BACKGROUND INFORMATION NOTE ON A POTENTIAL JTI IN SPACE

PREPARING FOR A CONSULTATION ON A JTI SCOPE, MANDATE AND GOVERNANCE

Contents

INTRODUCTION

About Public Private Partnerships (PPPs) and Joint Technology Initiatives/ Joint Undertakings:

The framework programme for research and development (FP) had always been open to private sector institution participation. **The evolution of EU research and innovation policies led to the development of different forms of strategic Public Private Partnerships** (ETPs, JTIs, KICs, cPPPs and EIPs) that illustrate the shift in recent years in research policies towards addressing economic, social and environmental challenges but also with facing the economic context in the late 2000s.

PPPs are characterised by long-term public support, requiring large funding commitments which aim to address strategic issues to:

- strengthen the industrial base;
- address long-standing or global problems;
- support economic growth;
- create employment;
- maintain leadership at the technological frontier;
- maintain a comparative advantage.

Hence, they display a stronger top-down orientation and often revolve around emerging scientific and technological fields.[1] Furthermore, PPPs are called to demonstrate strategic importance for the Union, namely to preserve and reinforce EU leadership in key technologies and to contribute achieving policy objectives under Europe 2020.

In May 2007, the Commission adopted the first proposals for **Joint Technology Initiatives (JTIs)**[2]. It was the first time that public-private partnerships, involving industry, the research community and public authorities, were proposed at European level to pursue ambitious large-scale multinational research activities in areas of major interest to European industrial competitiveness.[3]

The Joint Undertaking (JU) is the independent legal entity that implements the JTIs activities and manages research and innovation projects in an integrated way, with industry joining forces with other stakeholders[4]. JUs are long-term Public-Private Partnerships based on Article 187 TFEU and adapted to the specificities of each JTI. Joint Undertakings are endorsed by the Council of the European Union after a positive opinion of the European Parliament upon a proposal of the European Commission.

The Innovation Package proposed under the Horizon 2020 programme [5] established a number of criteria for the extension of the mandate of existing JTIs or the setting up of new ones. These criteria are:

- European added value;
- Impacts;
- Scale and long-term nature of industry commitments;
- Openness and transparency.

[1] *Reillon V., Public-private partnerships in research, EPRS, European Parliament, May 2017.*
[2] *As a reminder, a JTI is one form of a European institutional PPP*
[3] "*About JTIs*", ec.europa.eu
[4] *The JTIs are open to a wide range of industries across Europe, including SMEs, and all types of research organisations can apply for funding.*
[5] *Horizon 2020, article 19*

If JTIs were one of the first types of PPPs implemented in research at EU level, **they are still highly relevant especially when "there is a major strategic research and innovation objective that cannot be met through the normal Horizon 2020 implementation".**[6]

Today there is no Joint Technology Initiative (JTI) in the domain of space in Europe. Hence there is a need of an in-depth analysis of the scope and objectives of such an initiative. A first opportunity for this analysis occurs with the **proposal of the European Parliament for a pilot project on space technologies** in the framework of the Draft Budget 2017.[7]

Pilot projects of article 54 of the EU Financial Regulation are an important tool for the formulation of political priorities and the introduction of new initiatives that might turn into standing EU activities and programmes (having their own budget lines). **Therefore, from a political and budgetary point of view, the pilot project on space technologies prepares for the conditions to set up a JTI for space technologies through a public-private partnership.**

Eventually, an industry-driven JTI will **accelerate innovation, provide more focus, more agility and more budgets for research through a coordinated approach to achieve competitiveness goals because the investment by industry will be leveraged by the Union. This is the positive basis of the PPPs partnership.**

As already mentioned, to implement a Joint Technology Initiative a Joint Undertaking (JU) is needed. **JUs have a dedicated budget and staff and provide a framework for the public and private players to work and take decisions together**. They organise calls for proposals, oversee selection procedures and put in place contractual arrangements for projects set up to implement the JTI research agenda. They, thus, allow funds from different sources to be jointly managed, they are responsible for the related communication and dissemination activities and they cooperate with Commission services to valorise and use the outcomes or funded projects[8]. Each JU includes an Executive Director with the Programme Office, a Governing Board, as well as other bodies, including advisory bodies, depending on its specific operational and governance needs. As a matter of fact, JTI JUs are just **one type of public-private partnerships (PPPs) implemented by the European Union in the field of research**.

JOINT UNDERTAKING'S LEGAL FRAMEWORK[9]

Joint Technology Initiatives involve a dedicated legal structure to implement a clearly defined objective.

Article 187 of the Treaty on the Functioning of the European Union *(TFEU) specifies that the EU may set up joint undertakings (JUs) or any other structure necessary for the efficient execution of EU research, technological development and demonstration programmes.*

Article 187 TFEU has been used under the EU's seventh framework programme for research and technological development (FP7) and the Horizon 2020 research framework programmes to set up, in particular, public-private partnership bodies in order to integrate industrial research in specific areas.

The members of these JUs are typically the European Union (represented by the European Commission) and, industry-led association(s), as well as other partners. JUs adopt their own research agenda and award funding mainly on the basis of open calls for proposals and other tools such as procurement if applicable.

[6] *"Public-private partnerships in Horizon 2020: a powerful tool to deliver on innovation and growth in Europe", COM/2013/0494 final*
[7] *This is a pilot project within the meaning of article 54 of the EU Financial Regulation proposed in line with the procedural conditions of the Inter-institutional Agreement of 20 December 2013.*
[8] *The EU Common Support Centre and in particular the common service for H2020 information and data.*
[9] *http://eur-lex.europa.eu/summary/glossary/joint_undertaking.html*

Joint technology initiatives joint undertakings (JTI JUs) are a type of JU set up to implement part of a strategic research agenda of a broader industrial initiative (the JTI) arising primarily from the work of European technology platforms.[10]

A JU offers the advantage of creating a strong and efficient coordination mechanism, able to structure and handle contributions coming from different sources. As such, a JU appears to be the most appropriate structure for the implementation of JTIs.

Objectives and justification for a JU:

The objectives of JUs include:

- ensuring coherent implementation of European research efforts in the strategic technological fields for the future;
- accelerating the generation of new knowledge, innovation and the uptake of research into strategic technologies, leading to enhanced productivity and strengthened industrial competitiveness;
- concentrating efforts on key projects that can help meet Europe's industrial competitiveness goals;
- enhancing the technology verification process in order to identify and remove obstacles to future market penetration;
- pooling user requirements to guide investment in research and development towards operational and marketable solutions.

An essential justification for a JU is that it makes a significant contribution to Europe's competitiveness in strategic technologies. This would apply to the space JTI.

Indeed, in order to identify the European Technology Platforms for which the Strategic Research Agendas suggest the need for a JTI to be set up, a **thorough and rigorous identification process must be carried out**; the purpose being to ensure that identification is objective and rigorous and, in this way, **enhance the credibility of JTIs as an innovative mechanism for supporting industrial research**. As a result, the identification process involves applying successively a series of criteria under the following headings:

- the demonstration of the added value of the action at Union level and of the choice of the instrument to be used;
- the scale of impact on industrial competitiveness, job creation, sustainable growth and socio-economic issues, including societal challenges, assessed against clearly specified and measurable objectives;
- the long-term commitment, including a balanced contribution from all partners based on a shared vision and clearly defined objectives;
- the scale of the resources involved and the ability to leverage additional investments in research and innovation;
- a clear definition of roles for each of the partners and agreed key performance indicators over the period chosen;
- complementarity with other parts of Horizon 2020 and alignment with the Union research and innovation strategic priorities, in particular those of the Europe 2020 strategy.[11]

Main features of a JTI according to official texts:

[10] http://eur-lex.europa.eu/summary/glossary/joint_undertaking.html

[11] *REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC*

As stated in the Commission report to the June 2005 European Council[12], **JTIs should not be 'closed shops', but should be open structures**. The founding members of the Joint Undertaking are typically the European Commission and private/public co-investors. In some cases, Member States can also be founding members of these Joint Undertakings[13]. As a result, **Member States, small and medium-sized enterprises (SMEs), research organisations (including universities) and corporate members are all welcome to join the industrial associations in setting up a JTI.**

From a practical point of view, members can vote, participate in key decisions, and shape the policies and evolution of the Strategic Research Agenda.

In all JTI JUs, **the European Union (represented by the Commission) is a founding member and is involved in the decision-making process**.

Financial resources are necessary to support the running costs of each Joint Undertaking[14] as well as the costs of the R&D.[15] For the implementation of the SRIA/SRA **the Commission annually commits funds from the research budget and Industry commits matching in-kind (i.e. non-monetary) contributions and funds, amounting to 50% or more of the total costs of the projects undertaken to carry out the project.** In addition, JUs may combine other sources of public funding, including, where appropriate, the Structural Funds and the Risk-Sharing Finance Facility.[16]

All calls for proposals organised by the JTI JUs are open and competitive. It implies that any legal entity is eligible to respond to calls for proposals to be organised by the JU. The proposals to be funded are selected on the basis of well-defined criteria.[17]

JTI JUs channel substantial amounts of public funds to selected proposals that may give them a technological edge and therefore a competitive edge. **Accordingly, in developing the JTIs, it has been ensured that their design is compatible with competition rules**. Particular attention was paid to State Aid rules, antitrust issues and merger controls.[18]

TARGET GROUPS FOR THE SPACE JTI

The Pilot Project is targeting a group of stakeholders that will be directly impacted by the creation of a JTI for space technologies: **the upstream space technology suppliers**. Technology suppliers will have to support the collective elaboration of a Strategic Agenda, and organically and financially support at the appropriate levels the JTI structure (i.e. the JU).

Technology suppliers shall benefit from the JTI in the form of leverage to their own RDT investment, de-risking of developments, improved technology availability, and overall improvement of competitiveness.

The Pilot Project also targets another group of stakeholders for which the creation of a JTI will have an indirect impact on their activities, and that will also benefit from the outcome of the activities carried out in the JTI context. In this perspective they will need to maintain operational coordination channels with the JTI, answering thus the called for need for European enhanced coordination of RDT efforts for

[12] *Report on European Technology Platforms and Joint Technology Initiatives: Fostering Public-Private R&D Partnerships to Boost Europe's Industrial Competitiveness (SEC(2005)800), ec.europa.eu*
[13] *This is e.g. the case of ECSEL https://www.ecsel.eu/*
[14] *i.e. the Secretariat of the JU*
[15] *The Commission (and the Member States in those cases where they are part of the Joint Undertakings) annually commits funds from the research budget. Industry commits matching in-kind (i.e. non-monetary) contributions and funds, amounting to 50% or more of the total costs of the projects undertaken to carry out the research.*
[16] *"About JTIs", ec.europa.eu*
[17] *"About JTIs", ec.europa.eu*
[18] *For additional information, see: "Joint Technology Initiatives: Background, State-of-Play and Main Features (SEC(2007) 692)" and "Public-private partnerships in Horizon 2020: a powerful tool to deliver on innovation and growth in Europe (COM/2013/0494)", ec.europa.eu*

space. These stakeholders are the upstream **space technology promoters**. A subset of the technology promoters are also **the end users of the space technology** developed in Europe.

Technology suppliers (and users) shall benefit from the JTI in the form of improved performance of products and systems they procure and operate, overall service and output quality improvement, de-risking of investment and ultimately, improved quality of life for EU citizens thanks to the wide impact space systems have on EU citizens and policy.

Technology suppliers include the following stakeholders:

Space manufacturing industry[19], **including SMEs**: This is the (mostly) private industrial sector who designs, develops, and builds space systems (launchers, spacecraft, Ground segment). The European space manufacturing industry has consolidated sales of 8,2B€ in 2016 and is strong of 40400 employees across Europe. The majority (>70%) are working within 4 large industrial conglomerates such as Airbus, Thales, ArianeGroup, Leonardo, the remaining (<30%) are distributed amongst a large population of smaller players, including medium size actors such as OHB, RUAG and Avio (worth 7-10%), and more than 600 SMEs (worth 6% of space employment in industry). These stakeholders are organised within two main professional associations: ASD-Eurospace[20] (representing 85% of sector workforce), and SME4Space[21] (representing 5-10% of sector workforce).

Aerospace research establishments: the complex technology environment of space systems takes advantage of an established base of specialised space and aerospace research establishments (such as the DLR institutes in Germany, CIRA in Italy, NLR in the Netherland, INTA and Tecnalia in Spain, Onera in France etc.). These research establishments support industry in the context of RDT activities with specific competences in research. They are also equipped with highly technical modelling, simulation, research and test facilities (space propulsion vacuum test chambers, vibration benches, aerothermodynamics tools, space environment models and simulation tools, radiation test facilities etc.). While there is no unified information source on the importance of this sector, current knowledge suggests that this group of entities represent between 5000 and 10000 researchers and technicians involved in space programmes in Europe. There are three main professional associations representing these stakeholders: two with a special focus on space research: ESRE[22], and NERO[23] plus a larger organisation bringing together all public research establishments in Europe: EARTO[24].

*Exemplifying the strong ties and the convergence of interests of these two categories of stakeholders, we note that in the larger aerospace domain, industry and research establishments have often established joint partnerships. **At regional level they have formed a variety of clusters**, mostly with an aerospace focus (more than 50 identified in Europe, of which about half have space system stakeholders). **At European level they also have partnerships in established PPPs**, the best-known example being CleanSky[25], which is the JTI JU for aeronautics. They are also jointly members of the ASD[26], the largest professional federation of Aerospace and Defence sector stakeholders.*

Research units in universities and other higher education establishments: referred as 'Labs' these are usually small (2-10 people) highly specialised research teams providing support in advanced areas relevant to space systems design, development and sometimes production. These labs support the space-manufacturing sector for scientific research (such as wave propagation, materials characterisation, high particle physics, astrophysics, planetary physics, exobiology, etc...) often in RDT phases, but also for the production of complex scientific payloads. These labs will often also be end-

[19] *All space industry data is sourced:* Eurospace Facts & Figures 2017 edition.
[20] *Eurospace.org*
[21] sme4space.org
[22] esre-space.org
[23] nero-space.net
[24] earto.eu
[25] *http://www.cleansky.eu/*
[26] asd-europe.org

users of the research produced in space, and thus support space agencies in Europe for their scientific programmes. There are no unified statistics on the workforce involved in these activities, but the ESA capabilities database[27] (updated annually by Eurospace) identifies 151 of such labs across Europe. The European Science Foundation has a Space Sciences Committee[28] bringing together space science researchers and labs to *"establish an independent voice and leadership role for European space scientists in the international space arena".*

Technology promoters include the following stakeholders:

The European Union (EU): with such programmes as Galileo, Copernicus and H2020-Space the European Union is an important promoter and user of space technology. With a global annual investment in space systems and technology exceeding 1B€/year[29] the Union is a core stakeholder for the space JTI. It is also the promoter of the Pilot Project itself. Consequently, the pilot project shall seek the proper level of involvement of Union bodies and commission services. The Commission DG GROW and DG Research and Innovation will play a pivotal role in both the pilot project and the forthcoming JTI. European Parliament is also an active stakeholder in the Pilot Project, being at its origin, and its involvement shall be coordinated with Commission services. Other Union bodies, such as the GSA, REA EASME and EDA for instance, may also be relevant stakeholders either to the project, either to the forthcoming JTI.

The European Space Agency (ESA): ESA is the largest space development agency in Europe, with a managed budget of 4,2B€ in 2015, of which more than 400M€ for RDT programmes[30]. It is the main customer of the space private sector (worth 3,4B€ of sales in 2016) and it is a political and technical partner of the EU, indeed through a variety of agreements ESA manages the largest portion (90%) of the EU budget for space programmes (worth 1B€ in 2015 and in 2016). ESA also promotes a Europe-wide technology coordination effort known as the Technology Harmonisation Process aiming at rationalising all European space technology developments with the active involvement of all stakeholders (technology suppliers and technology promoters). Other relevant space technology coordination processes where ESA is actively involved include the Joint Task Force for Critical Technologies (JTF - with the EC and EDA) and the European Space Components Coordination (ESCC - with national agencies and Eurospace). ESA also owns and operates complex test and research infrastructures for its own and for third party programmes. The Directorate for Technology of ESA is foreseen to be an important stakeholder in the Pilot Project, acting directly and also through the Technology Advisory Working Group (TAWG) where ESA Member states are gathered to address technology policy aspects.

National space agencies (NSA) in Europe: Usually located in the countries providing the largest national contributions to the European space programmes (France: CNES, Germany: DLR, Italy: ASI, the UK: UKSA) NSAs are also promoters and users of space technology developed in Europe, within their own programmes. Their budget contribution to the European space RDT programmes is estimated close to 200M€ in 2015[31]. NSAs actively support the European technology Harmonisation (together with other ESA Member States). Some have also advisory roles to their national delegations in the context of the H2020-Space Programme Committee. NSAs are foreseen to be active stakeholders in the Pilot Project and in the JTI.

The downstream space segment, representing technology end users and beneficiaries

Space systems provide infrastructure solutions to deliver a variety of services in three main domains: localisation, remote sensing and telecommunications. In many cases these services are in the public

[27] *tec-polaris.esa.int*
[28] *esf.org/our-services/expert-boards-and-committees/essc/*
[29] *Ares(2017)1745073 - 31/03/2017*
[30] *Source: European Space Technology Master Plan (ESA 2016)*
[31] *Source: European Space Technology Master Plan (ESA 2016)*

domain and the interface with technology promoters will provide the Pilot Project with the suitable level of information in end user needs and expectations. Notwithstanding, in the three main application domains an ecosystem of downstream users and stakeholders exists that may provide useful insight to the project and the activities of the future JTI. Three professional associations effectively represent downstream users in Europe:

- For localisation/positioning applications: Galileo Services[32]
- For commercial telecommunications: EMEA Satellite Operators Association - ESOA[33]
- For remote sensing applications: European Association of Remote Sensing Companies - EARSC[34]

The Pilot Project will seek their involvement as appropriate, considering the scope of a potential future JTI, as well as the Pilot Topics (see hereunder).

Other key actors in the space downstream segment, such as Eumetsat for example, will also be assessed for their potential relevance and involvement in the Pilot Project and/or the potential future JTI.

TOWARDS A GOVERNANCE MODEL FOR THE SPACE JTI JU

As stated in EC official documents[35], each Joint Undertaking will include **one or more decision-making bodies, a Secretariat, and Executive Director (appointed by the decision-making body; responsible for day-to-day management; and legal representative of the Joint Undertaking) and in some cases a scientific advisory committee**. In addition, clear rules for the adoption of the annual implementation plan and its implementation (e.g. via calls for proposals or public procurement) and annual activity report are defined by each JU and according to existing provisions.

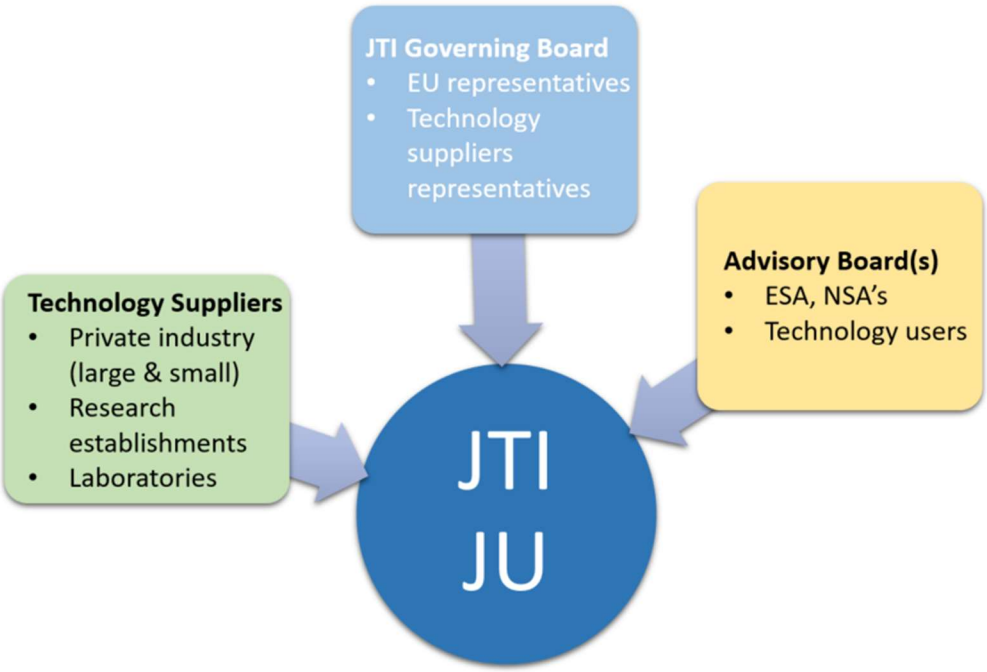
The European Union (represented by the Commission) is a founding member of each JTI JU and is involved in the decision-making process. In each initiative, the Commission enjoys a veto right (a list of minimum issues on which the Commission enjoys veto right is being established[36]).

Financial resources are necessary to support the running costs of the Secretariat as well as the costs of the R&D. In all JTI JUs, these will be provided jointly by the public and private partners. The way in which the R&D will be financed differs between JTIs. In addition, the financial mechanisms for JTIs are tailored to their specific objectives and stakeholder base. While the procedures for organising calls for proposals are open in all JTIs, the precise way in which funds will be disbursed differs. **The way in which the RD&I will be financed as well as the procedures for organising and implementing calls for proposals and tenders will be aligned as much as possible to the FP rules and possible needed modifications will be tackled during the implementation of the Pilot Project.**

Taking into account EC rules and the targeting of the group of stakeholders that will be directly impacted by the creation of a JTI for space technologies, a potential/draft governance structure of the JU which could be best suited for space technologies has been drafted as follows.

This first draft is just a baseline based on the generic JU organisation adapted to the European space context. The governance structure is one of the main subjects of the consultation. It will be modified and improved based on stakeholders' views.

[32] *galileo-services.org*
[33] *esoa.net*
[34] *earsc.org*
[35] *Commission staff working document - Joint Technology Initiatives: Background, State-of-Play and Main Features /* SEC/2007/0692 final */*
[36] *such as the use of the European Union contribution, the modification of the Statutes, the derogations to the framework Financial Regulation, the method of calculating in kind contributions.*



- JTI Governing Board:

The JU Governing Board could be composed of the Executive Director and representatives of the JTI Technology Suppliers, each one appointing lead delegates. They shall have the function of supervising the calls definition and planning but also ensuring the consistent implementation of the Strategic Research Agenda. European Commission representatives (on behalf of the Union) also participate in the governing board as founding members.

- Advisory Board(s):

Considering the important role in space RDT of Space Agencies in Europe (including ESA and national agencies), an Advisory Board could be created to involve them, as well as technology end-users. These representatives would review the Strategic Research Agenda and promote *technical* coordination with their own activities and plans, and promote further synergies.

- Technology Suppliers:

Composed of all the technology suppliers (private or public entities) committed to the existence of the JTI. They shall have the role of co-funding the JTI-JU activities and running-costs, design and implement the Strategy Research Agenda. They can be represented by individual members/stakeholders and/or representative associations, or both. **Technology suppliers are the main beneficiaries of the calls implemented through the JTI**.

THE STRATEGIC RESEARCH AGENDA (SRA[37]) FOR THE JTI

About Strategic Research Agendas (SRAs):

[37] *The term SRA is the most widely used, but other terms can be used as well, for example: RIAP (Research and Innovation Action Plan), SRIA (Strategic Research and Innovation Agenda) etc. Each sector will adopt the terminology it prefers, for example Eurospace uses the term RIAP (Research and Innovation Action Plan).*

As already outlined, the JTI is a particular type of PPP between industry and the EU where EU budgets are used to leverage private sector investment in RDT&I with a view to enhancing the value and impact of said investment towards increased competitiveness.

The key challenge of the JTI JU is implementing a Strategic Research Agenda (SRA) while considering the multi-criteria and multi-dimensional approach to Space RDT&I programmes (variety of funding sources/channels and of development drivers).

The objective of the Strategic Research Agenda (SRA) is to outline a roadmap for the implementation of a research programme aiming at the development of European space technologies.

As a result, the SRA shall contain:

- **High level (top down) goals** which are organised by:
  - Application area
  - Technology area
  - Grand challenge (strategic, societal etc.);
- **Low level (bottom up) technology proposals** which are organised by:
  - Application area
  - Technology area
  - Grand challenge (strategic, societal etc.);
- **Multiannual planning;**
- **Draft proposals for calls;**
- **Budget requirements by Call and by Year.**
- **Based on SRA, the JTI Executive Director prepares an annual Work Plan including topics for call and available budget**[38]

The SRA is usually prepared by a professional association, or an ad hoc organisation such as a European Technology Platform[39]. **It shall be supported by a good level of consensus**. Indeed, its process shall be transparent and open to all stakeholders willing to participate and is at the same time a voluntary process.

It shall be coordinated with existing technology plans (including cPPPs and other JUs), and particularly, for space, those of ESA in order to ensure complementarity of research programmes. In view of the space JTI, Eurospace will create a dedicated SRA process with a Charter**. The process and charter will be subject to consultation in the context of the Pilot Project.**

The elaboration of the SRA shall be based on a bottom-up top-down iterative process which shall cover a:

- Bottom-up requirements database with:
  - Data collection
  - Data consolidation
  - Tracking system
- Top-down analysis of needs with:
  - Expert analysis
    - Technology strands
    - Applications/services strands
  - Technical authority.

[38] *Commission staff working document - Joint Technology Initiatives: Background, State-of-Play and Main Features /* SEC/2007/0692 final */*

[39] *for instance ACARE prepares the SRA for the aviation sector implemented in two JUs (SESAR and Cleansky), AENEAS, ARTEMIS and EPoSS prepare the SRAs for implementation in ECSEL…*

JTI/SRA preliminary scoping:

The JTI/SRA scoping is an essential step of the consultation.

The scoping of the JTI (and the SRA) will be defined by stakeholders. Criteria to define the scope of the JTI and SRA may include:

- **the maturity level**, to be appreciated from the point of view of the current maturity level and of the target maturity level of the actions (using the TRL scale) up to technology demonstrators if applicable;
- **the type of application** considered (remote sensing, telecommunications, science/astronomy, planetary exploration, space weather, on-orbit servicing, human activities in space etc.);
- **the type of system** considered, focusing on the three main system categories of space infrastructures: launch systems, spacecraft systems, ground systems, and not forgetting the tools required to support design, development, and test activities;
- **the functional area**, such as thermal functions (active/passive regulation, insulation), attitude control, guidance and navigation, data handling (processing, storage, transmission), power functions (storage, distribution, generation), structural functions, propulsion etc;
- **the technology domain**, which can be a subset of the functional domain, but can also be transversal to it, such as composite materials, GaN technologies, etc. In Europe we usually rely on the ESA technology tree typology;
- **the level of implementation**, from the lowest levels of integration (component, material, building block) up to higher levels (equipment, sub-systems, full system/mission demonstration).

Items for preliminary discussion

Eurospace has already proposed its own preliminary reflections on the Strategic Research Agenda content in the context of a JTI for Space Technologies. ESRE (Association of Space Research Establishments) has released its preliminary views for Space activities in FP9. These reflections can be found in their respective FP9 position papers.[40]

Both contributions could serve as a baseline to propose a preliminary scope of activities to cover within the JTI, which will be modified and discussed during the consultation process.

SUMMARY OF EUROSPACE VIEWS

- The Eurospace FP9 Task Force has identified **five main challenges proposed for implementation within a JTI to support a competitive space industrial base focusing on technology, building blocks, equipment, and software in the next decade**. These are:
- **Components, materials & tools for non-dependence and leading edge**:
  - EEE[41] components as well as material and processes are key elements in the competitiveness of European space systems but is at the same time an area where widespread technological dependence provides programme uncertainties and where supply chain and dependence issues are common;
  - In order to face these challenges, it is recommended to support the development of a complete supply chain for European components and materials, including the relevant

[40] *Eurospace's "FP9 Position Paper" http://eurospace.org/Data/Sites/1/pdf/positionpapers/fp9positionpapereurospace20nov2017.pdf and ESRE's White Paper "Selected Trends and Space Technologies Expected to Shape the Next Decade" http://esre-space.org/wp-content/uploads/2018/01/ESRE_Whitepaper_-2017.pdf*

[41] *Electric, Electronic and Electromechanical*

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.

- **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. Indeed, a competitive equipment supply chain provides the essential foundation to European space systems performance and worldwide competitiveness;
  - As a result, the supply chain is thus expected to be proactive, reactive, innovative, reliable and sustainable. Therefore, 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) and on;
    - Launcher systems, focusing on all functional areas, including structures, avionics and propulsion.
- **Beyond (Space) Industry 4.0**:
  - Digital technology has become essential to competing in the space industry to gain competitive advantages. Companies which invest in digital technology 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;
  - 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;
  - As a result, key areas for development are: European tools for system, subsystem and equipment design, simulation, engineering and integration, and solutions for simulation, virtualisation, performance modelling.
- **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. European launch services competitiveness and reliability are driving factors for this challenge;
  - Key areas of improvement 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.
- **Innovative Ground Segment**:
  - Ground systems are integral part of the space infrastructure (programme operations, Earth observation, telecommunications applications);
  - 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.

SUMMARY OF ESRE VIEWS

- ESRE has also set out a series of technology recommendations/roadmaps for space in FP9[42]:

- **Future launching concepts - Micro and re-usable** with the aim to identify the most promising reusable launcher concept(s), (e.g. ground launched vs. air-launched) with respect to overall lifecycle costs, reliability, robustness, flexibility and availability, and identification of required advanced key-technologies essential for the realization of the promising concept(s). The micro-launcher has also been identified as a key domain in the Eurospace document;
- **Optical communications** with the aim to demonstrate feasibility and technological maturity (≥ TRL 7) of optical communications technology for the feeder links of very high throughput satellites in geostationary orbit;
- **Time and Time standards in GNSS systems** with the objective to establish a robust system time for Galileo. Advance the EU goal to provide a robust timing service for Galileo and EGNOS;
- **CO2 monitoring from space** made possible with the pre-development of a LIDAR instrument with the target to allow for an active CO2/GHG precursor mission to be launched around 2025, followed by a first operational mission in the timeframe 2030;
- **Monitoring the environment - local scale matters** with the aim to develop tasking and data exploitation approaches to match the spatial/temporal/spectral resolution requirements from end users (e.g. environmental protection agencies, local governments, public bodies, etc.), typically exceeding the capabilities of the single Earth Observation (EO) system, through synergies among different space and non-space remote sensing platforms (e.g. HAPS);
- **Small satellites - collaborative constellations** to accelerate the EU competitiveness by building challenging and innovative collaborative EU demonstrator missions ("learning by doing") in the timeframe of H2020 and FP9, and develop in parallel the enabling technologies that allow for proof-of-concept based on in-orbit (and/or on-ground) demonstration of selected technologies;
- **Satellite sub-systems - COTS components** by establishing a roadmap to promote the massive use of COTS in space;
- **Technologies for compact sensors - smart sensors for new space and planetary exploration** with the increase of EU miniaturization capabilities and developing and qualifying complete instruments based on them. The development of specific technologies would end into the construction of miniaturized payloads or satellite-borne instruments devoted to very specific duties to be allocated in small satellite constellations which could act as distributed instruments;
- **New optical technologies - improving detecting and sensing capabilities** with the aim to establish a roadmap to promote the use of freeform optics and ultra-stable materials in space optics instrumentation;
- **Manufacturing for space applications** with the establishment of a roadmap to develop 3D multi-material and multi-functional micro and macro for extra-terrestrial fabrication;
- **On board processing for VHTS** with the aim to demonstrate feasibility and technological maturity (≥ TRL 7) of a hybrid transponder for very high throughput satellites in geostationary orbit capable of handling the conversion from optical feeder links to RF user links and vice versa.
- **Technologies for autonomous and cooperative swarm exploration** to demonstrate the use of robotic swarms for future extra-terrestrial in-situ exploration missions.

It appears that the technology recommendations coming from ESRE have many commonalities with Eurospace's preliminary reflection on the SRA and shall be taken as a basis for the SRA scoping consultation.

[42] *ESRE has not yet decided what would be, within these technology areas, the ones suitable for implementation within a JTI.*

PILOT PROJECT: PILOT THEMES

The pilot project will focus on those areas not yet addressed by current programmes within the two pilot themes defined: innovative materials for space equipment and cleaner space through deorbiting. The aim is to achieve sustainable long-term replacement solutions for materials through innovation and to identify solutions for space debris is critical for industry.

The specific area of **innovative materials for space equipment** is critical for the European space sector due to dependence situations, i.e. unguaranteed access to supplies and re-export limitations. In order to support the dependence reduction on materials and a sustainable REACH-compliant competitive space sector, two major topics could be addressed by developing innovative materials for space equipment: this theme is fully driven by the critical items list jointly assessed by the Joint Task Force[43] for non-dependence set up by ESA, the EC and EDA to address consistently the issue of critical dependence on technologies for European space systems. Non-dependence on materials and processes should aim at promoting European sources for critical materials and processes affected by both dependence issues and/or the REACH regulation. The critical functions to cover with this topic are mainly adhesives, thermal control, primers and lubricants (oils and greases).

The topic on **de-orbiting** is addressing the need to preserve the Earth orbital environment in good condition in order to enable safe operations in space for the future. EU should support the necessary actions for limiting the growth of the orbiting debris.

Considering the current Technology Harmonisation process coordinated by ESA on de-orbiting, the project will thrive at ensuring the most appropriate synergy. The definition of topics for implementation in the pilot project will be refined with stakeholders, also in line with the ESA coordinated process.

HOW TO GET INVOLVED

Entities/organisations in the Technology Suppliers domain, willing to participate in the discussions on the elaboration of the Space JTI JU governance shall join the Stakeholders Consultation Group.

In addition, if relevant experts from your organisation are also interested in joining the 'expert consultation groups' focusing on each of the pilot themes, they should also be registered through the online registration tool.

To join the consultations, please complete the online registration tool available at https://docs.google.com/forms/d/e/1FAIpQLSf18Dgllxr4rj8PkvGXOxXqX13PFYHVbGmdRiOUc9STF-GGvA/viewform?c=0&w=1 by February 23rd 2018.

CONSULTATION CALENDAR

Two key events for 2018 are already fixed and should be kept in mind:

- 16th and 17th May 2018: Mapping outreach workshops for both pilot themes (critical materials and deorbiting) in **Brussels**;
- 18th or 20th September 2018: Potential areas for JTI implementation outreach workshop in **Brussels**.

Consultation calendar: governance

	Months	Jan	February	March	April	May	June	July	September		October	Novembe	December
2018	JTI & SRA Scope		Initial Stakeholder information round (06/02)	INFORMATION GATHERING	**Consultation start** : Potential aeras for JTI implementation (18/04)		CONSULTATION (12 weeks)	**Consultation end :** Potential aeras for JTI implementation approved (11/07)	Potential aeras for JTI implementation **Workshop (18 or 20/09)**	**Consultation start** : JTI Scope (26/09)	CONSULTATION (11 weeks)		JTI Scope approved (19/12)
	Months	Jan	February	March	April	May	June	July	September		October	Novembe	December
2019	JTI & SRA governance definition		Consultation start : JTI & SRA governance definition	CONSULTATION			Consultation end : JTI & SRA governance definition	JTI & SRA governance consensus building Workshop	Consultation start : JTI&SRA bodies - outreach	CONSULTATION	Consultation end : JTI&SRA bodies - outreach	Consultation start : JTI draft status & SRA charter	CONSULTATION	JTI status and SRA charter for implementation approved

Consultation calendar: pilot themes

	Months	January		February	March	April	May		June	July	September	October	November	December
2018	STEPP De-orbiting / Critical Materials		Stakeholder identification	**Consultation start :** Technical Document Draft (06/02)	CONSULTATION (13 weeks)		**Consultation end :** Outreach **Workshop (16 and 17/05)** + Conclusions		Start **Requirements capture (RC)**: Identification of draft priorities	Scoping for requirements	**Consultation Start :** Technical Requirements (19/09)	CONSULTATION (12 weeks)		**Consultation end :** Technical Requirements Final (19/12)
	Months	January		February	March	April	May		June	July	September	October	November	
2019	STEPP De-orbiting / Critical Materials	**Consultation Start:** Roadmapping (RM)	CONSULTATION				**Consultation end** : key development proposals	**RM :** Outreach **Workshop** + Conclusions	Start **Call Text**	CONSULTATION	**Released:** Final Development Plan	CONSULTATION		**Call Text Draft Final**