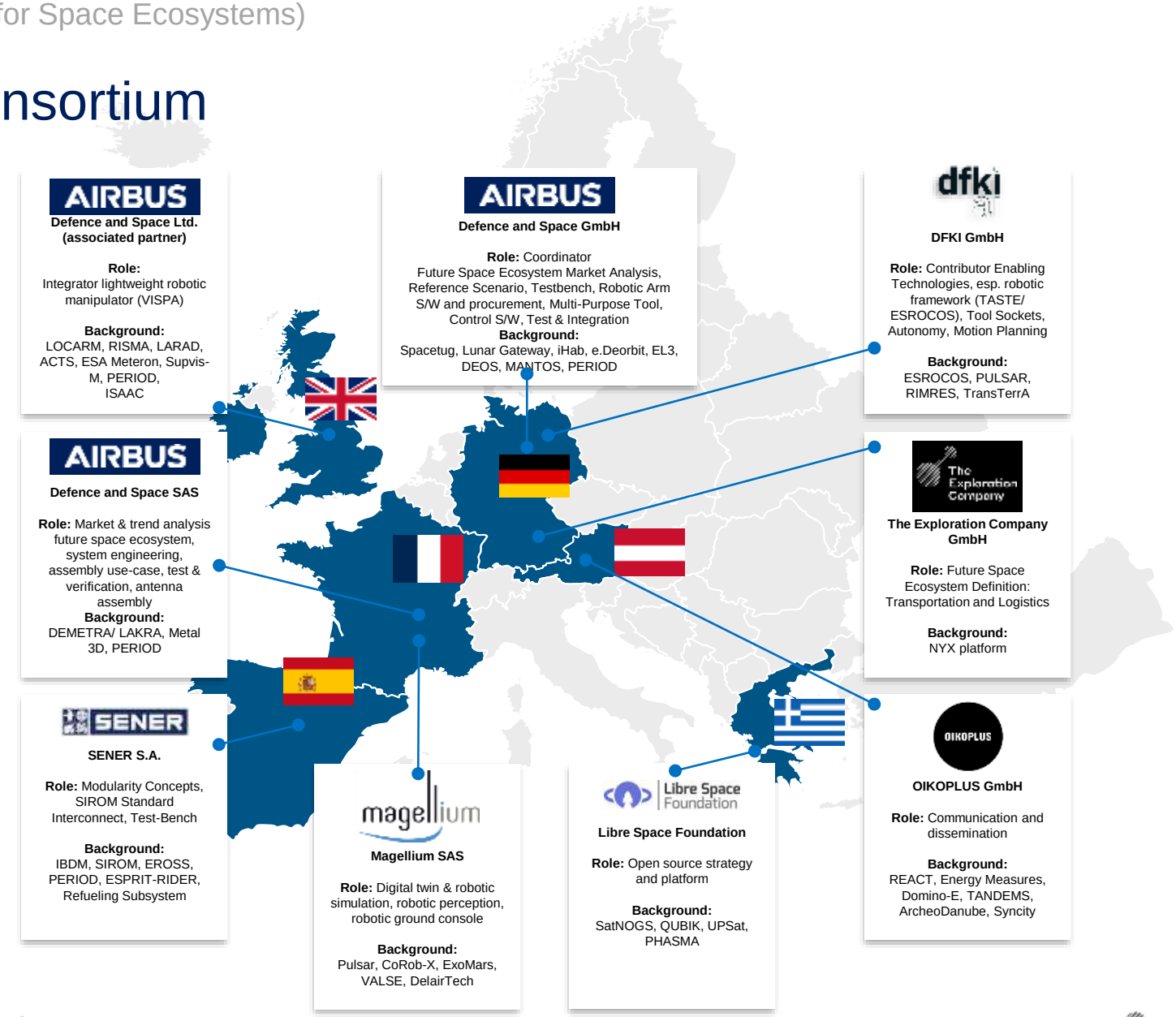
- Lack of suitable hardware building blocks (tools and manipulators)
- Inadequacy of available open-source robotic flight software
- Restricted integration of technologies on system level and within end-to-end demonstrators

The objectives of this enabling technologies workstream are:

- Development and adaptation of building blocks to fit to the system concept
- Integration of the building blocks into a full robotic system
  - Ground console
  - Representative avionics
  - Robotic software elements
  - Robotic hardware elements
- Verification of the building blocks during the development
- Verification of the full robotic system and validation on a reference scenario

Introduction of partners

The EU-RISE Consortium



Airbus Defence and Space Ltd. (associated partner)

Role: Integrator lightweight robotic manipulator (VISPA)

Background: LOCARM, RISMA, LARAD, ACTS, ESA Meteron, Supvis-M, PERIOD, ISAAC

Airbus Defence and Space GmbH

Role: Coordinator Future Space Ecosystem Market Analysis, Reference Scenario, Testbench, Robotic Arm S/W and procurement, Multi-Purpose Tool, Control S/W, Test & Integration

Background: Spacetug, Lunar Gateway, iHab, e.Deorbit, EL3, DEOS, MANTOS, PERIOD

DFKI GmbH

Role: Contributor Enabling Technologies, esp. robotic framework (TASTE/ ESROCOS), Tool Sockets, Autonomy, Motion Planning

Background: ESROCOS, PULSAR, RIMRES, TransTerrA

Airbus Defence and Space SAS

Role: Market & trend analysis future space ecosystem, system engineering, assembly use-case, test & verification, antenna assembly

Background: DEMETRA/ LAKRA, Metal 3D, PERIOD

The Exploration Company GmbH

Role: Future Space Ecosystem Definition: Transportation and Logistics

Background: NYX platform

SENER S.A.

Role: Modularity Concepts, SIROM Standard Interconnect, Test-Bench

Background: IBDM, SIROM, EROSS, PERIOD, ESPRIT-RIDER, Refueling Subsystem

Magellium SAS

Role: Digital twin & robotic simulation, robotic perception, robotic ground console

Background: Pulsar, CoRob-X, ExoMars, VALSE, DelairTech

Libre Space Foundation

Role: Open source strategy and platform

Background: SatNOGS, QUBIK, UPSat, PHASMA

OIKOPLUS GmbH

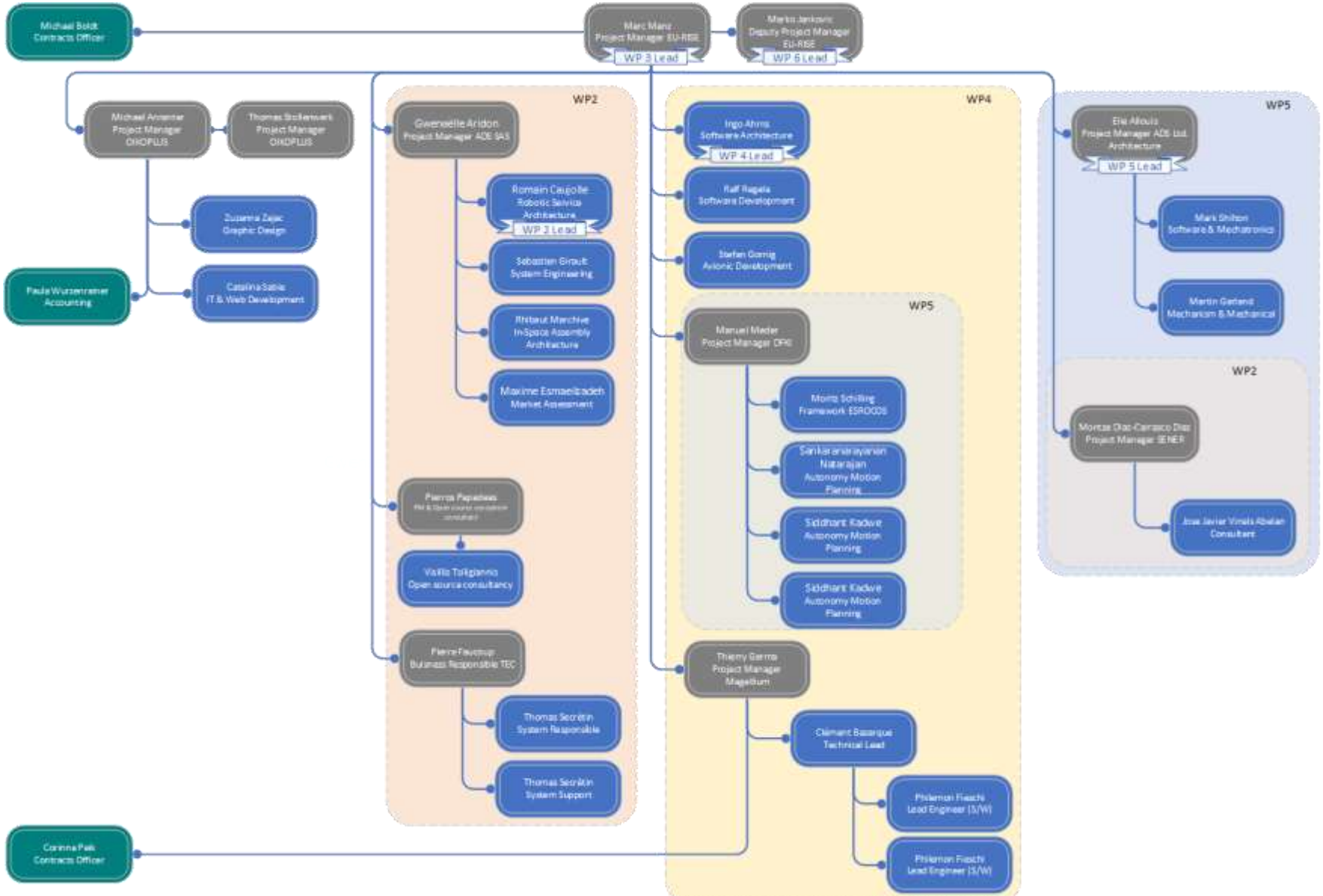
Role: Communication and dissemination

Background: REACT, Energy Measures, Domino-E, TANDEMS, ArcheoDanube, Syncity

Airbus Amber

Project OBS

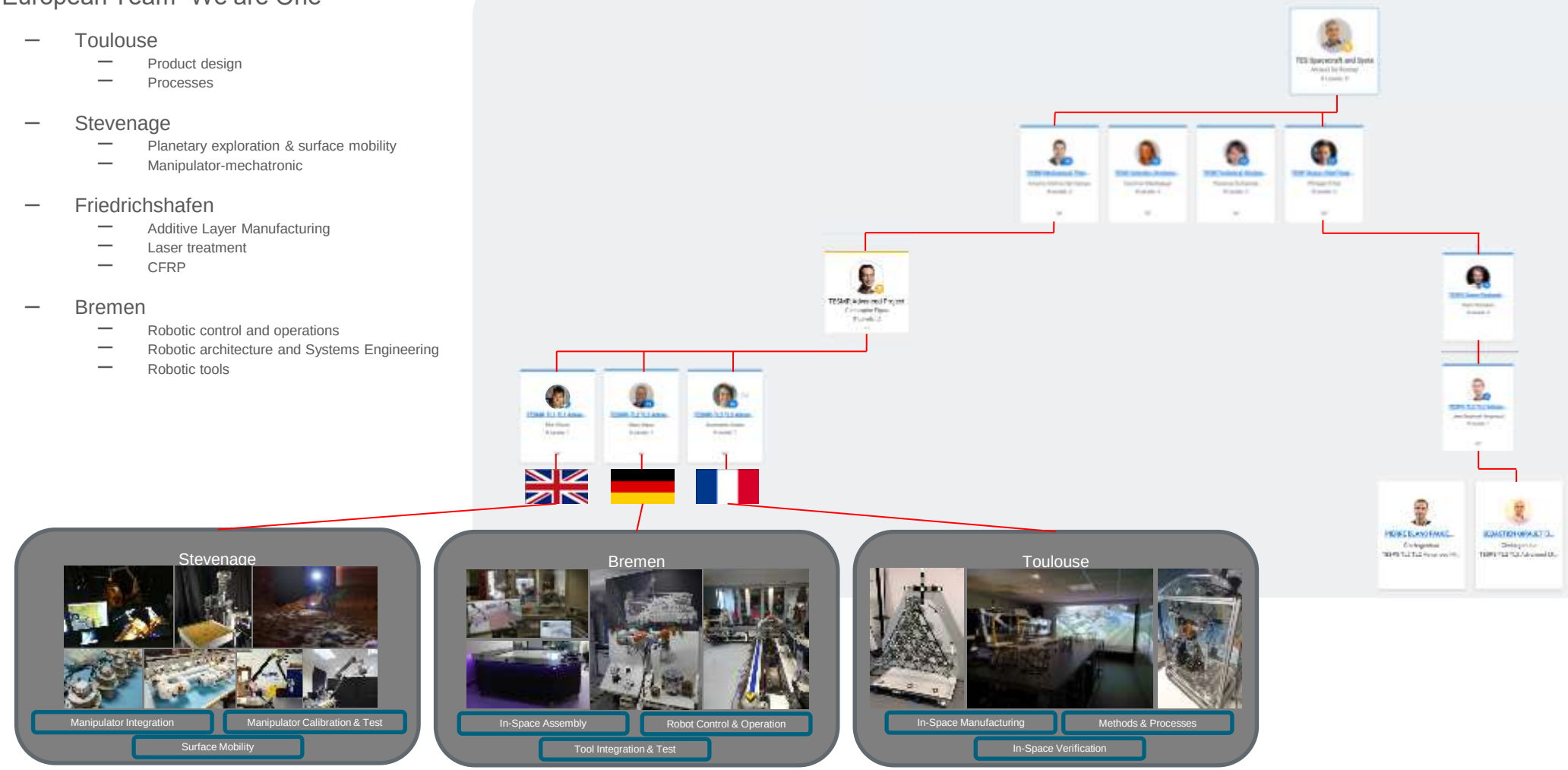
- Living document
- Please send me your updates
- Please send me the contact details in the excel



Introduction of partners – Airbus Defence and Space

AIRBUS Defence and Space - Advanced Project and Robotics

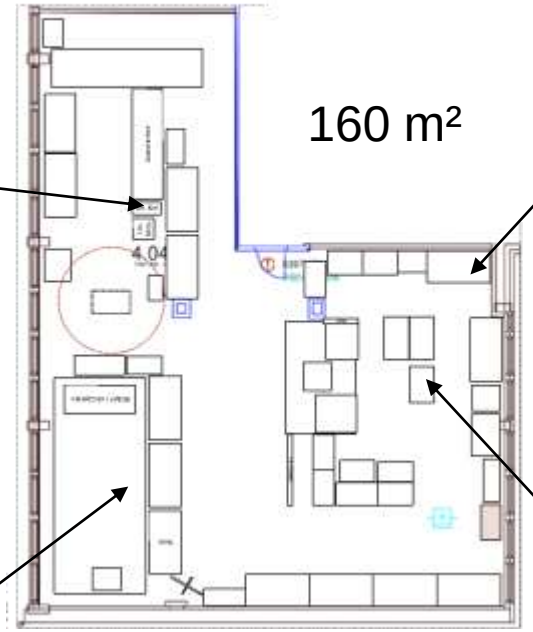
- European Team “We are One”
  - Toulouse
    - Product design
    - Processes
  - Stevenage
    - Planetary exploration & surface mobility
    - Manipulator-mechatronic
  - Friedrichshafen
    - Additive Layer Manufacturing
    - Laser treatment
    - CFRP
  - Bremen
    - Robotic control and operations
    - Robotic architecture and Systems Engineering
    - Robotic tools



AIRBUS- Robotics Lab in Bremen

Airbus Amber

- Climatic control
- Darkening cloak
- Motion tracking system
- Multiple F/T sensors
- Multiple power supplies
- Multiple co-bots
- dSpace hardware in the loop (HIL) systems
- 3D printer
- Rotational Air-Bearing



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Airbus Defence and Space – Project Heritage Highlights

EU - H2020 – PERIOD (PERASPERA In-Orbit Demonstration Phase 0/A/B1) — Finished

DLR – STARLIT (Tool architecture for robots) — Finished

BPI – DEMARLUS (Phase A) In-Orbit demonstration — Ongoing

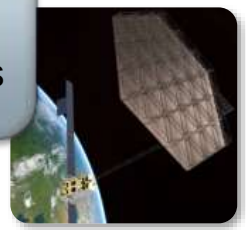
ESA – 3D Metal Printer (First metal 3D printer in space) — Ongoing

ESA – In-Orbit Servicing, Assembly and Manufacture Opportunities for Telecom Missions — Ongoing

SpaceTug – Satellite servicing study (Phase 0/A/B1/B2) — Finished

CIMON (Crew assistant free flyer on the ISS) — Ongoing

ESA – Preliminary Design of On-Orbit Manufacturing of Large Antenna Reflectors — Ongoing



VISPA (Versatile robotic arm for orbital and planetary applications) — Ongoing

Airbus Defence & Space GmbH People

ADS GmbH Key People

Marc MANZ
Project Management
System Engineering

Marko Jankovic
Dept. Project Manager
Arm Control Software

Ingo Ahrns
Software Architecture

Ralf Regele
Software Development

Stefan Gornig
Avionic Development

Airbus Defence & Space SAS People

ADS SAS Key People

Gwenaelle Aridon
Project Management

Sebastien GIRAULT
System engineering

Romain CAUJOLLE
Robotic service architecture

Thibaut MARCHIVE
In space assembly architecture

Maxime ESMAEILZADEH
Market assessment

Airbus Defence & Space Ltd
People

ADS Ltd Key People

Elie Allouis
Project Management
System Engineering

Mark Shilton
Mechatronics & Software

Martin Garland
Mechanism & Mechanical

Introduction of partners – DFKI

DFKI – Introduction

RIC – Robotics Innovation Center

Facts and Figures

- Location: Bremen (Branch in Osnabrück)
- Founded: 2006 as DFKI Lab
- since 2009 official DFKI Location
- about 125 researchers (DFKI and University) plus 75 student workers

Goals and Organisation

- long term goal: long term autonomous and interacting robotic systems
- many disciplines come together: Computer Science, Engineering, Biology, Mathematics, …

DFKI – RIC Research Facilities

Maritime Exploration Hall

Human-Robot Collaboration Lab

Workshops & Foundries

Locomotion Lab

Crater landscape

Multifunctional Hall

Underactuated Lab

underactuated lab

Brain Behavioral Lab

Pressure Chamber Lab

Virtual Reality Lab

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AIRBUS

DFKI – Team structure

Manuel Meder

Project lead

Autonomy
Motion planning

Sankaranarayanan Natarajan

Moritz Schilling

Framework
ESROCOS

Autonomy
Motion planning

Siddhant Kadwe

TBD

Framework
C++ Developer

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Introduction of partners – Magellium

Magellium

Algorithmics
(SoA, scientific studies, tech transfer, …)

Acquisition
(cameras, IMU, GNSS, multi-sensor fusion, embedded systems, …)

Software engineering
(PoCs, prototypes, …)

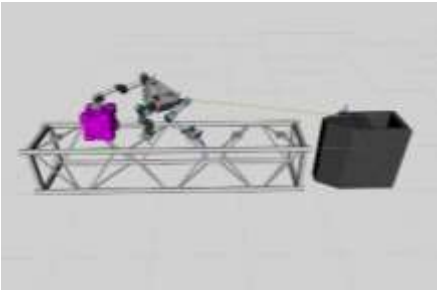
Capitalisation & modularity
(Knowledge bases, Software tooling, …)

System PoC
(Industrial prototypes, demonstrators, …)

Operational systems
(Industrialisation, Maintainance, Evolutions, …)

Partners

Magellium
Space Robotics



2005
CNES
Martian rover stereo perception
R&D on vision based localisation

2014-2015
CNES – Rosetta/Philae
Vision based localisation for landing

2016
H2020 InFuse
Vision based navigation and data fusion

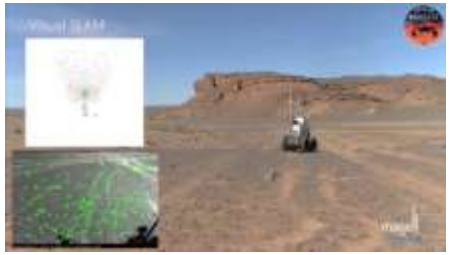
2019
H2020 PULSAR
In-orbit autonomous assembly, Simulation, perception and Sequencing

2019
H2020 ADE
Autonomous Navigation for long traverse

2021
H2020 CoRob-X
Collaborative navigation in extreme environments

2022
ESA – ALPER
Vision based absolute localisation
CNES
DL Hybrid stereo

2023
ESA ISAAC, BPI DEMARLUS, HE EU-RISE
In-orbit autonomous assembly
Ground simulation and verification
Digital twin



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AIRBUS

Magellium – Core Team

Project Manager
Thierry Germa

Contract Manager
Corinna Peik

Technical Lead
Clément Bazerque

Lead Engineer (robotics)
Isabelle Maroger

Lead Engineer (software)
Philemon Fieschi

Introduction of partners – SENER

SENER Aeroespacial

SPACE

DEFENSE

SCIENCE

ELECTRO-MECHANICAL SYSTEMS

- Mechanical ground support equipment (MGSE)
- Rotary actuators
- Mechanisms for platforms & Payloads

- Fin control and actuation systems (CAS)
- Stabilization systems

- Ground telescopes mechanical systems
- Mechanisms for RIs

POSTION, NAVIGATION & TIME SYSTEMS (PNT)

- Attitude control
- Guidance, navigation and control
- Test equipments
- Hybrid navigation equipment

- Autonomous Navigation

RF & COMMUNICATION SYSTEMS

- Antennae pointing sub-systems
- RF active, passive and antenna products

- Communications intelligence (COMINT)
- Data Link Systems

- Waveguides and cavities for accelerators and other research institutes

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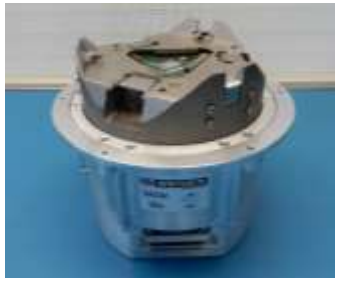
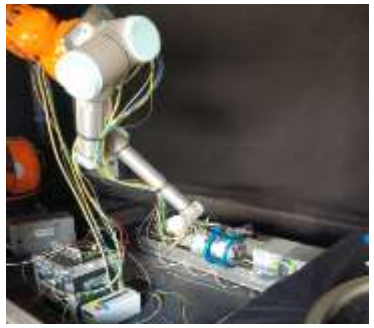
SIROM development



SIROM

H2020 – OG5
Start development
(2016)



EROSS

H2020 – OG7
IOS Demo
(2019)

MIRROR

ESA Project
Assembly of large reflectors
(2021)

PERIOD

H2020 – OG12
ISMA Demo
(2021)

EROSS IOD

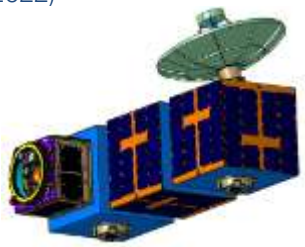
Horizon Europe
In-Orbit demonstration
(2022)

ISAAC

ESA Project
ISMA Demo
(2022)

ORU-BOAS

SENER development
Scalable modular satellites
(2022)



SENER Team

Project manager

Montse Diaz-Carrasco

Consultant & Product Manager

Javier Viñals

Mechanical Team

- Alejandro Lazar
- Ana Ruiz
- Juan Carlos Bahillo

Electronics Team

- Marta Centeno
- Jose Gala

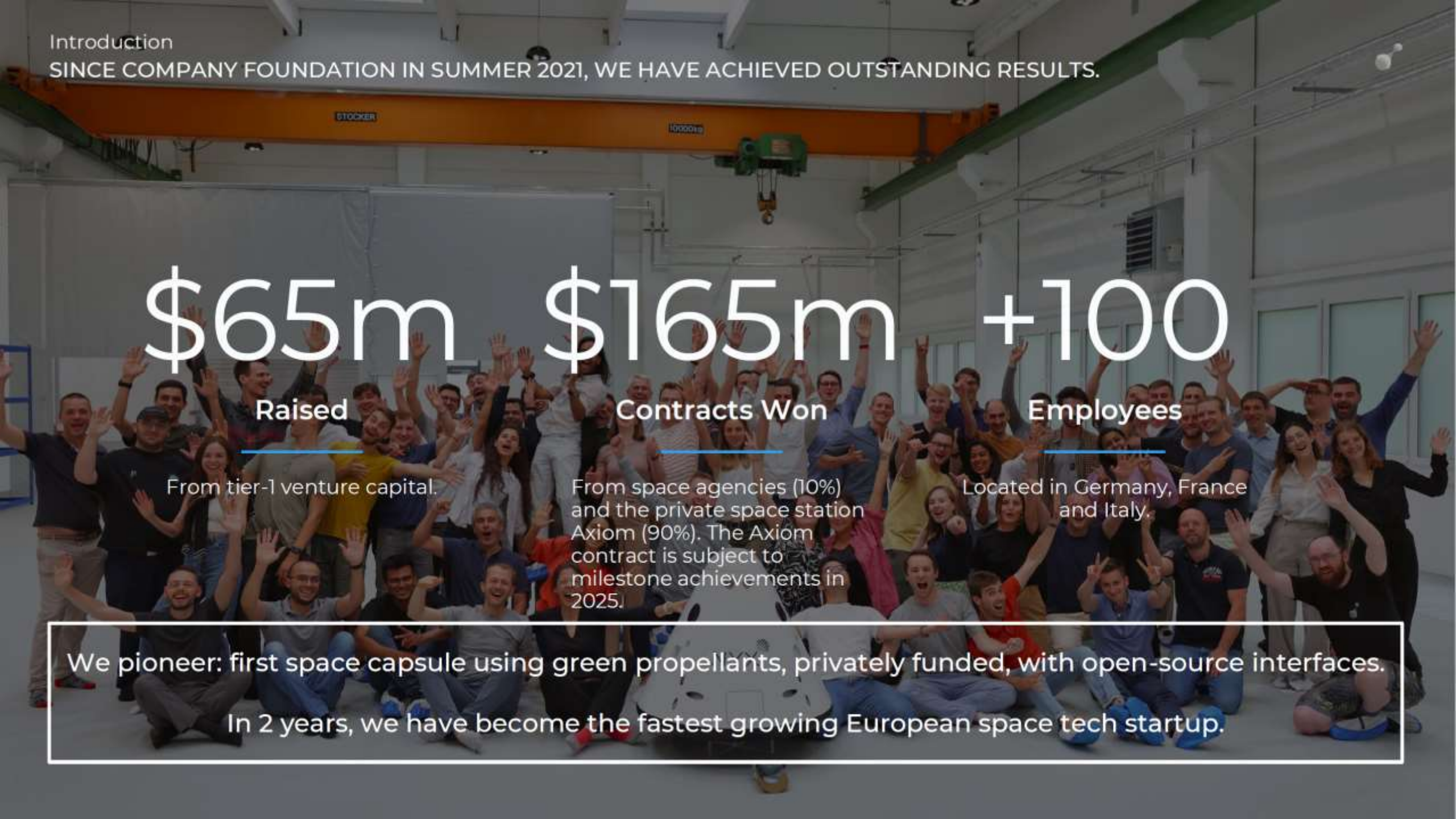
MAIT Responsible

- Alfredo Fernandez

Introduction of partners – The Exploration Company

Introduction

SINCE COMPANY FOUNDATION IN SUMMER 2021, WE HAVE ACHIEVED OUTSTANDING RESULTS.



$65m

Raised

From tier-1 venture capital.

$165m

Contracts Won

From space agencies (10%) and the private space station Axiom (90%). The Axiom contract is subject to milestone achievements in 2025.

+100

Employees

Located in Germany, France and Italy.

We pioneer: first space capsule using green propellants, privately funded, with open-source interfaces.

In 2 years, we have become the fastest growing European space tech startup.

The Exploration Company – Introduction People and Role in the Project

Thomas Secrétin

Senior Mission Analysis Engineer

System Responsible for the Project

Olivier Faure

Lead System Engineer,

System support

Pierre Faucoup

Chief Space and Defense Revenue Officer

Business Responsible for the project

Introduction of partners – OIKOPLUS

Introduction: OIKOPLUS

OIKOPLUS

is a Vienna based **communications agency**, specialized in **communication and dissemination for multi-national research and innovation projects**. It supports consortia in their external appearances and in doing so also encourages the rethinking of established communication strategies and target groups.

To ensure that the suggested communication measures are as well received as possible, **solutions are jointly developed and implemented under the guidance of Oikoplus**.

Founded in 2018, Oikoplus has **experience in various EU-funded projects** (JPI Urban Europe, Interreg, Horizon 2020, Horizon Europe, LIFE).

Oikoplus has worked in the fields of **urbanism, archaeology, energy markets, earth observation, and insect biotechnology**.

Introduction: OIKOPLUS staff working on EU-RISE

Michael Anranter

CEO

Communication expert
E-mail: anranter@oikoplus.com

Thomas Stollenwerk

CEO

Communication expert
E-mail: stollenwerk@oikoplus.com

Zuzanna Zajac

Graphic Designer
E-mail: zajac@oikoplus.com

Catalina Sabie

IT & Web Dev
E-mail: sabie@oikoplus.com

Paula Wurzenrainer

Accounting
E-mail:
wurzenrainer@oikoplus.com

Introduction of partners – Libre Space Foundation

Libre Space Foundation

- Non-profit foundation based in Greece
- Open source technology development for upstream and midstream sectors
  - Mission development
  - Operations
  - Sub-system and system level design, development, assembly, testing and deployment
- Open source consulting for ESA
- Ecosystem development
  - Individual contributors engagement
  - B2B ecosystems with controlled approach
- Open source ecosystem management
  - Hundreds of individual contributors
  - Dozen entities

Libre Space Foundation

Pierros Papadeas - PM and Open source consultancy

Vasilis Tsiligiannis - Open source consultancy

- Introduction
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- Action plan
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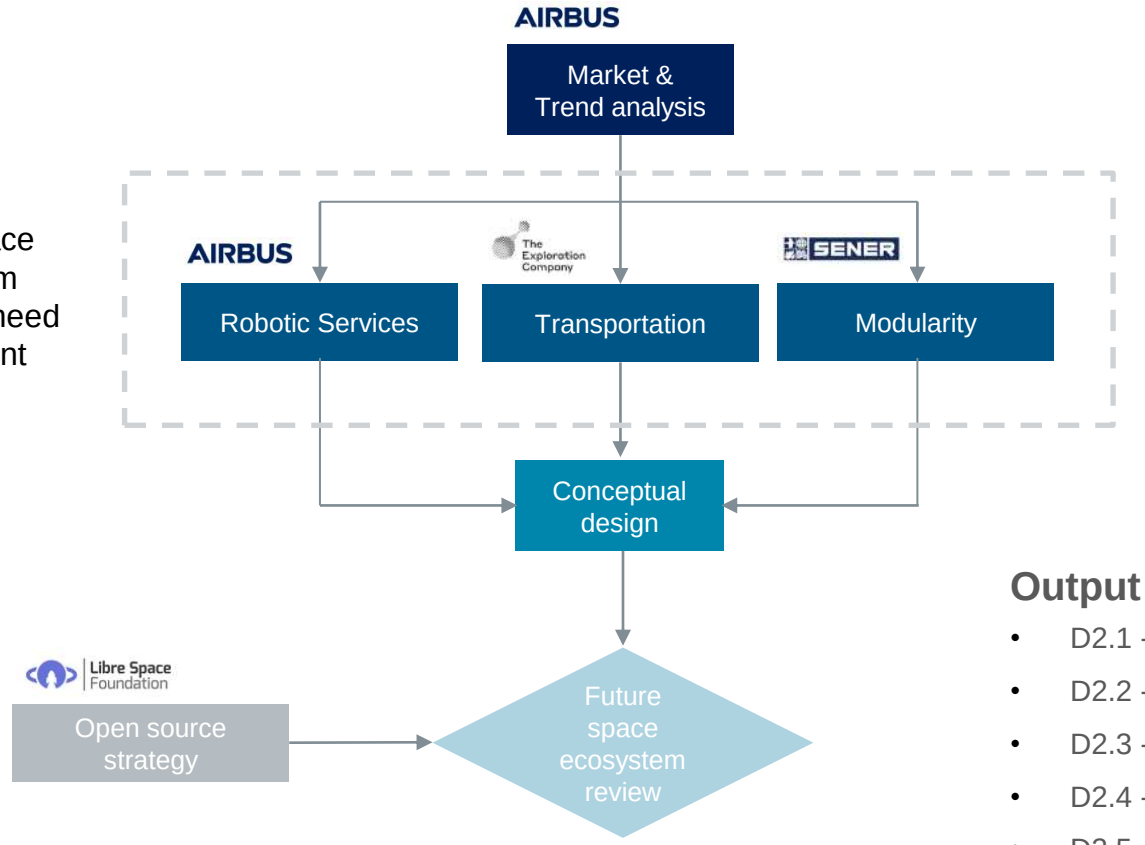
Workstream Number 1 - Explanation of study part

Future space ecosystem capabilities need assessment



Objectives

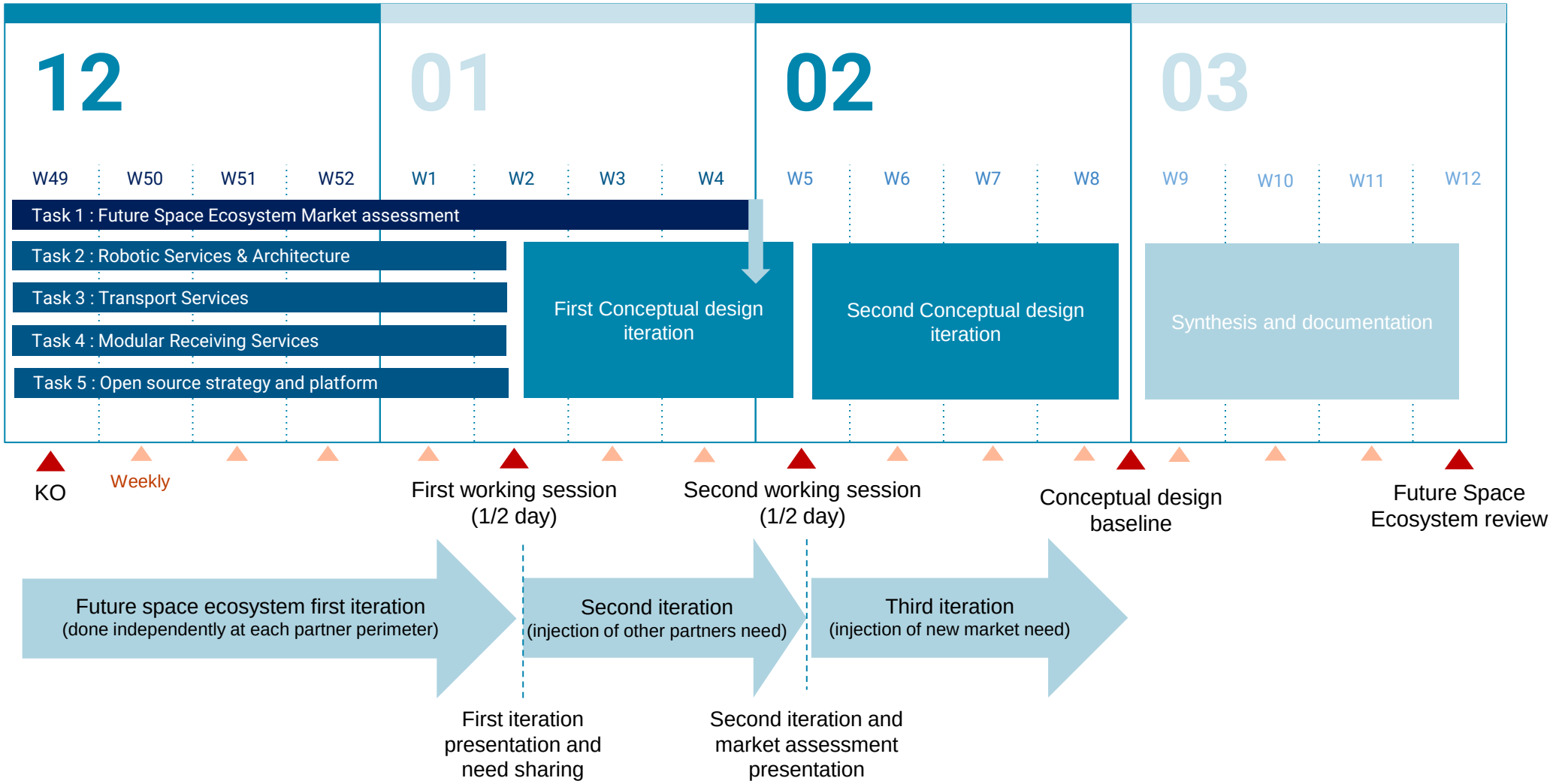
Definition of future space ecosystem including :

- Robotic providing services systems
- Transportation and logistics
- Modularity in software and receiving services hardware

Output documentation

- D2.1 - Market and Trend Analysis & Exploitation Plan
- D2.2 - Mission Scenario Description Document (MSD)
- D2.3 - Future Space Ecosystem Requirements Document
- D2.4 - System Concepts Document for Future Space Ecosystem: Robotic Services
- D2.5 - System Concepts Document for Future Space Ecosystem: Logistics
- D2.6 - System Concepts Document for Future Space Ecosystem: Receiving Services
- D2.7 - Open-Source Strategy and Implementation Plan for Future Space Ecosystem

Workstream Number 1 - Explanation of study part



First iteration details

AIRBUS | SENER | The Exploration Company | Libre Space Foundation

PERIOD market assessment as input

Market trend analysis for transportation services

Functions identification for future space ecosystem	• Main functions associated to robotic services & architecture	• Main functions associated to modular receiving services	• Main functions associated to transport services	• Past and on going open-source S/W and H/W activity analysis in the space community • Assess different business models based on open-source for space industry • Assess challenges and potential solutions for open-source in space business
Conceptual design	• Robotic system definition • Modular factory conceptual design	• Modules definition (sub-system, payload, ORU …) • Modules conceptual design based on standardized interfaces/interconnect	• Orbital localisation identification and design impacts • Single versus multiple vehicle concept • Platform conceptual design	
Preliminary system budget	• Mass, power and data, volume preliminary budget allocation	• Mass, power and data, volume preliminary budget allocation	• Mass, power and propulsion preliminary budget allocation	

Set of preliminary requirements

KO meeting

First working session (W2 2024)

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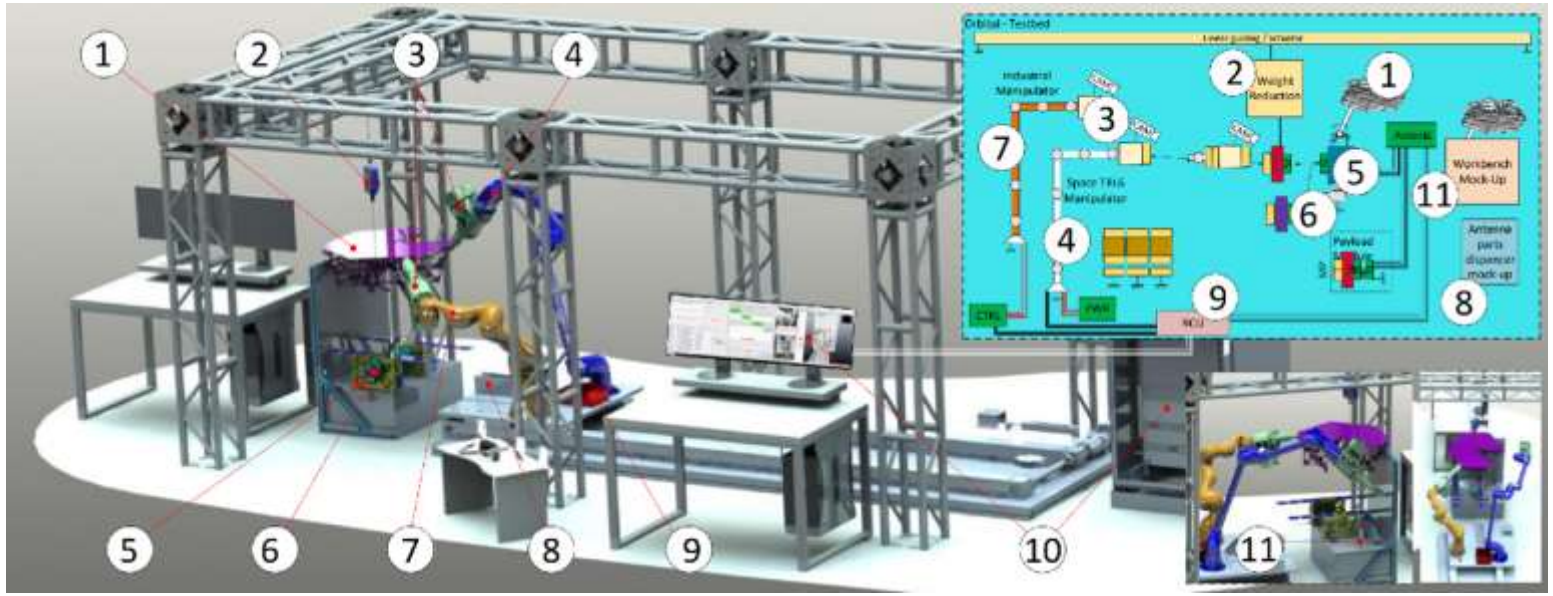
Workstream Number 2 - Envisioned end-to-end demonstrator

The final goal is the integration of many AIRBUS and PERASPERA building blocks into a single ISAM demonstrator:

- Integration of building blocks:
  - Airbus VISPA arm incl. control S/W
  - Airbus tools (MPT) incl. control S/W
  - Airbus Robotic System Control S/W
  - Standard Interconnect (SI by SENER)
  - ESA/EU OBSW framework (TASTE)
  - S/W components of functional layer:
    - Perception S/W by magellium SAS (PERASPERA)
    - DFKI contribution to autonomy (motion planning)
  - Ground S/W by magellium
- Application to antenna reflector assembly (ADS SAS, with heritage of PERIOD)



1) Antenna reflector
2) Gravity off-loading tool
3) Multi-Purpose Tool (MPT)
4) VISPA Robotic Manipulator
5) Standard Interconnects (SIROM)
6) Tool-sockets
7) Industrial manipulator (e.g. iiwa)
8) Assembly part dispenser
9) Robotic control unit (RCU)
10) Robotic Ground Console
11) Workbench Mock-Up

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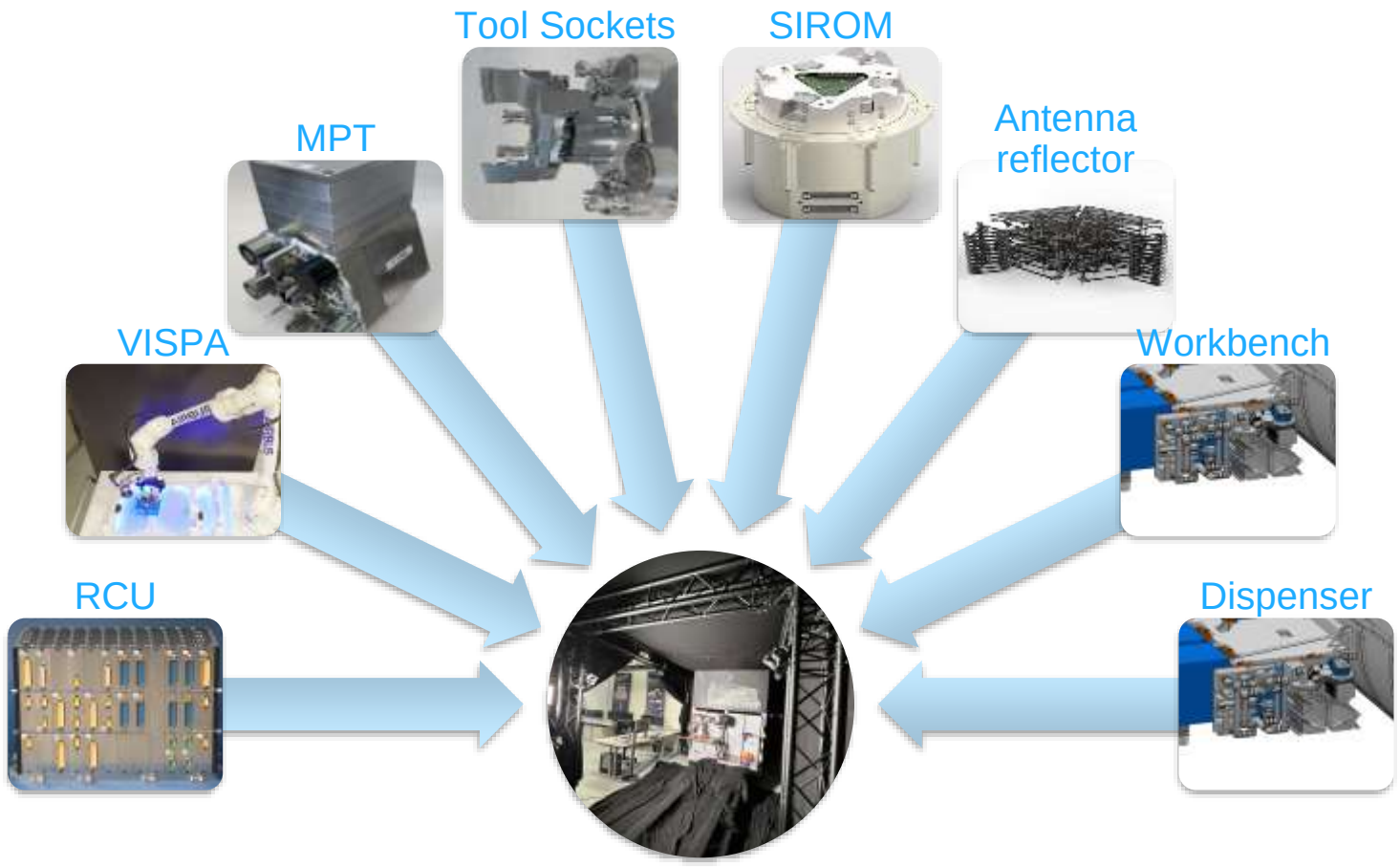
Workstream Number 2 - Hardware Developments & Maturation

The following H/W building will be further developed and maturated or demonstrated in an integrated application scenario:

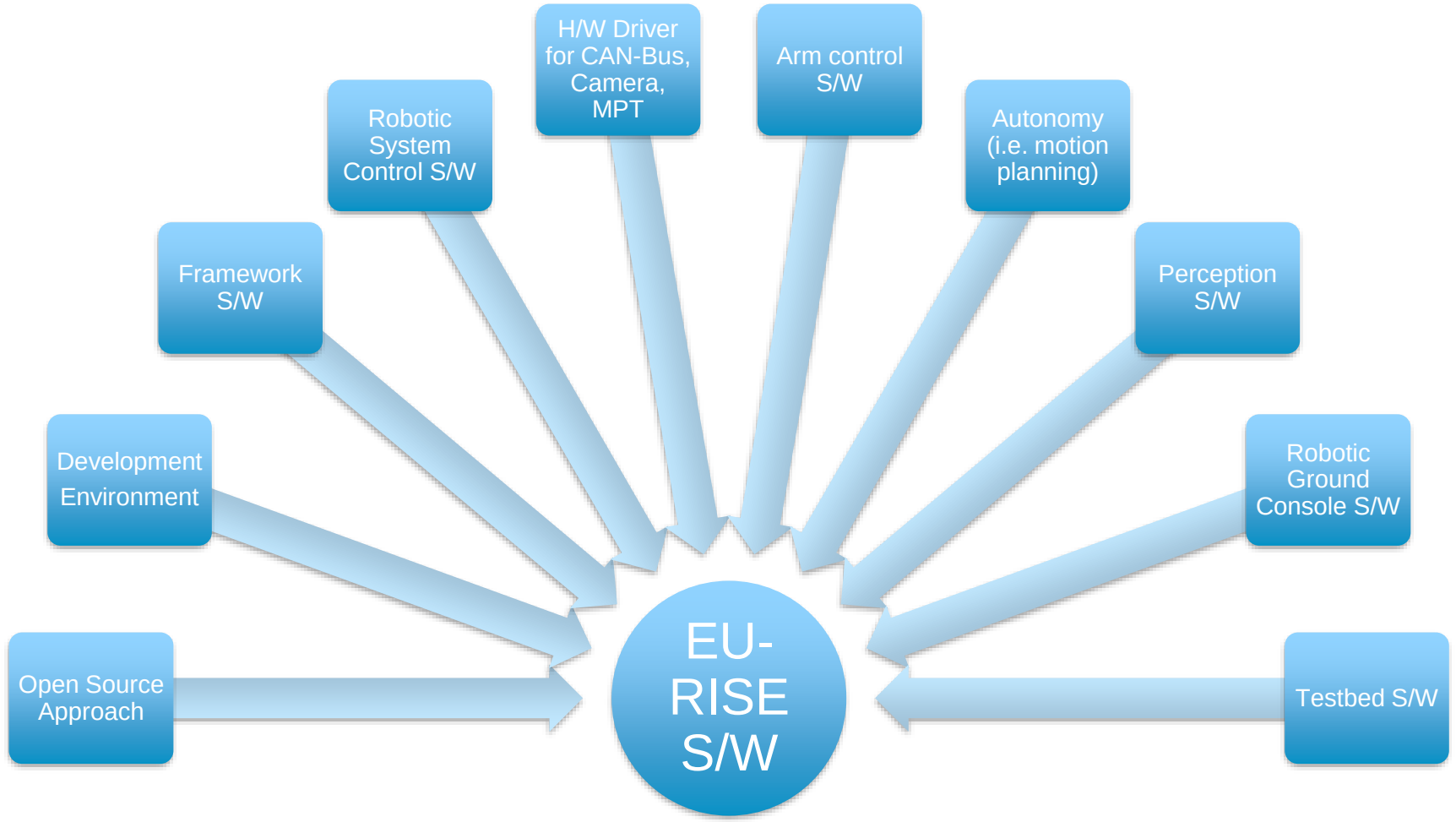
- Robotic Control Unit (RCU)
- Robotic Manipulator (VISPA)
- Robotic Tool Unit (MPT)
- Robotic Tool Sockets
- Standard Interconnect (SIROM)
- Assembly kit for a antenna
- Workbench for the assembly
- Dispenser for the parts



Workstream Number 2 - Software Developments & Maturation

The following S/W building will be further developed and maturated or demonstrated in an integrated application scenario:

- Robotic Framework
- Robotic Control Software
- Driver for Hardware
- Arm Control Software
- Autonomy Software
- Perception Software
- Robotic Ground Console



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Roadmap

WE BUILD AND DE-RISK FAST.

From the Baby to the Adult Capsule.

2022 – 2024
Bikini

- Reentry demonstrator #1.
- Ballistic reentry.
- Ready to fly in 2022 but had to be launched later because of A6 delays.

2022 – 2025
Mission Possible

- Reentry demonstrator #2.
- Controlled reentry.
- Flying with clients.
- Recovery of the capsule.
- Green propulsion.

2023 – 2025
On-Ground Demos

- Docking demonstration.
- Qualification of the green propulsion system.

2023 – 2027
Nyx Earth

- Low Earth Orbit vehicle flying to space stations and coming back on Earth.

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Airbus Amber

ONE MODULAR VEHICLE SERVING MULTIPLE DESTINATIONS.

We Master In-Space Logistics.

Low Earth Orbit Stations

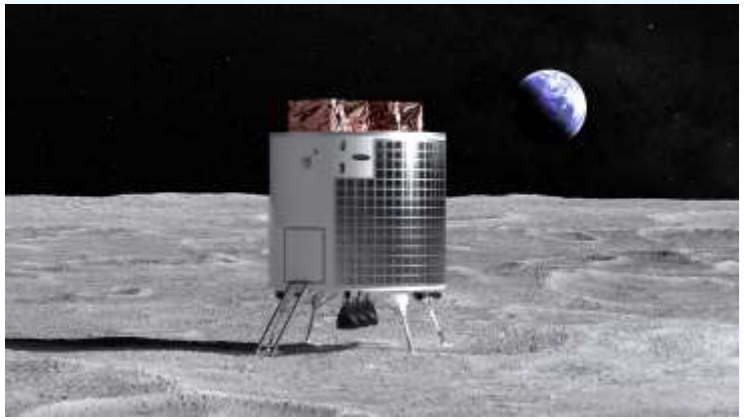
- 4,000 kg up (6,000 kg growth potential).
- 2,600 kg down.
- SpaceX Dragon Challenger.

Lunar Gateway

- 3,000 kg up.
- 1,000 kg down.
- Core element of Artemis architecture.

Lunar Surface

- 2,500 kg up.
- Hopping & refueling capability.
- Large lunar lander complementing CLPS & Starship.



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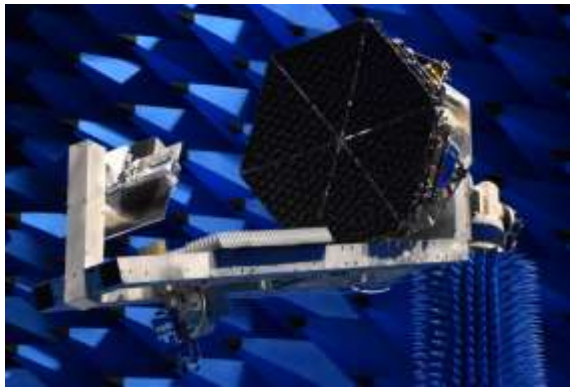
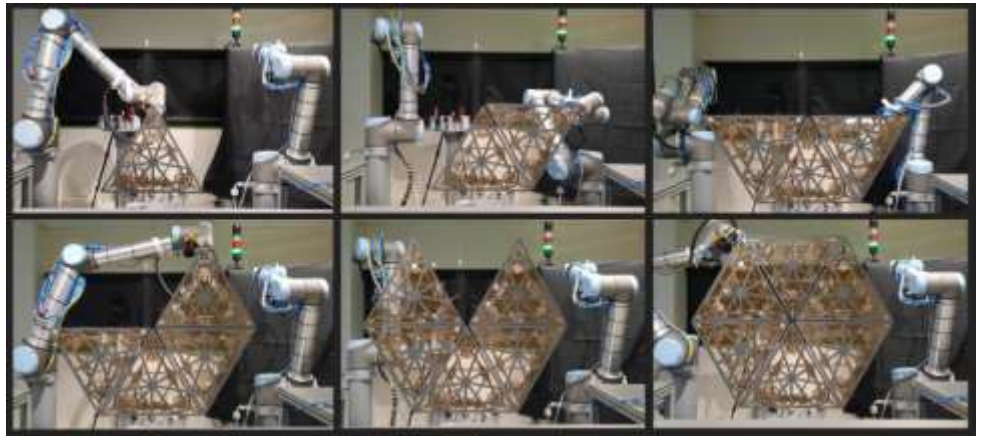
LAKRA – Large Antenna Kit for Robotic Assembly

- Reflector kit for robotic assembly currently under development by Airbus Defence and Space SAS
- Achieves TRL6 by end 2023
- Associated workbench for robotic assembly under development
- A mock-up of the reflector and the workbench will be provided for EU-RISE demonstrator





Airbus Amber

SIROM
(WP5 – Task 4)

- Multi-purpose interface for robotic manipulation
- Mechanical coupling, data and power transfer, fluidic connection

- Development since 2016, participation in:
  - EROSS / EROSS IOD (Thales)
  - PERIOD (Airbus)
  - MIRROR (GMV)
  - ISAAC (Airbus)
  - ORU-BOAS (Sener)

- On-going work on flight families (SIROM E/G)
- Tested family for ground demos (SIROM C)

- Videos:
  - https://youtu.be/uwpm_SOnYE8
  - https://youtu.be/fO-iVjy4voA

SIROM C
Ground demos

SIROM E
Electrical

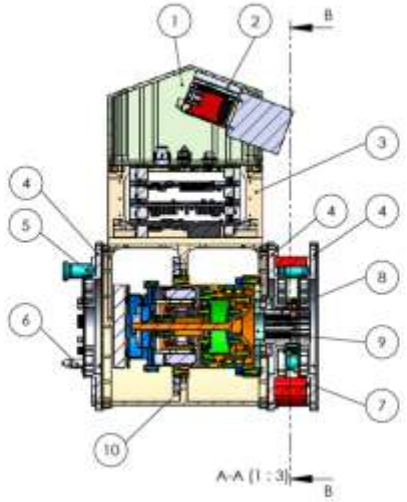
SIROM G
Electrical/fluidic

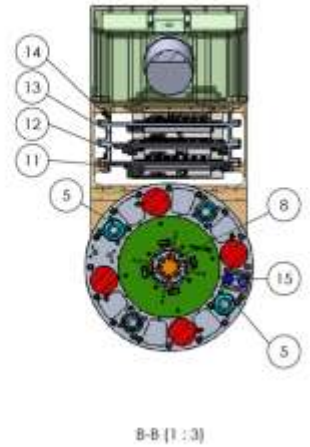
Robotic Arms: VISPA – Versatile In-Space and Planetary Arm (WP5 - Task 1)

- Versatile space robotic manipulator currently under development by Airbus Defence and Space UK
- Achieves TRL6 by end of 2023
- 6 DOF
- Low-cost approach
- Designed for in-space assembly operations
- A copy of TRL6 DM will be provided for EU-RISE demonstrator.

Robotic Tools – MPT (Multi Purpose Tool) (WP5 - Task 2)

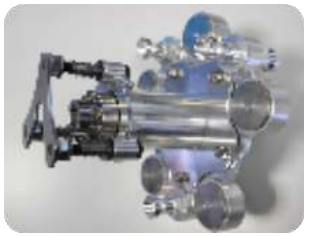
- Robotic tool for multiple purposes is currently under development at Airbus Defence and Space GmbH
- TRL4 reached beginning of 2023
- Tool consists of central avionics box including E-box, interfaces, motor, gears and drive shaft, as well as end-effector camera.
- Many different tool-sockets under investigation for different purposes (e.g. drilling, clinching, cutting, screwing, graspeng, etc.)
- Multi-purpose tool will be further matured and integrated into demonstrator of EU-RISE.





MPT

Sockets

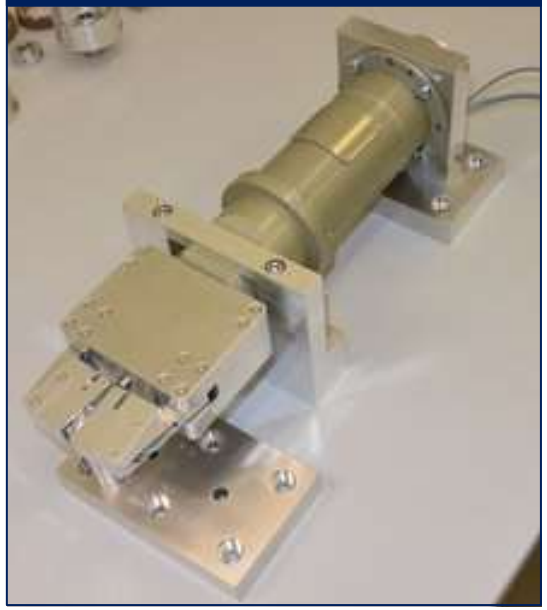


Avionic

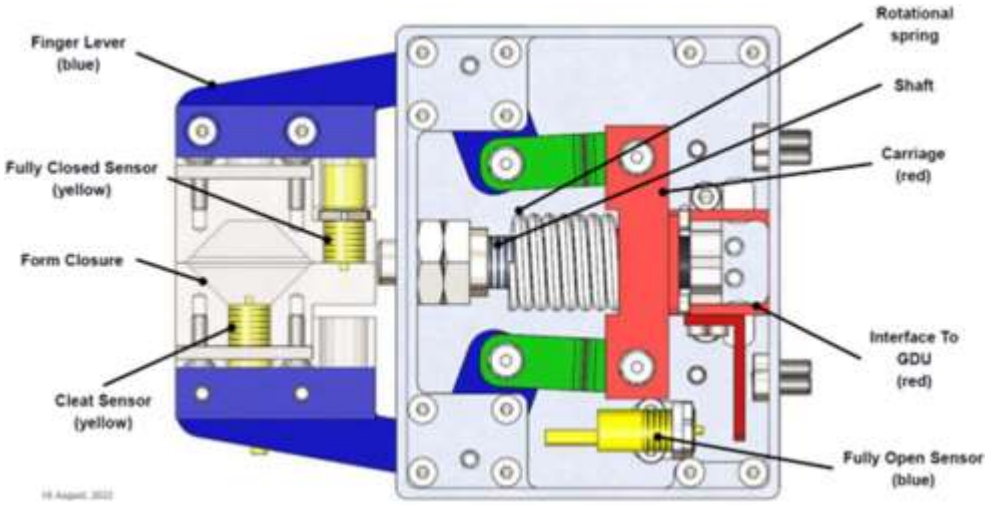
Tool changing interface

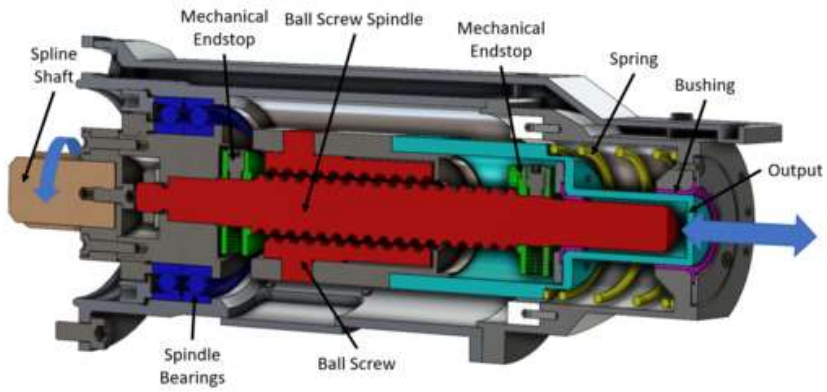
Robotic sockets (WP5 – Task 3)

Cleat Gripper



Frame Gripper





Compatible with MPT from Airbus

Planned work

- Adaption of existing tool sockets for the different manipulation tasks
- Manufacture, assemble, integrate and test tools
- Test the performance of the sockets together with the MPT

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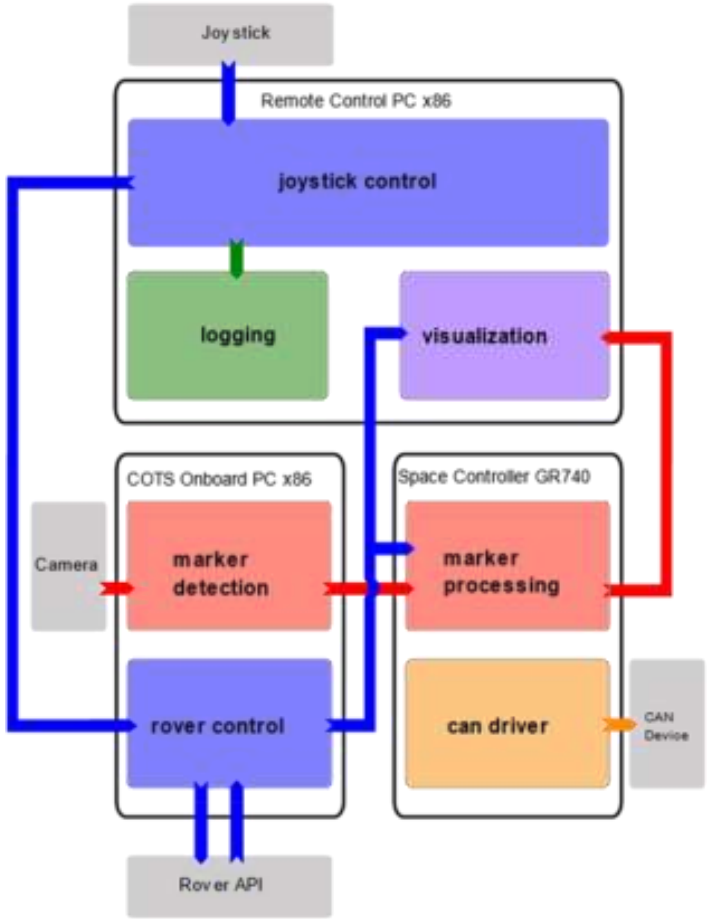
Framework (WP4 – Task 1)



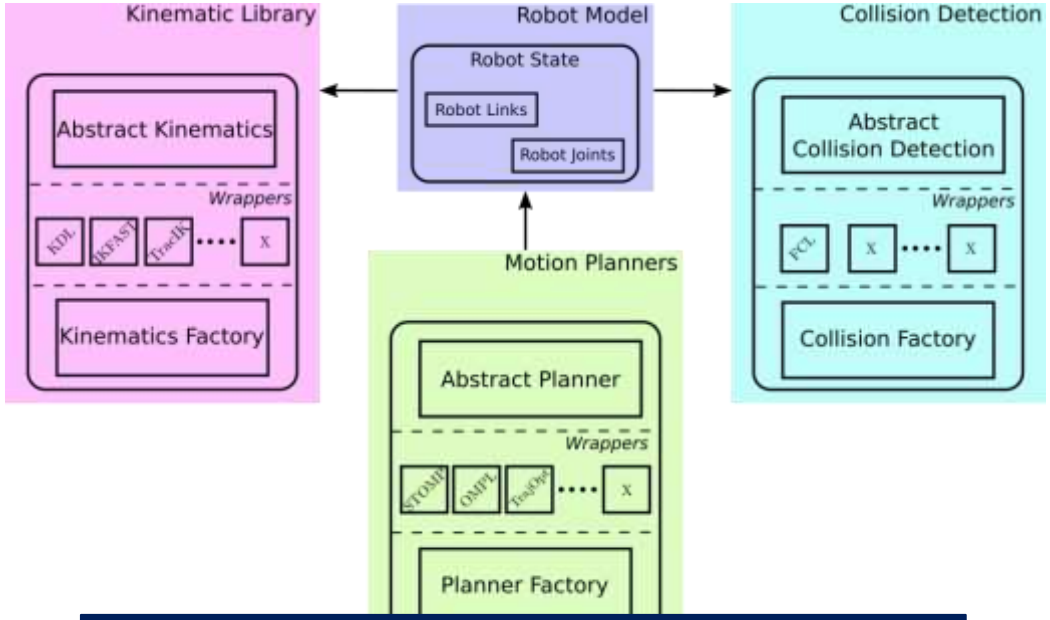
Previous work on ESROCOS

- Based on ESA TASTE 9
- Added common robotic software features from DFKI Rock
- Base types for robotic systems (e.g. Position, Velocity, Images)
- Repository management and build system *autoproj*
- Support for handling frames and transformations between them (transformer)
- Support for timely synchronizing streams of data (stream aligner)
- Behavior Interaction Priority extensions for further correctness checking
- Has been successfully tested in a heterogeneous hardware setup and real robotic systems

Planned work

- Moving from TASTE 9 to TASTE 10
- Reintegration/migration of ESROCOS/Rock Tooling on top TASTE 10
- Improvements of the tooling (see ASTRA2019 Paper)
- Provide common ground for all members of the project (including Continuous Integration etc.)

Autonomy
(WP4 – Task 6)



Existing work

- Modular composition of components for motion planning
- Used in PULSAR (OG8) (ID: 821858)
- Not coded with respect to space-standards

Planned work

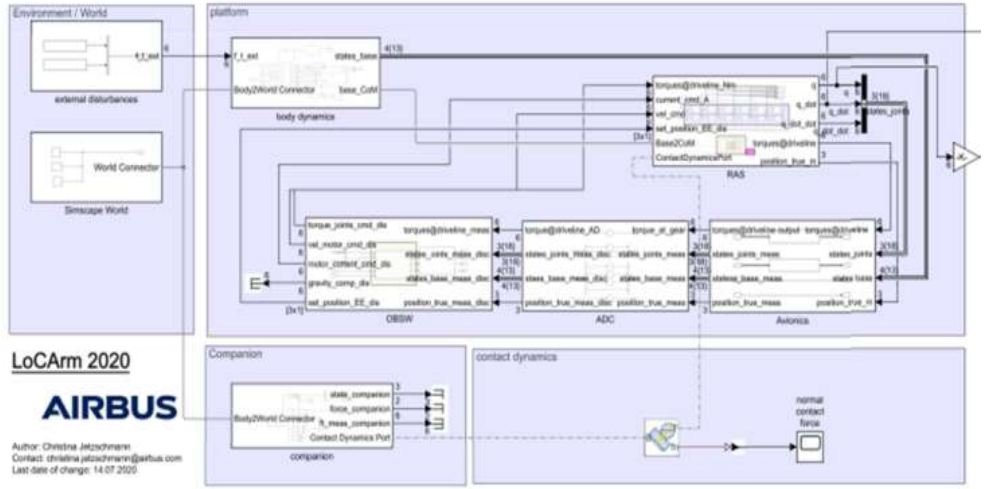
- Review of existing and open-source S/W for autonomy, motion planning and collision avoidance
- Define algorithmic concept and implement selected S/W w.r.t on-board requirements and constraints
- Implement the motion planning component
- Test of the implemented motion planning component

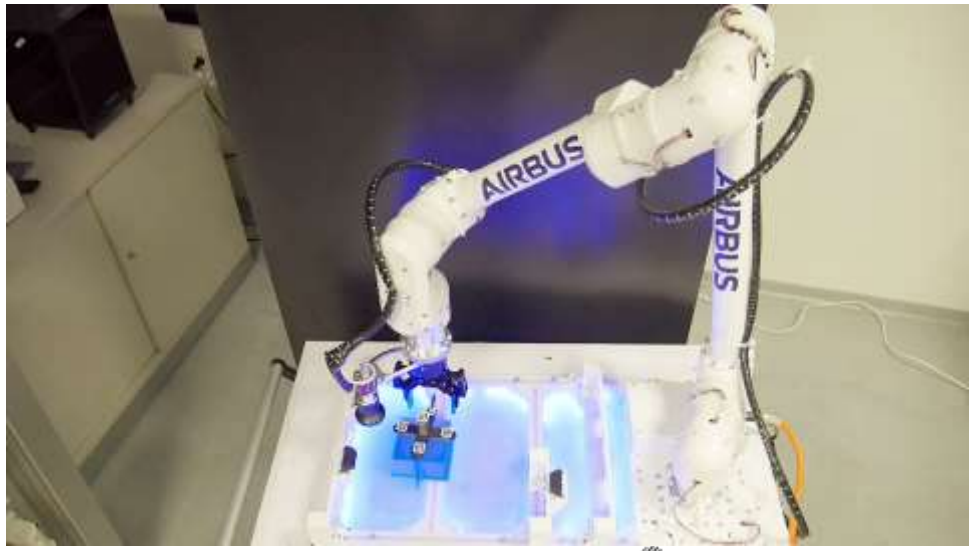
Robotics Flight Software: Robotics System Control S/W for High-Level Control (WP4 - Task 2)

- Airbus Defence and Space GmbH developed a robotic system control S/W based on existing SW frameworks for robotics and OBSW:
  - NASA cFS
  - ESA TASTE-9/ESROCOS
  - ESA TASTE-10
  - ROS2/ SpaceROS
- Robotic System Control S/W shall orchestrate all robotic building blocks including H/W drivers and smart robotic skills. It will be based on NASREM and ESA FRM.
- Autonomous behaviour by introducing by *behaviour trees*
- It will the frame of OBSW integration,
  i.e. all S/W elements have to integrated:
  - H/W driver (e.g. SENER SIROM driver)
  - Robotic arm control S/W
  - Perception and autonomy skills
- The RSC frame shall be subject to open source S/W!

Robotics Flight Software: Perception & Arm Control (WP4 - Task 3)

- Airbus Defence and Space GmbH developed control S/W for the VISPA arm and further perception S/W for vision-based guidance of manipulation processes by means of visual servoing.
- Arm control S/W integrates full 6DOF forward and inverse kinematic control of the arm and impedance control based on pure current measurements.
- Robotic arm control S/W will be further maturated and integrated into EU-RISE demonstrator.
- Vision-based methods for manipulator guidance will be continued by magellium SAS.
- Contact operations might be supported with external FTS measurements for EU-RISE.





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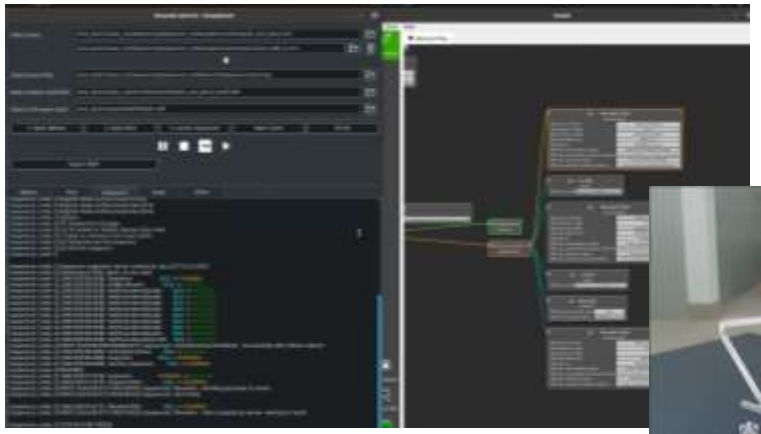
Robotic Ground Software – Digital Twin and Test Console (WP4 - Task 4 & 5)

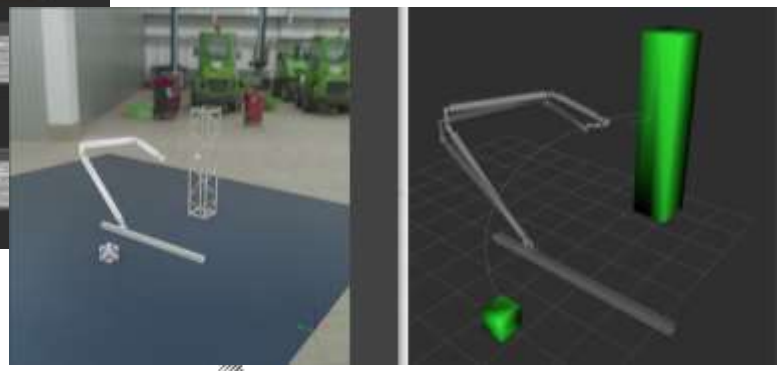
Digital twin and simulation

- Inherited from H2020 PULSAR
- Simulation enables mission assembly plan validation
- Digital twin allows to integrate *as-build* model in the simulation loop to correct *as-designed* simulated models
- Digital twin integrates TM to update models and provide feedback to the end-user during the demonstration/execution of the assembly

Robotic Test Console

- Inherited from current projects (ISAAC, DEMARLUS)
- Closely coupled with simulation and digital twin
- Allows to pre-run tasks in the update simulation before executing on-board
- Allows to replan actions if necessary
- Monitors the current status of the demonstration





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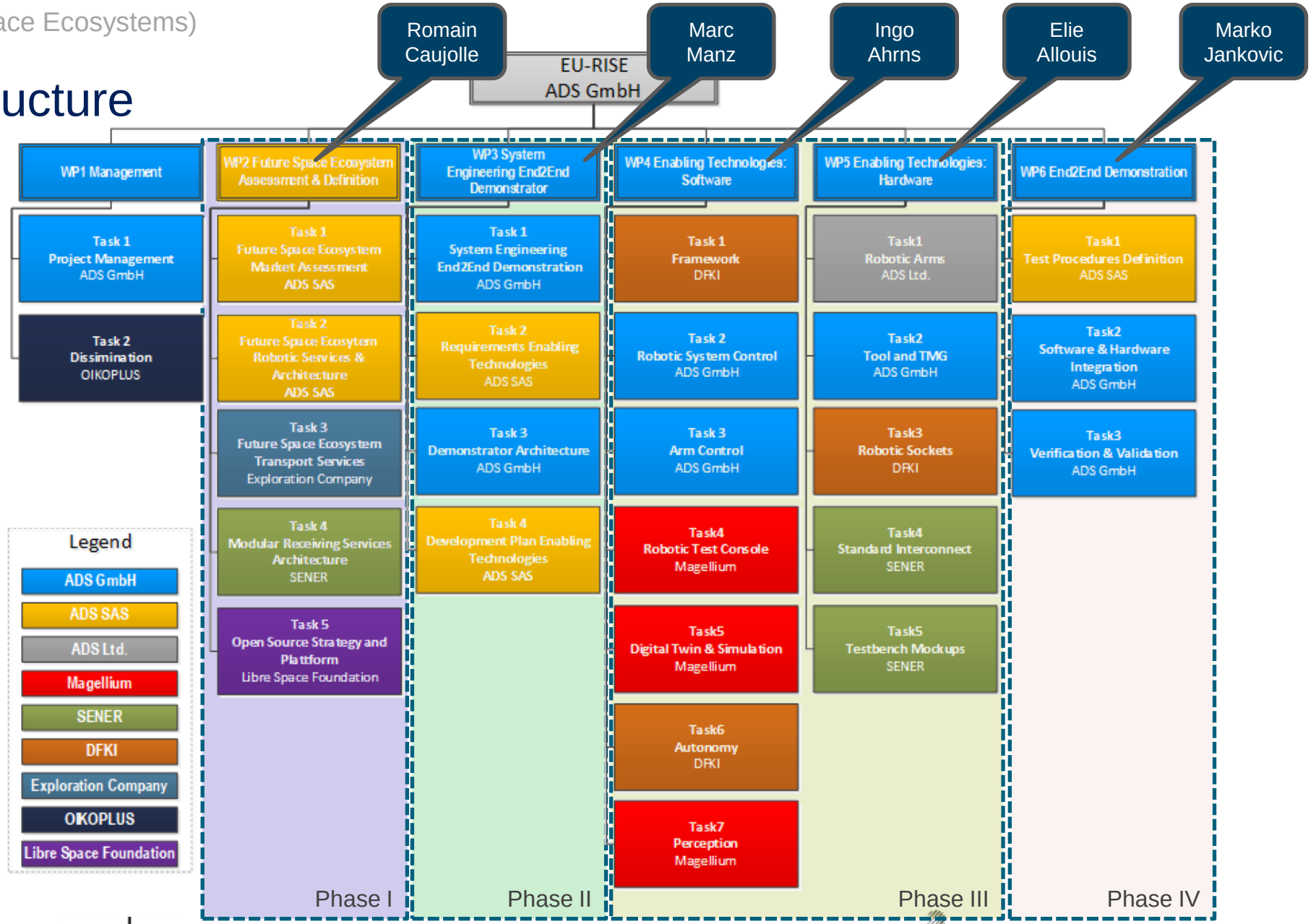
- Introduction
- Workstream Objectives
- Technology Building Blocks
- **Action plan**
- Success criteria and next steps
- Presentation HaDEA
- Discussion and feedback from the EU

Work Breakdown Structure



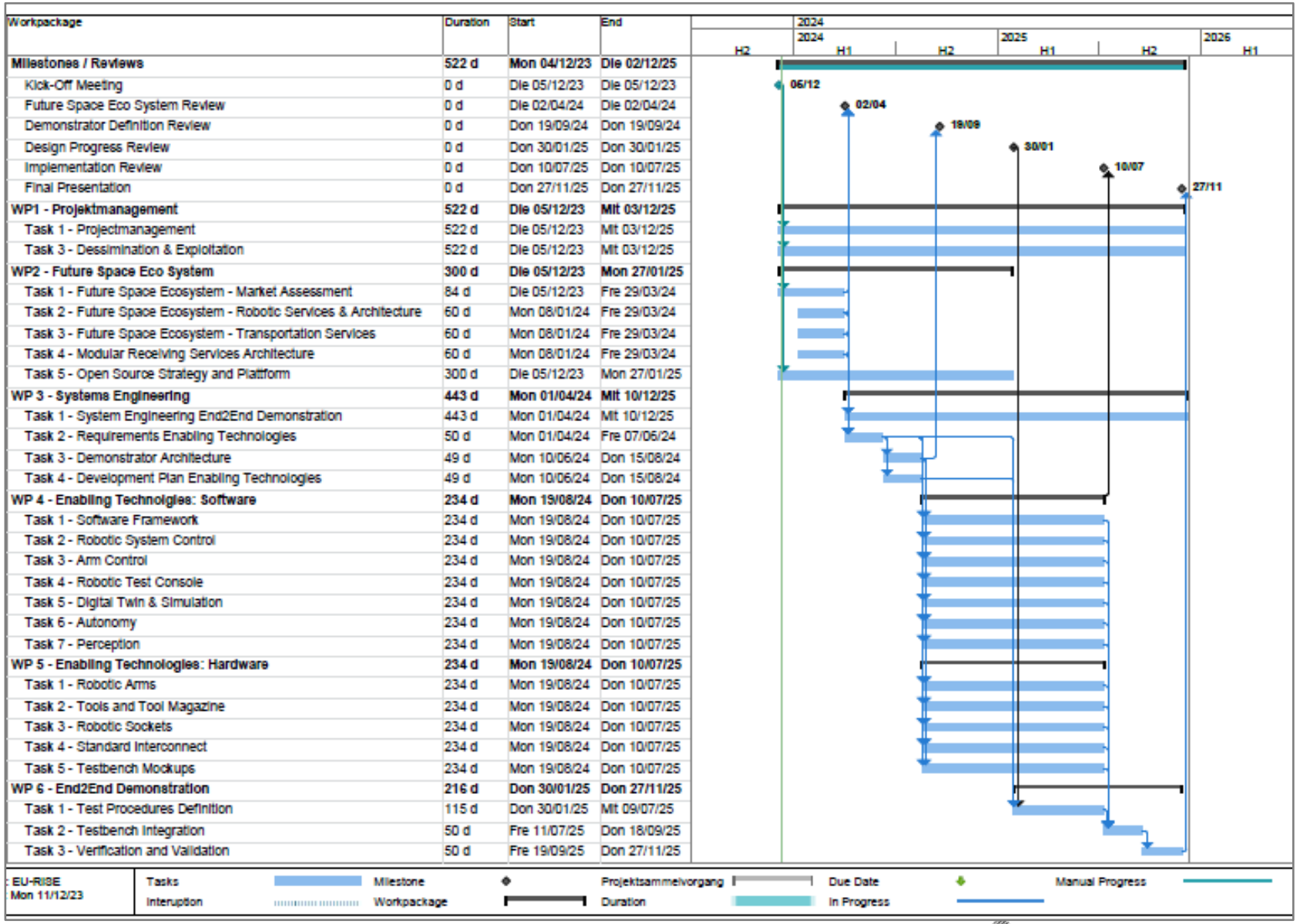
WP2: romain.caujolle@airbus.com
WP3: marc.manz@airbus.com
WP4: ingo.ahrns@airbus.com
WP5: elie.allouis@airbus.com
WP6: marko.m.jankovic@airbus.com

Schedule

Deadlines for Deliverables:

- WP2 - 14.03.24
- WP3 – 05.09.24
- WP4 & WP5 - 16.01.25
- WP4 & WP5 - 26.06.25
- WP6 - 12.11.25

Workpackage	Duration	Start	End
Milestones / Reviews	**522 d**	**Mon 04/12/23**	**Die 02/12/25**
Kick-Off Meeting	0 d	Die 05/12/23	Die 05/12/23
Future Space Eco System Review	0 d	Die 02/04/24	Die 02/04/24
Demonstrator Definition Review	0 d	Don 19/09/24	Don 19/09/24
Design Progress Review	0 d	Don 30/01/25	Don 30/01/25
Implementation Review	0 d	Don 10/07/25	Don 10/07/25
Final Presentation	0 d	Don 27/11/25	Don 27/11/25
WP1 - Projektmanagement	**522 d**	**Die 05/12/23**	**Mit 03/12/25**
Task 1 - Projectmanagement	522 d	Die 05/12/23	Mit 03/12/25
Task 3 - Dessimination & Exploitation	522 d	Die 05/12/23	Mit 03/12/25
WP2 - Future Space Eco System	**300 d**	**Die 05/12/23**	**Mon 27/01/25**
Task 1 - Future Space Ecosystem - Market Assessment	84 d	Die 05/12/23	Fre 29/03/24
Task 2 - Future Space Ecosystem - Robotic Services & Architecture	60 d	Mon 08/01/24	Fre 29/03/24
Task 3 - Future Space Ecosystem - Transportation Services	60 d	Mon 08/01/24	Fre 29/03/24
Task 4 - Modular Receiving Services Architecture	60 d	Mon 08/01/24	Fre 29/03/24
Task 5 - Open Source Strategy and Platform	300 d	Die 05/12/23	Mon 27/01/25
WP 3 - Systems Engineering	**443 d**	**Mon 01/04/24**	**Mit 10/12/25**
Task 1 - System Engineering End2End Demonstration	443 d	Mon 01/04/24	Mit 10/12/25
Task 2 - Requirements Enabling Technologies	50 d	Mon 01/04/24	Fre 07/06/24
Task 3 - Demonstrator Architecture	49 d	Mon 10/06/24	Don 15/08/24
Task 4 - Development Plan Enabling Technologies	49 d	Mon 10/06/24	Don 15/08/24
WP 4 - Enabling Technologies: Software	**234 d**	**Mon 19/08/24**	**Don 10/07/25**
Task 1 - Software Framework	234 d	Mon 19/08/24	Don 10/07/25
Task 2 - Robotic System Control	234 d	Mon 19/08/24	Don 10/07/25
Task 3 - Arm Control	234 d	Mon 19/08/24	Don 10/07/25
Task 4 - Robotic Test Console	234 d	Mon 19/08/24	Don 10/07/25
Task 5 - Digital Twin & Simulation	234 d	Mon 19/08/24	Don 10/07/25
Task 6 - Autonomy	234 d	Mon 19/08/24	Don 10/07/25
Task 7 - Perception	234 d	Mon 19/08/24	Don 10/07/25
WP 5 - Enabling Technologies: Hardware	**234 d**	**Mon 19/08/24**	**Don 10/07/25**
Task 1 - Robotic Arms	234 d	Mon 19/08/24	Don 10/07/25
Task 2 - Tools and Tool Magazine	234 d	Mon 19/08/24	Don 10/07/25
Task 3 - Robotic Sockets	234 d	Mon 19/08/24	Don 10/07/25
Task 4 - Standard Interconnect	234 d	Mon 19/08/24	Don 10/07/25
Task 5 - Testbench Mockups	234 d	Mon 19/08/24	Don 10/07/25
WP 6 - End2End Demonstration	**216 d**	**Don 30/01/25**	**Don 27/11/25**
Task 1 - Test Procedures Definition	115 d	Don 30/01/25	Mit 09/07/25
Task 2 - Testbench Integration	50 d	Fre 11/07/25	Don 18/09/25
Task 3 - Verification and Validation	50 d	Fre 19/09/25	Don 27/11/25



Milestones

No.	Milestone name	Related work package(s)	Due date (in month)	Location	Means of verification
1	Kick-Off (KO)	WP1, WP2	M0	Bremen	KO performed and KO data package distributed
2	Future Space Ecosystem Review (FSER)	WP1, WP2	M3	Toulouse	FSER performed and FSER data package distributed (including presentation of future space ecosystem concepts)
3	Demonstrator Definition Review (DDR)	WP1, WP2, WP3	M8	Toulouse	DR performed and DDR data package distributed
4	Design Progress Review (DPR)	WP1, WP3, WP4, WP5	M14	Online only	PR performed and PR data package distributed, On-Board Computer available
5	Implementation Review (IR)	WP1, WP3, WP4, WP5, WP6	M19	Bremen	IR performed and IR data package distributed, Arm(s) available, MPT available, Sockets available, SIs available, Mockups available, Test-bench available
6	Final Presentation (FP)	WP1, WP3, WP6	M24	Bremen	FP performed and FP data package distributed Demonstration running in test-bench

List of Deliverables

Deadlines for Deliverables:

- WP2 - 14.03.24
- WP3 - 05.09.24
- WP4 & WP5 - 16.01.25
- WP4 & WP5 - 26.06.25
- WP6 - 12.11.25

Deliverable Number	Deliverable Name	Work Package Number	Short Name of Lead Participant	Type	Dissemination Level	Delivery date (in months)					
						M1 (KoM)	M4	M9	M12	M18	M24
D1.1	Kick-Off Presentation	WP1 -Task 1	ADS GmbH	R	PU	X					
D1.2	Data Package FSER	WP1 - Task 1	ADS GmbH	R	PU		X				
D1.3	Data Package DDR	WP1 - Task 1	ADS GmbH	R	PU			X			
D1.4	Data Package DR	WP1 - Task 1	ADS GmbH	R	PU				X		
D1.5	Data Package IR	WP1 - Task 1	ADS GmbH	R	PU					X	
D1.6	Data Package FP	WP1 - Task 1	ADS GmbH	R	PU						X
D1.7	Cost Estimate Report (CER)	WP1 - Task 1	ADS GmbH	R	PU		X	X	X	X	X
D1.8- D1.15	Quarterly Progress Report <1..8>	WP1 - Task 1	ADS GmbH		PU	Quarterly in definition phase					
D1.16	Risk Register	WP1 - Task 1	ADS GmbH	R	PU			X	X	X	X
D1.17	Data Management Plan (DMP)	WP1 - Task 2	OIKOPLUS	DMP	PU			X	X	X	X
D1.18	Communication and Dissemination Strategy	WP1 - Task 2	OIKOPLUS	R	PU		X				
D1.19	Communication Pack #1	WP1 - Task 2	OIKOPLUS	DEC	PU			X			
D1.20	Communication Pack #2	WP1 - Task 2	OIKOPLUS	DEC	PU					X	
D1.21	Dissemination and Communication Report	WP1 - Task 2	OIKOPLUS	R	PU						X
D1.22	Project Website & Social Media set up	WP1 - Task 2	OIKOPLUS	DEC	PU		X				
D2.1	Market and Trend Analysis & Exploitation Plan	WP2 - Task 1	ADS SAS	R	PU		X				
D2.2	Mission Scenario Description Document (MSD)	WP2 - Task 1	ADS SAS	R	PU		X				
D2.3	Future Space Ecosystem Requirements Document	WP2 - Task 1	ADS SAS	R	PU		X				
D2.4	System Concepts Document for Future Space Ecosystem: Robotic Services	WP2 - Task 2	ADS SAS	R	PU		X				
D2.5	System Concepts Document for Future Space Ecosystem: Logistics	WP2 - Task 3	Expl. Com.	R	PU		X				
D2.6	System Concepts Document for Future Space Ecosystem: Receiving Services	WP2 - Task 4	SENER	R	PU		X				
D2.7	Open-Source Strategy and Implementation Plan for Future Space Ecosystem	WP2 - Task 5	Libre Space	R	PU		X	X			
D3.1	System Engineering Plan (SEP)	WP3 - Task 1	ADS GmbH	R	PU			X	X	X	X
D3.2	Design Definition File (DDF) for End to End Demonstrator	WP3 Task 1,2,3	ADS GmbH	R	PU			X	X	X	X
D3.3	Design Justification File (DJF) for End to End Demonstrator	WP3 Task 1,2,3	ADS GmbH	R	PU			X	X	X	X
D3.4	End to End Demonstrator Requirements Document (S/W & H/W)	WP3 Task2	ADS SAS	R	PU			X			
D3.5	Coordinate System Document (CSD) for End to End Demonstrator	WP3 Task 3	ADS GmbH	R	PU			X	X	X	X
D3.6	Interface Control Document (ICD) for End to End Demonstrator	WP3 Task 3	ADS GmbH	R	PU			X	X	X	X
D3.7	Development Plan Enabling Technologies (DP)	WP3 Task 4	ADS SAS	R	PU			X			X
D4.1	Framework Documentation	WP4 Task 1	DFKI	R	PU				X	X	X
D4.2	Documentation Robotic System Control S/W	WP4 Task 2	ADS GmbH	R	PU				X	X	X
D4.3	Arm Control S/W documentation	WP4 Task 3	ADS GmbH	R	PU				X	X	X
D4.4	Robotic test Console Documentation	WP4 Task 4	Magellium	R	PU				X	X	X
D4.5	Robotic Simulator Documentation	WP4 Task 5	Magellium	R	PU				X	X	X
D4.6	Motion Planning/ Autonomy S/W Documentation	WP4 Task 6	DFKI	R	PU				X	X	X
D4.7	Perception S/W Documentation	WP4 Task 7	Magellium	R	PU				X	X	X
D5.1	SI documentation	WP5 Task 4	SENER	R	PU				X		
D6.1	Testbed Definition Document (TDD)	WP6 Task 1	ADS GmbH	R	PU			X	X	X	
D6.2	Enabling Technologies Development Test & Validation Plan	WP6 Task 1	ADS SAS	R	PU			X	X	X	
D6.3	Enabling Technologies Development Test Report	WP6 Task 3	ADS GmbH	R	PU						X

Meeting Set-Up

Monthly status meeting (90 minutes)

Moderator	Marc Manz & Marko Jankovic
Topics	• Status report from work package manager • Schedule update an progress tracking • Risk register tracking • Dissimination
Attendees	• Project manager from each partner • System engineering (ADS SAS and GmbH)

Weekly status meeting for each work package

Moderator	WP2 - Romain Caujole | WP3 - Marc Manz | WP4 - Ingo Ahrns | WP5 - Elie Allouis | WP6 - Marko Jankovic
Topics	• Status work package • Status deliverables • Task tracking
Attendees	• People working in the work package from all partners • System engineering (ADS SAS and GmbH)

Url: https://nuudel.digitalcourage.de/xvY6ZPgCAq7rgi7u

Please sign up for your day preference

Registration deadline: 08.12.2023

Meeting Set-Up

Monthly status meeting

Start

Kick-Off Meeting

Future Space Ecosystem Review

Demonstrator Definition Review

Progress Review

Implementation Review

End

Final Presentation

Weekly status meeting for each work package 2
(ADS SAS)

Weekly status meeting for each work package 3
(ADS GmbH)

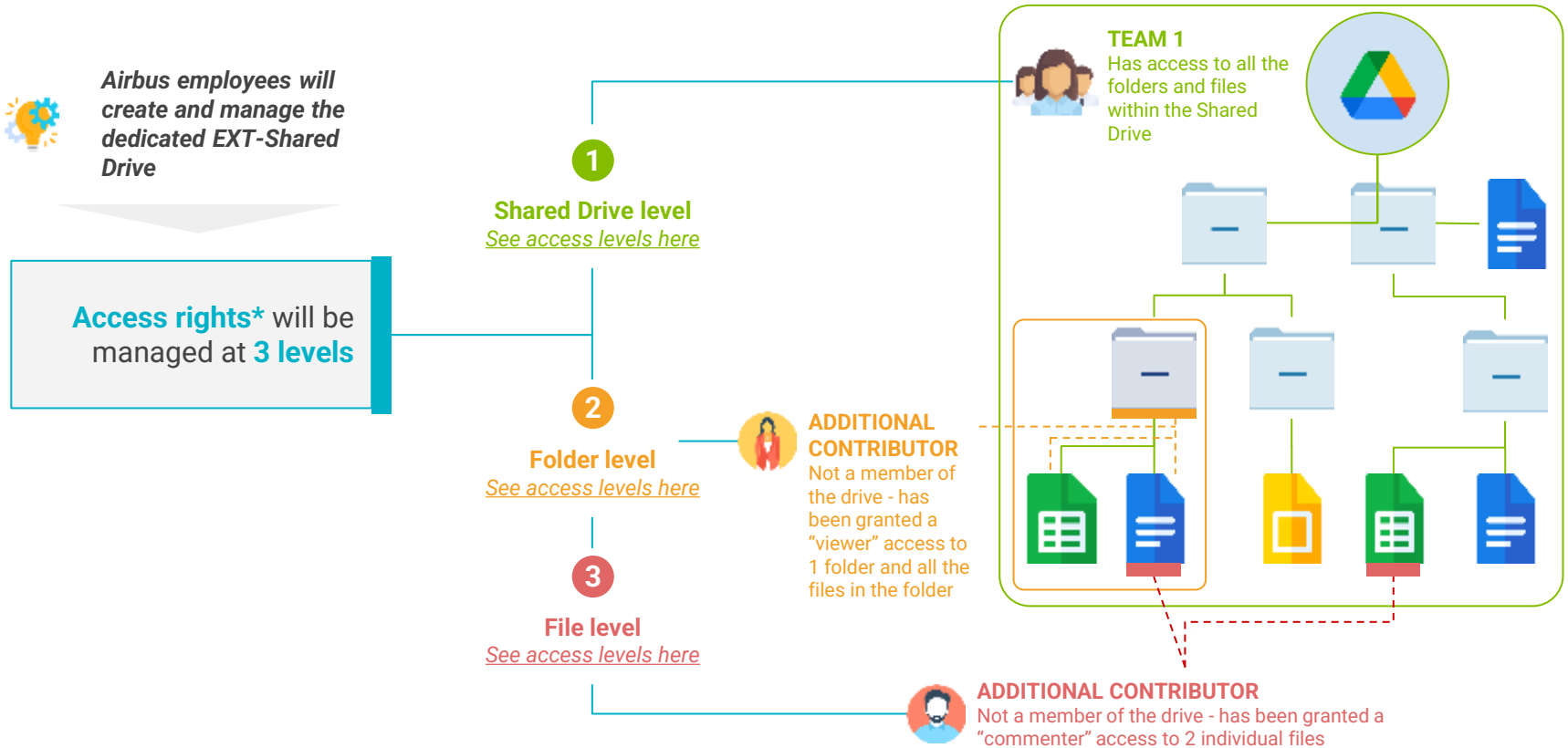
Weekly status meeting for each work package 4
(ADS GmbH)

Weekly status meeting for each work package 5
(ADS Ltd)

Weekly status meeting for each work package 6
(ADS GmbH)

Digital Collaboration Platform

POPULATION	DOMAIN							
AIRBUS Employees External in-situ	airbus.com	✓	✓	✓		✓	✓	✓	✓
Suppliers Affiliates	partner.airbus.com	✓	✗	✓		✓	✓	✓	✗



Digital Collaboration Platform

- Full collaboration in document (writing at the same time)
- Download as MS Office or PDF possible for every partner
- Google Sites as Wiki

POPULATION	DOMAIN							
AIRBUS Employees External in-situ	airbus.com	✓	✓	✓	✓	✓	✓	✓
Suppliers Affiliates	partner.airbus.com	✓	✗	✓	✓	✓	✓	✗

TOOL	FUNCTION	MICROSOFT EQUIVALENT (if any)
Google Drive	Storage	OneDrive
Google Docs	Text documents	Word
Google Sheets	Spreadsheets **ATTENTION :** Macros are not available on Partner Domain.	Excel
Google Slides	Presentations	PowerPoint
Google Forms	Surveys	Forms
Google Calendar	Agenda	Outlook
Google Contacts	Contacts	Outlook
Google Meet	Videoconferencing	Teams
Google Chat	Live chat intradomain	Teams
Google Keep	Sticky notes	OneNotes
Google Sites	Websites	-

Dissemination

Application Form Wrap-up

C&D MEASURES	MONTH	KPIs	RESPONSIBILITIES
Comm. Workshop 1: Target Groups/Personas	1	Min. 15 Personas developed	OKP & all partners
Comm. Workshop 1: Key messages	1	Min. 10 Key claims developed	OKP & all partners
Visual Identity	1	1 Logo developed; 1 project claim developed	OKP
Stakeholder webinar #1	3	15 participants	OKP & AIRBUS
Stakeholder webinar #2	6	15 participants	OKP & AIRBUS
EU-Rise website	6-24	1 website; 3500 until FP	OKP
LinkedIn channel	6-24	1 SM channel; regular postings	OKP & AIRBUS
Comms package #1	6	Incl.: 1 leaflet, 1 poster, 1 banner, 1 presentation template, 1 project description/ fact sheet	OKP
Scientific conferences	7-24	4 papers at scientific conferences	Scientific partners
Scientific papers	7-24	1-2 manuscripts submitted to scientific journals	Scientific partners
Datasets/Algorithms shared on public repositories	7-24	1 combined dataset per technical WP (incl. meta description) to be published on an open repository.	OKP & WP leaders
Professional Exhibition and conferences	13-24	Participation at 2 International Exhibitions and Fairs	OKP & AIRBUS
Stakeholder Workshop at the Implementation Review in Bremen	19	2 roundtable discussions on strategic development in the field of robotic devices in space ecosystems	OKP & AIRBUS
Comms package #2	20	Incl.: Policy briefs based on roundtable discussions; Summary for technical datasets, promotion video, final leaflet.	OKP
Final presentation, press conference & press release	24	1 Final presentation of selected project results at the FP in Bremen	OKP + all partners

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Preliminary Outlook; Year 1

Application Form Wrap-up

Communication Workshop 1: Target Groups & Personas
Duration: 1,5 hrs.

Url: https://nuudel.digitalcourage.de/5T6ugvg4mva9ouKA
Please sign up for all dates possible.
Registration deadline: 08.12.2023

Communication Workshop 2: Key messages
Duration: 1,5 hrs.

Url: https://nuudel.digitalcourage.de/HPKu1yiZUay7Po1Z
Please sign up for all dates possible.
Registration deadline: 08.12.2023

Preliminary Logo Iterations

Open Source Action Plan

Open source action plan

- Previous open source approaches are short-lived and not tested thoroughly
- Maturation of TASTE-based developments needs evaluation
- Consequent open-source strategy may be the answer
- A clear definition of roles of the industry and the space-agencies needs to be found.
- New business models including open-source developments need to be defined and accepted by industry.
- Develop an open-source strategy for the software components of the project, making them accessible to a wider community of developers and researchers.
- Promote collaboration, knowledge exchange, and further innovation in the space robotics ecosystem

Libre Space Foundation

01
- Analyze past and ongoing activities wrt open source development

02
- Assess different business models based on open-source for space industry

03
- Assess challenges and potential solutions for open-source in the frame of space business

04
- Make a concrete proposal of how an open-source strategy could be implemented and contribute to a platform provision

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- Introduction
- Workstream Objectives
- Technology Building Blocks
- Action plan
- **Success criteria and next steps**
- Presentation HaDEA
- Discussion and feedback from the EU

Success criteria for the project

- Definition of the Future Space Eco System
  - Definition of services and robotic capabilities required for those services
  - Architecture for a robotic system capable of providing the needed robotic capabilities
  - Definition of a open source robotic S/W strategy

- Development of a robotic system for the Future Space Eco System
  - Development of all needed building blocks (H/W and S/W)
  - Integration of all building blocks into a robotic system
  - Verification of robotic system functionality
  - Validation of robotic operation suitability for servicing and assembly tasks

Next steps

- Meetings and Workshops
  - Poll to find the best date for meetings (Poll by Airbus & Oikoplus)
  - Invitation for the work package meeting (ADS SAS)
  - Invitation for future space ecosystem workshops (ADS SAS)
  - Invitation for the project meeting (ADS GmbH)
  - Invitation to dissemination workshops (Oikoplus)
- Collaboration platform
  - Last airbus partner portal onboarding (DFKI missing)
  - Creation of GDrive and assignment of external partners
  - Creation of individual GSuit accounts for all project members

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EU RISE

Kick-Off

Fabio MELLONE
European Health and Digital Executive Agency (HaDEA)
B4 –Space Research

European Commission

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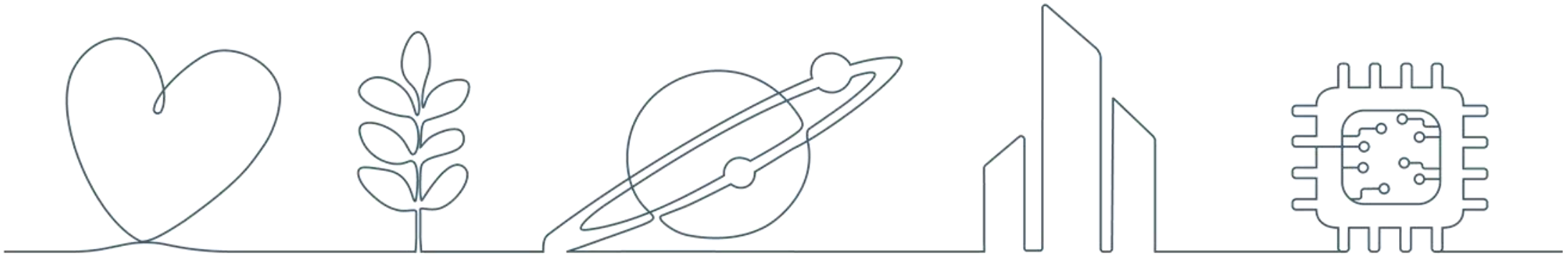
European Commission

HaDEA since 1st April 2021 (https://hadea.ec.europa.eu)

European Commission

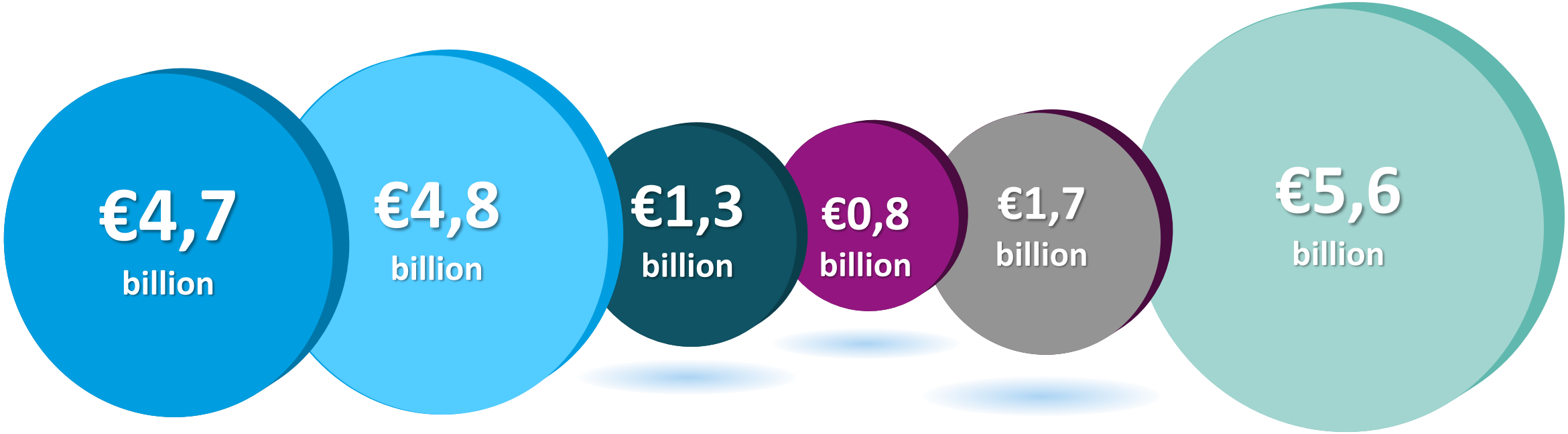
Funding programmes on



health **food safety** **space** **industry** **digital**

European Commission

Programme implementation & budgets



EU4Health
Out of total budget of €5.3 billion

Horizon Europe, Health cluster

Single Market Programme, Food safety

Digital Europe

Connecting Europe Facility

Horizon Europe
Digital, Industry & Space cluster

European Commission

HORIZON EUROPE (FP9, 2021-2027, €95.5 billion)

SPECIFIC PROGRAMME: EUROPEAN DEFENCE FUND

Exclusive focus on defence research & development

- Research actions
- Development actions

SPECIFIC PROGRAMME IMPLEMENTING HORIZON EUROPE & EIT*

Exclusive focus on civil applications

Pillar I
EXCELLENT SCIENCE

- European Research Council
- Marie Skłodowska-Curie
- Research Infrastructures

Pillar II
GLOBAL CHALLENGES & EUROPEAN INDUSTRIAL COMPETITIVENESS

Clusters

- Health
- Culture, Creativity & Inclusive Society
- Civil Security for Society
- Digital, Industry & Space
- Climate, Energy & Mobility
- Food, Bioeconomy, Natural Resources, Agriculture & Environment

Joint Research Centre

Pillar III
INNOVATIVE EUROPE

- European Innovation Council
- European Innovation Ecosystems
- European Institute of Innovation & Technology*

WIDENING PARTICIPATION AND STRENGTHENING THE EUROPEAN RESEARCH AREA

- Widening participation & spreading excellence
- Reforming & Enhancing the European R&I system

EURATOM

- Fusion
- Fission
- Joint Research Center

* The European Institute of Innovation & Technology (EIT) is not part of the Specific Programme

European Commission

HaDEA turns policy into action

Key feedback to DGs

Call for proposals

Evaluation and Selection

Technical and financial follow-up

Preparation of Grant Agreements

European Commission

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European Commission

Reference Documents HORIZON

- Legislation
- Work programme & call documents
- Grant agreements and contracts
- Simplified cost decisions
- Guidance
  - HE Programme Guide >
  - HE List of eligible countries >
  - HE Complementary funding mechanisms in third countries >
  - Online Manual >
  - Rules for Legal Entity Validation, LEAR Appointment and Financial Capacity Assessment >
  - Amendment Guide >
  - AGA- Annotated Grant Agreement >
  - Indicative Audit Programme (IAP) >
  - Rules for Grant Reductions >
  - Rules for Arbitration >
- Templates & forms
- Funding & Tenders Portal

European Commission

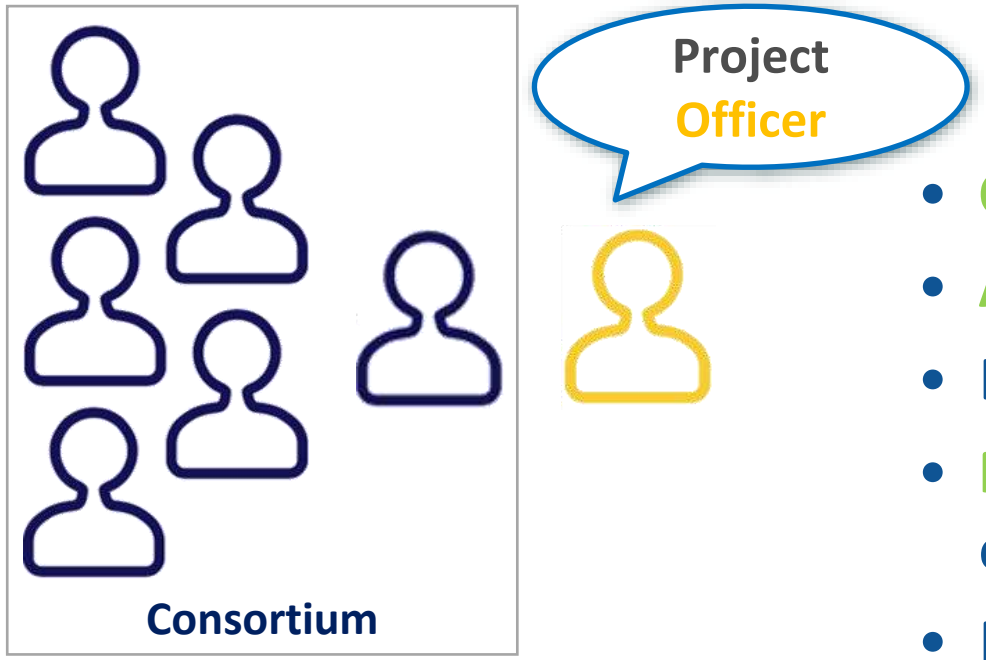
Your master reference

Annotated Model Grant Agreement

HE Online Manual on the Funding & Tenders Portal

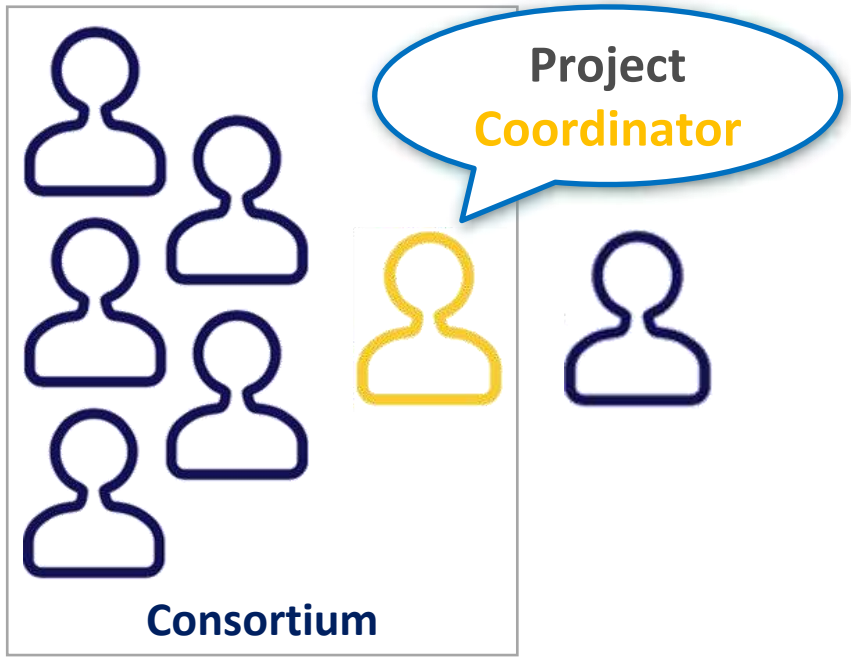
European Commission

GA – Roles – Project officer



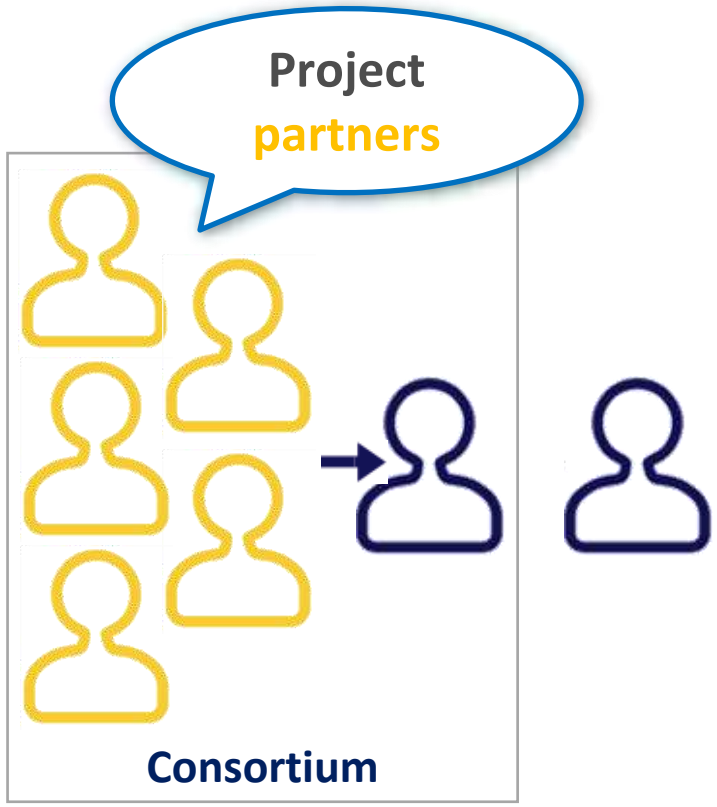
- **Contact point** for the consortium
- **Advisory role**
- Ensures **proper implementation**
- **Monitors** fulfilment of contract obligations
- Processes **periodic reviews** and **payments**

GA – Roles – Coordinator



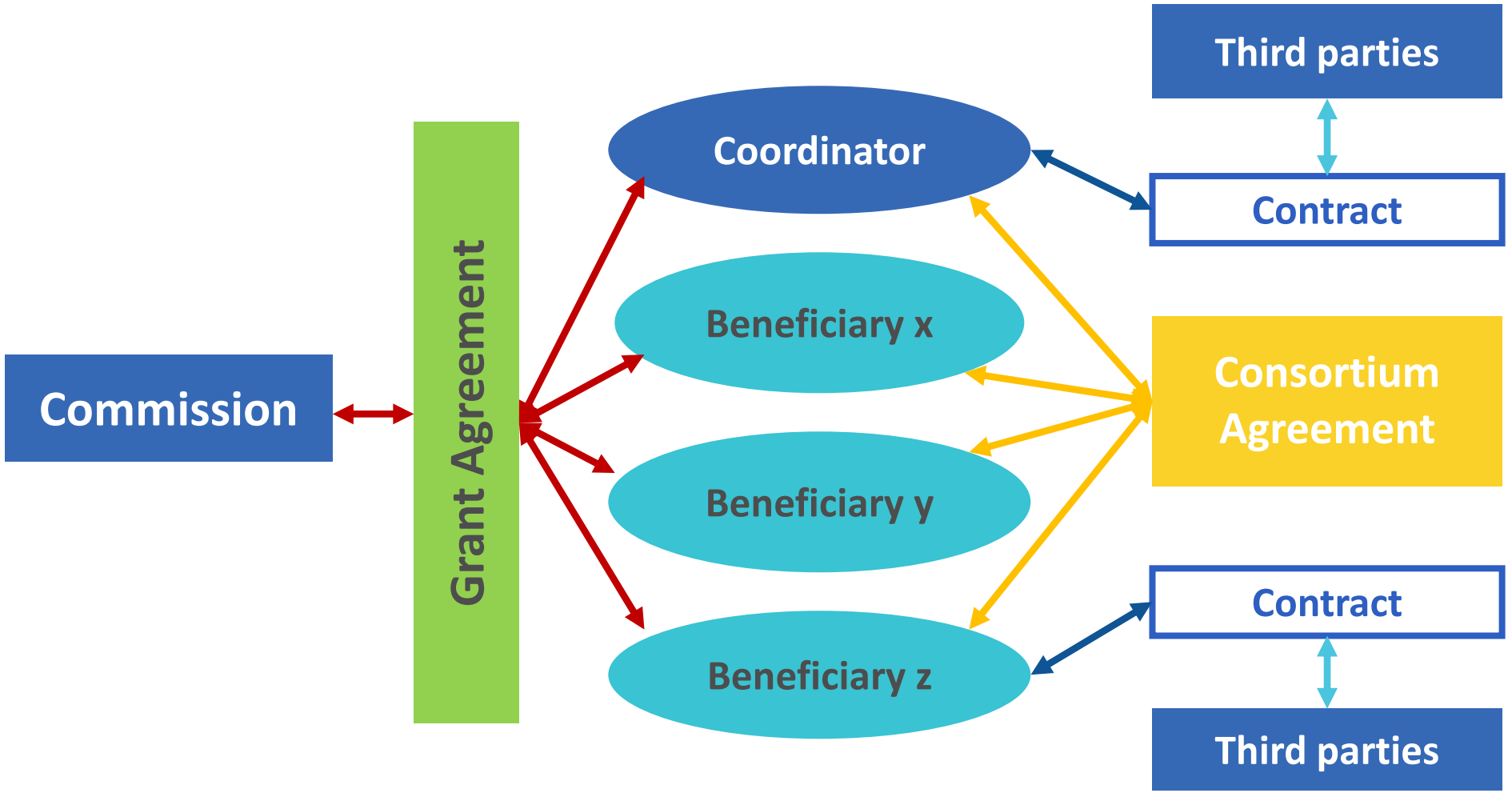
- **Accountable** to the EC for the project
- Central **contact point** for the EC and HaDEA
- **Represents all beneficiaries** of the project
- Administers EU **financial contribution**
- Reviews **reports** to verify consistency
- **Monitors** the compliance with the GA

GA – Roles – Partners



- Accountable for their **performance and work**
- **Draft deliverables** and contribute to Periodic Technical Reports
- **Report** to the coordinator, e.g. Financial Statements

GA – Range of contractual arrangements



European Commission

Continuous reporting

- During the project, you are expected to provide **regular updates on the status** of the project
- Report on **critical risks**, prepare the **summary for publication** and the **programme-specific information on indicators** (e.g. Trainings, Gender, Open Data, etc.)
- **Milestones and deliverables** should be submitted by each participant for their work in accordance with the schedule set out for them
- **No delays** for deliverables due at the end of reporting periods. **PO approval** for other delays
- **Public deliverables** are automatically published by the EC

Review meetings – GA

- **Planned at the end of each reporting period and in the need of additional technical assessment**
  - Combined with a project meeting, when possible
- **Present the work carried out, the main achievements and the use of the resources**
  - Participation of the coordinator and of the WP leaders – standard practice (others to be discussed on a case-by-case basis)
- **The Agency is assisted by external reviewers**
- The relevant report and deliverables need to be ready 2 or 3 weeks prior to the meeting

Periodic reporting

Periodic report to be submitted by coordinator within **60 calendar days** after end of reporting period

- The structure is:
  - ✓ the Periodic Technical Report (PTR),
  - ✓ the Web based reporting

- **Talk to your PO during the project implementation!**
- **The end of a reporting period is NOT the default time to raise problems or major changes compared with the GA or introduce amendments!**

European Commission

Amendments to the GA

- Takes time – **ANTICIPATE!!!**
- Must not have the purpose of making changes to the GA, which might call into question the decision awarding the grant
- Must be launched and submitted electronically via the Funding & Tenders portal by the coordinator – implies working in SyGma
- Give priority to urgent issues (e.g. termination of beneficiaries, partial transfers or rights and obligations, addition of linked third parties, etc.)
- Provide a very clear justification supported by the DoA - Why is this necessary for the project and what is the impact to the objectives, expected results and overall funding?

TYPE OF CHANGE to GA

Insignificant / minor changes: no amendment needed

Substantial changes: amendment needed

Changes modifying the nature of the project: the amendment will be rejected!

HOW TO

European Commission

Communication, dissemination, visibility

Article 17

- It's **obligatory**
- Inform and alert the PO about important events, webinars, conferences, milestones and articles published, especially those related to policy feedback
- **Connect with HaDEA's Twitter** (tag us!) & **LinkedIn**
- Check H2020/HE communication guidelines
- **Always acknowledge EU funding** (download the emblem)

Let us know about any communication activity with media impact.

European Commission

Thank you!

https://hadea.ec.europa.eu

http://ec.europa.eu/horizon-europe

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Feedback and Discussion

Time for your questions!

- Is the project definition clear for everybody?
- Have you understood what are the next steps?

Feedback from the EU

Thank you

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