SPACE R.I.A.P.

RESEARCH AND INNOVATION ACTION PLAN - SCOPING PAPER

This paper is an Annex to Eurospace position paper on FP9. It provides initial scoping and definition of challenges to support the current discussion in view of establishing a JTI for Space technology.

For a competitive and sustainable space industrial base and supply chain: readiness, independence, and innovation in components, materials, equipment, software and processes for spacecraft, launcher and ground segments.

Contents

BACKGROUND OF THIS PAPER

This paper is a technical annex to Eurospace FP9 position paper. It is intended to provide preliminary scoping of activities with a view to the future setting up of a JTI for Space. It was prepared by the FP9 Task Force of Eurospace, the Association of the European space industry (the Space Group of ASD). It provides a preliminary framing context for the future elaboration of a **Research and Innovation Action Plan (RIAP)** for a TBD JTI for Space.

PRINCIPLES AND GENERAL SCOPE

The **RIAP** shall embrace all research, development and technology (RDT) activities for implementation with FP9 instruments having all the following characteristics:

- Activities driving industry competitiveness and sustainability through the full supply chain in launchers, spacecraft and ground systems, as well as in the development, manufacturing, integration and test processes.
- Activities aiming at the development, characterisation and/or validation of materials, processes, components, building blocks, software and equipment, exclusive of system level research
- Activities with potential for industry co-investment together with the EU, through grants, in the context of FP9 mechanisms
- Activities suitable for industry coordinated road-mapping. It is understood that the RIAP should focus in general and whenever possible on common user requirements for technologies and building blocks developments. European double sourcing and/or multiple technological competitive solutions can also be envisaged if considered necessary.

The driving principles for the establishment of the RIAP are presented in the introduction, they respond to the well-identified need to **promote readiness and innovation for materials, processes, components, building blocks and equipment to support competitive European space systems**.

DRIVERS FOR THE RIAP

The Eurospace Task Force has identified 7 key drivers for space systems RDT&I, all aiming at improving the competitiveness of the European space systems supply chain.

MADE IN EUROPE

Space systems and related technologies are highly regulated goods, which cannot be traded freely at international level. Unrestricted access to state of the art solutions can only be guaranteed in the long range by developing domestic capabilities with the suitable levels of readiness (maturity) and competitiveness (cost/performance mix). **Whenever a technological solution is required to perform a critical function on a European space system but cannot be procured in Europe a situation of dependence is created with dire political and economic consequences**. Since 2009 European institutions (ESA, EC, EDA) have decided to address the critical dependence situations from a political perspective aiming at reducing critical dependence situations. A permanent monitoring process (The Joint Task Force for critical technologies - JTF) enables the identification of critical technologies with dependence situations with the support of all stakeholders. A dedicated line in Horizon 2020-Space specifically targets dependence reduction, but can only address a subset of the critical situations.

The **'made in Europe' approach for all critical products and technologies is an important driver** of the RIAP. It will complement and enhance the current efforts for critical dependence reduction.

PRODUCT-ORIENTED FOCUS

Historically space systems have been produced in rather limited numbers every year[1], giving a strong emphasis on customer driven optimisation at all levels of the system, from the overall system architecture down to the specification of components, equipment and building blocks supporting the various system functions (power, thermal control, propulsion, computing, data handling etc.). This situation resulted in a supply chain mostly geared at providing tailored solutions for each system, with limited standardisation and few commonalities of requirements[2].

The evolution of space markets where customers are more drawn to services and more focused on life cycle costs, as well as the development of applications requiring the production of batches or series of identical systems in (for constellations e.g.) introduces a new paradigm where low level components, building blocks and equipment can now be produced in much larger quantities than before. This trend has to be supported by product-driven RDT&I, promoting, e.g., **commonalities of requirements, the standardisation of interfaces, and product re-use across various sub-system designs and architectures**. Furthermore, a product-oriented focus shall enable the production in large batches and even long series when the demand allows it. To this end **the streamlining of the quality process is an essential enabler, supported by the reduction/optimisation of testing, solutions for quality increase and lower rejection of parts**. Successful products developed for successful markets are the key to **supply chain sustainability**.

FAST TIME TO MARKET

Space based services and space data are playing a growing role in the global digital economy (e.g. Earth resources data and imaging, climate monitoring, device tracking, border control, fast data transmission, mobile communications, location based services etc.). Space systems must keep up with the fast paced innovation of digital services that drives modern economies. **Solutions for fast track innovation in space systems and services shall be promoted, to reduce the lead production time of space systems at large, through the promotion of an integrated innovation to development and production processes**.

SPIN-IN AND COTS

Space technology and products are required to withstand the harshness of space environment (extreme temperatures, radiations, micro-particles, vacuum...) for long time durations ensuring the continuity of operations. To this end, components, technologies and products undergo incremental development cycles before they can be qualified for use in space systems, resulting in higher costs, lower production rates, and slow integration processes. **The use of Commercial-off-the-shelf (COTS) components can be a solution to improve the readiness and competitiveness of European space systems**, particularly for large satellite series and for applications where cost and performance trade-offs are necessary. Notwithstanding, **the integration of COTS products in space systems requires specific research to ensure the appropriate delta qualification, to validate their use in the space environment and to certify and validate new materials and production techniques**.

[1] *In average European space industry delivers 20-30 spacecraft and 8-10 launchers to the launch pad every year, with associated ground segment infrastructures*

[2] *This is particularly true for spacecraft systems but much less as far as launcher and ground systems are concerned*

MATURITY AND IRL (INTEGRATION READINESS LEVEL)

The maturity of a technology is an essential factor for the reduction of risks associated to the introduction of innovations in space systems. A specific technology readiness levels (TRL) scale has been elaborated for space technologies, with 9 steps, from the moment where the basic scientific principles have been demonstrated up the eventual demonstration of the technology in operational conditions. While space systems are often developed as prototypes pursuing science and technology missions for which taking some technological risks is acceptable, whenever space systems are expected to pursue an operational service the introduction of technological risks is inacceptable. For this reason all space technologies must be brought to the appropriate maturity level in the TRL scale to allow their integration in operational systems. This maturity level is the integration readiness level (IRL). Achieving IRL is an essential target of product driven research activities. Depending on the type of system and on the customer/service expectations the IRL will be associated to a TRL of 5 and above. **The objective of achieving proper maturity and IRL is to avoid the need for delta-qualification for the introduction of technological advances in space products and systems**.

The technology readiness scale for space

Readiness Level	Definition	Explanation
TRL 1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development.
TRL 2	Technology concept and/or application formulated	Once basic principles are observed, practical applications can be invented and R&D started. Applications are speculative and may be unproven.
TRL 3	Analytical and experimental critical function and/or characteristic proof-of-concept	Active research and development is initiated, including analytical / laboratory studies to validate predictions regarding the technology.
TRL 4	Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that they will work together.
TRL 5	Component and/or breadboard validation in relevant environment	The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment.
TRL 6	System/subsystem model or prototype demonstration in a relevant environment (ground or space)	A representative model or prototype system is tested in a relevant environment.
TRL 7	System prototype demonstration in a space environment	A prototype system that is near, or at, the planned operational system.
TRL 8	Actual system completed and “flight qualified” through test and demonstration (ground or space)	In an actual system, the technology has been proven to work in its final form and under expected conditions.
TRL 9	Actual system “flight proven” through successful mission operations	The system incorporating the new technology in its final form has been used under actual mission conditions.
TRL 9	Actual system “flight proven” through successful mission operations	The system incorporating the new technology in its final form has been used under actual mission conditions.

ENVIRONMENTAL CONCERNS AND REGULATIONS

The world has become increasingly environmentally conscious, and space is no exception, particularly when considering how much space systems have contributed to the understanding of the global eco-system. In Europe the REACH[3] regulation is spearheading the reduction of the environmental impact of industrial activities. The regulation affects the way and pace systems are designed and produced by phasing out progressively all chemical substances causing 'very high concern'. The space sector is a high-end integrator of many technologies, and is **highly affected by many substances subject to REACH** (for surface treatment, propellant, adhesives, cleaning etc.). Specific RDT actions are taken to identify and qualify for space use suitable substitutes, and/or to reduce the overall impact of using substances with environmental concerns by applying **eco-design and eco manufacturing** techniques.

END OF LIFE REQUIREMENTS & DEBRIS MITIGATION

The protection of Earth environment now stretches beyond the Earth atmosphere, and growing concerns are arising regarding the pollution of the Earth orbital environment: what is generally called the **space debris situation**. Space debris can be created by satellites having reached their end of life, by unexpected/unavoidable collisions with already existing debris or by operations for the satellite insertion in orbit. Space debris pose a real threat to the safety of operations in orbit, and their reduction and mitigation has now become a major commitment of European space stakeholders. For instance, regulation is now introduced for the controlled removal of satellites from their operational orbit when the mission is over. This regulation is enforced for the majority of European institutional programmes.

To pursue the goal to mitigate space debris[4] growth in the future, and abide to current regulation, targeted research is required in such areas as **equipment and subsystem demise-ability, the characterisation of materials in the context of controlled orbital re-entry as well as controlled break-up solutions**.

INNOVATION AND BREAKTHROUGH

Each and every product and application in modern economies seek the opportunity for breakthrough and disruptive innovations, game changers that will broaden the horizon of applications, or enable new markets and services. **The pursuit of innovation is thus a major driver for space research and technology development.** The careful evaluation of technologies at very low maturity levels, the assessment of **disruptive solutions**, the elaboration of **new concepts and new product designs**, the introduction of advanced technologies and **new approaches in modelisation, test, and manufacturing** will support the medium to long term evolution of space systems, services and applications.

Activities that provide breakthrough solutions or new horizons for space systems and missions, include **low TRL research, new mission concepts ground breaking innovations in development and manufacturing techniques, models improvements** etc.

FIVE CHALLENGES FOR A COMPETITIVE AND SUSTAINABLE INDUSTRIAL BASE AND SUPPLY CHAIN

The Eurospace FP9 Task Force has identified 5 main challenges for a competitive space industrial base focusing on technology, building blocks, equipment, and software in the next decade. This list is not limitative, and does not preclude the further identification of actions of interest for implementation

[3] https://echa.europa.eu/regulations/reach

[4] *De-orbiting is a pilot topic identified for implementation in the upcoming Pilot Project for Space technologies funded by the European Union as a prototyping approach for a future JTI in the space sector.*

in the context of a JTI for space, such as the two topics already proposed by European Parliament in the context of the Pilot Project: **Critical materials and De-orbiting**.

The five challenges are:

- Components, materials & tools for non dependence and leading edge
- Equipment supply chain and a stronger technology base
- Beyond (Space) Industry 4.0
- Affordable, greener, adaptable access to space
- Innovative Ground Segment

The total EU contribution required to comprehensively address the 5 challenges in the context of FP9-Space is estimated between 0.5 and 1,25 Billion Euro, to leverage investment by the private sector. The current working assumption is FP9 duration of 7 years.

Important note: budget estimates proposed to address each challenge are inclusive of both private sector and EU contribution. They are rough orders of magnitude and shall be further expanded and refined when the industry action plan is expanded into an actual planning and roadmapping of activities.

COMPONENTS, MATERIALS & TOOLS FOR NON DEPENDENCE AND LEADING EDGE

EEE[5] components are key elements in the competitiveness of European space systems: they are found in most space equipment, whereas all space equipment are significantly driven by EEE components w.r.t. cost, performance, reliability and timely availability.

The EEE components is an area where widespread technological dependence provides programme uncertainties; indeed, components with high levels of performance and reliability are often sourced outside Europe, and are associated to trade and export limitations that eventually hamper European system competitiveness. Today, the readiness of European solutions for EEE components is still an issue, despite the significant efforts already pursued in the past decade, and the results achieved so far to reduce the recourse to non-European components for European programmes.

The good alignment of all component related initiatives, programmatic actions and efforts would support the emergence of a sustainable European supply chain for high-reliability/high-performance components. In complement, developments aiming at introducing COTS components in space systems with less demanding performance and reliability requirements should be considered as well.

Materials and processes are providing the foundations of industry competitiveness. Materials, such as composite, ceramics, metals, and alloys are used for their many properties in the thermal, mechanical and electrical domains. Materials provide space systems with specific solutions, often un-dissociable from the production and design process itself. Like components, materials are an area where supply chain and dependence issues are common, with dire impact on industry competitiveness. The continued investigation, assessment and development of materials, and advanced manufacturing techniques need to be pursued.

For the efficient introduction of new materials and components in new products, the challenge needs to be complemented by suitable **advances in design, engineering and modelling tools**.

[5] *Electric, Electronic and Electromechanical*

The components materials & tools is a critical challenge for the European space systems supply chain.

Areas for development

Within this challenges it is recommended to support the **development of a complete supply chain for European components and materials, including the relevant engineering, modelling and validation tools** for a sustainable and competitive industrial base. In all areas, the concerns of thermal stability, high temperature (and high voltage) operations, the susceptibility to space environment and abidance to European environmental regulations will be paramount.

Recommended development strands

- EEE components
    - Hybrids and micro packaging
    - Digital and analogue
    - Optoelectronics active and passive
    - Power components
    - PCBs
    - Microwave and Millimetre wave
- Materials
    - Light metal alloys
    - Ceramics
    - Composites
    - Critical materials[6] e.g. greases, adhesives, solvents etc
- Specific engineering & analysis tools
    - Radiation, environment, outgassing, venting etc.
    - Validation of the models (radiation, environment etc.)

Expected impacts:

- A fully qualified and sustainable components and materials supply chain, including engineering, environmental and modelling tools
- A sustainable European EEE components supply base for state of the art systems and performance through the full data handling chain.
- New enhanced and qualified materials, with advanced properties.
- Better design and modelling capacities, faster development to production process, improved engineering margins for system optimisation.

Indicative budget

A total budget in the order of 250-300 Meuro is expected to appropriately cover this challenge.

EQUIPMENT SUPPLY CHAIN AND A STRONGER TECHNOLOGY BASE

Combined Innovation in Systems and Enabling/baseline Technologies is necessary to develop products with leading edge performance to meet customer expectations. The competitiveness of the global supply chain, and its ability to innovate is strongly driven by the integration of new state of the art technologies and innovation in manufacturing processes for the design, development and production of space equipment. A competitive equipment supply chain provides the essential

[6] This is the subject identified as N28 in the latest JTF assessment and a topic that will be addressed as a prototype within the upcoming Pilot Project for Space technologies funded by the European Union

foundation to European space systems performance and worldwide competitiveness. **The supply chain is thus expected to be proactive, reactive, innovative, reliable and sustainable.**

European equipment are also expected to support new challenges for space markets, and in particular shorter lead times, adaptability to market evolutions, production in larger series or batches, with global quality control, and a higher potential for re-use, considering interfaces, standard designs and applicability across a variety of systems, missions and applications.

The progressive integration of newly developed components, the use of innovative materials and the recourse of innovative models and engineering tools provide for strong synergies of this challenge with two other challenges in the RIAP: "Beyond (Space) Industry 4.0" and " Components, Materials & Tools For Non Dependence And Leading Edge".

Research for the strengthening of the European equipment supply chain will address two main areas:

- Incremental RDT, aiming at the adaptation, verification and qualification of incremental improvements to existing equipment and functions for spacecraft, launcher and ground systems; including the progressive integration of newly developed components and building blocks.
- Innovation or disruptive RDT, aiming at the introduction of more radical innovations in technology and/or or processes in the equipment supply chain for spacecraft, launcher and ground systems.

Areas for development

This challenge shall address RDT on equipment and building blocks (and related software) for:

- Spacecraft systems, focusing on payload and platform functions (including robotics and GNC)
- Launcher systems, focusing on all functional areas, including structures, avionics and propulsion

Recommended development strands

Equipment, technologies and building blocks (and related software) for system competitiveness:

- Propulsion for satellites, probes, landers, ascent vehicles, transfer stages
- In orbit refuelling building blocks
- Power, incl. generation, storage, power control & distribution technologies, digital control
- GNC/AOCS sensors and actuators
- Avionics equipment, on-board processing
- Thermal solutions, incl. deployable radiators, advanced heat transport systems, etc.
- Software components (protocols, operating systems, algorithms...)
- Payload generic equipment and building blocks (amplifiers, receivers, reflectors,...)
- Secure communication solutions (service and TT&C) counteracting threats (interference, jamming, spoofing) inc. active antennas, spread-spectrum, geolocation systems, etc
- Advanced mechanisms and structures
- E2E Cyber-security technology

Expected impacts

In all areas the key impacts will be the improvement of the cost/performance competitiveness mix, the enlargement of the demand base, the sustainability of the supply chain and the compliance to agreed debris mitigation guidelines. In some areas where space is at the forefront of research spin-off from space to Earth is another potential positive impact.

The expected impact will be further appreciated with respect to the functional areas concerned, for example:

- Electric Propulsion Technologies
  - High power and performance, versatility, ...
  - Low cost small EP systems,
  - Propulsion system building blocks competitiveness and independence (e.g. valves)
- Chemical Propulsion Technologies
  - REACH compliance, 'green' propellant formulations, low-toxicity/high-performance...
  - Propulsion system building blocks competitiveness and independence,
- Power
  - Improve system power density and cost
  - Innovative solutions for power system performance, new concepts, new technologies, disruption
  - Overall Power systems capability improvement
- Avionics
  - Data handling system performance, fast processing, fully digital data handling
  - Formation flying solutions for new system approaches, distributed payloads
  - Miniaturised and cost effective IMU
  - Miniaturised/integrated functions, hybridisation
  - Stability, pointing & accuracy, enablers for new missions
  - Autonomy and system performance,
- Telecommunications Payloads and TT&C
  - Digital payloads, bandwidth, flexibility, throughput, power and overall lifecycle efficiency for customer satisfaction
  - Improvement of QoS in terms of confidentiality, integrity and availability.
- Remote sensing payloads (all bands)
  - Thermal and mechanical stability, performance, support to new missions, market driven solutions...

Areas with high potential for spin-offs:

- Power systems (generation, storage, management)
- Processes (epitaxy, Advanced manufacturing, integrated testing, system health management)
- Hybridisation, and miniaturisation of functions (positions sensors, attitude sensors, micropackaging for electronics...)

Indicative budget

A total budget in the order of 200-250 Meuro is expected to appropriately cover this challenge.

BEYOND (SPACE) INDUSTRY 4.0

Digital technology has become essential to competing in the space industry. Today, many companies in the sector are investigating digital capabilities, they are prioritizing digital investments and investing significantly in specific areas to gain competitive advantages and must take a **comprehensive, integrated approach to digital adoption and for the introduction of processes for innovative manufacturing, from concepts development to the final output**.

New digital technologies that have high potential for applications in the space sector:

- Advanced and cooperating industrial robotics
- Additive and innovative manufacturing such as 3-D printing
- Horizontal data integration across companies in the supply chain promoting fast development and integration process throughout an automated value chain
- Solutions for augmented reality enabling higher quality, new designs and enhanced workforce efficiency and productivity
- Simulation, modelling, virtualisation for faster/better design to product and integration of production
- Innovative approaches to address data processing challenges and 'big data' management

The expected solutions shall also become enablers for the transition of the space industry towards **larger production batches and, when applicable, series and integrated production lines**.

Areas for development

This challenge shall address the development and take up of European design models and tools for system and architecture development and optimisation, in engineering, system virtualisation, simulation, and modelling.

It shall also promote new manufacturing approaches in all areas of space systems, from concept to design, development and production, and from the component to the final system.

Key areas for development are: European tools for system, subsystem and equipment design, simulation, engineering and integration, and solutions for simulation, virtualisation, performance modelling.

Recommended development strands:

- Streamlined industrialisation, manufacturing and testing processes
    - 'Digital' space manufacturing plant
    - Design and modelling tools
    - AIT & AIT-support technology
    - Integration of augmented reality for space systems AIT
    - Built-In Test Equipment (BITE) for space systems
    - Evolution of ground support equipment for test handling and integration (EGSE/MGSE)
    - Next generation check out common elements
    - Advanced Test facilities: Functional verification & environmental verification
    - Robotisation and automation
- Quality and dependability
    - Smart inspection and control

Expected impacts: fast design to product, fast time to market, embedded quality control, large production series, reduced environmental impact

Beyond industry 4.0 expects to unfold key productivity gains for the space sector with high impact at all levels of industry including the possibility to deliver production in larger batches or series with enhanced cost efficiency and fully controlled quality processes and products.

Changes will affect in depth the way space systems are conceived, designed, elaborated and effectively produced. Better integration in the value chain will result in shorter lead times with higher quality outputs. Automated processes will support unit cost reduction. The optimisation of designs, will support identifying & reducing over-margins (from system level to end-to-end operations).

Other benefits will include: the optimisation of trade offs between ground and space segment, the standardisation of approaches with more cross-platform solutions, unified approaches and lower environmental impact of industrial activities.

Indicative budget

A total budget in the order of 200-250 Meuro is expected to appropriately cover this challenge.

AFFORDABLE, GREENER, ADAPTABLE ACCESS TO SPACE

The challenge for an affordable, greener and adaptable access to space is considered in the context of the European next generation launchers development programmes. It addresses a subset of activities aiming at the preservation of a European independent access to space within a highly competitive environment, and it looks at the future. Overall, **European launch services competiveness and reliability are driving factors for this challenge**.

Improvements and evolutions are expected to contribute to propulsion improvement and to system and architecture level. Key areas will involve structure and materials at large (composites, REACH mitigation etc.), re-usability aspects, the propulsion system and advances in process and manufacturing at all levels of the supply chain.

Areas for development

Within this challenge, it is proposed to address functional studies for innovation in launch services, and developments for building blocks and technologies for a stronger and competitive launcher system supply chain.

Recommended development strands:

- Functional studies and system performance analysis
    - GNC
    - Advanced data system
    - Solutions for system re-usability (concepts)
    - Re-entry solutions
- Technologies and building blocks
    - Function channel and avionics (e.g. hybridisation of sensors, digitalisation)
    - Propulsion technologies (main and secondary, incl. alternative oxidiser/fuel combinations)
        - Performance
        - Re-ignitability
        - Throttle-ability
        - Re-usability
        - Clean and/or alternative propellant formulations
    - Structures, materials and manufacturing (new materials, hybrids, AM impact…)
        - Advanced Manufacturing
        - Composite materials qualification and implementation
        - REACH compliance/mitigation
        - Smart Materials
    - Materials, Processes & Manufacturing: new methods, new materials
        - Advanced Manufacturing

        - Composite materials qualification and implementation
        - REACH compliance/mitigation
        - Smart Materials
- Engineering tools
    - Tools for system engineering and simulation
    - Tools and simulation for flight physics
    - Health monitoring and management for re-usable systems

Expected impacts

- Improve launch service/system end-to-end competitiveness, from development and manufacturing aspects, to cost reduction strategies at system, subsystems and equipment levels
- Support full life cycle cost assessment, minimise environmental impact of launch service, from development to manufacturing and operations
- Develop re-usability aspects and modelling/engineering tools for global cost effectiveness of space launch services.

Indicative budget

A total budget in the order of 200-250 Meuro is expected to appropriately cover this challenge.

INNOVATIVE GROUND SEGMENT

Ground systems are integral part of the space infrastructure. During programme operations ground systems provide the capacity to interface with the space segment for mission control (telemetry and command) and for mission operations (data downlink and uplink; data processing, distribution and networks).

In Earth observation, the performance of ground infrastructures and distribution platforms (data and services) becomes paramount with the huge increase of space imagery data to be processed exploited and distributed and the growing number of satellites used in constellation approaches.

In telecommunications applications the space segment is no longer the key item: important investments now are also associated to the multiple satellite ground stations and the terrestrial telecommunications networks that interlink them.

The ground segment now holds a large share of the whole space applications value added potential. The last decade has seen the growth of both consumer and professional segments, with some millions of user terminals now in service and the expansion of satellite data receiving stations.

Areas for development

Within this challenge, it is proposed to address developments for building blocks and technologies for ground segment innovation. With the focus on core and horizontal technologies and building blocks, the developments performed in this context will support implementation across many different services and applications. They shall also support implementation in professional stations and systems, as well as user terminals, in a scaled approach.

Recommended development strands

- Ground station and terminals, common building blocks, such as antennas, receivers, digital technologies, software defined radio chains...

- Control Centres and mission planning (technologies for multi-mission operations and constellations/mega-constellations)
- Cost effective and affordable data handling (storage, processing, distribution)
  - Massive and scalable processing, cloud processing, virtualisation
  - New concepts for data fusions, processing algorithms and processing chains
  - Innovation in data storage, management and access
- Infrastructure protection and security
  - Cyber-security
  - SST technologies
  - Signal threats protection (interference, jamming, spoofing)
- Optimisation of operations, addressing two main lines:
  - Automation (artificial intelligence, Data fusion, analytics & situation awareness...)
  - Human machine interfaces (augmented reality, voice/kinetic interfaces, cognitive assistance...)
- Simulation tools
- Test and integration equipment

Expected impacts

The objective is a cost effective, secure and affordable space segment for control and data dissemination.

The developments are expected to support overall system competitiveness and performance improvement in the following areas:

- Lower operations costs
- Increased service availability
- Quality controlled processes and continuity
- System responsiveness
- Openness to new services, flexibility and overall life time
- Reduction of latency (from user needs to product delivery)
- Increased security (data integrity, data protection...)
- Higher communication throughput

Indicative budget

A total budget in the order of 150-200 Meuro is expected to appropriately cover this challenge.