

# Commercial Applications of Space-Enabled Robotics

## *ESA Business Applications Space Solutions*

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# Agenda



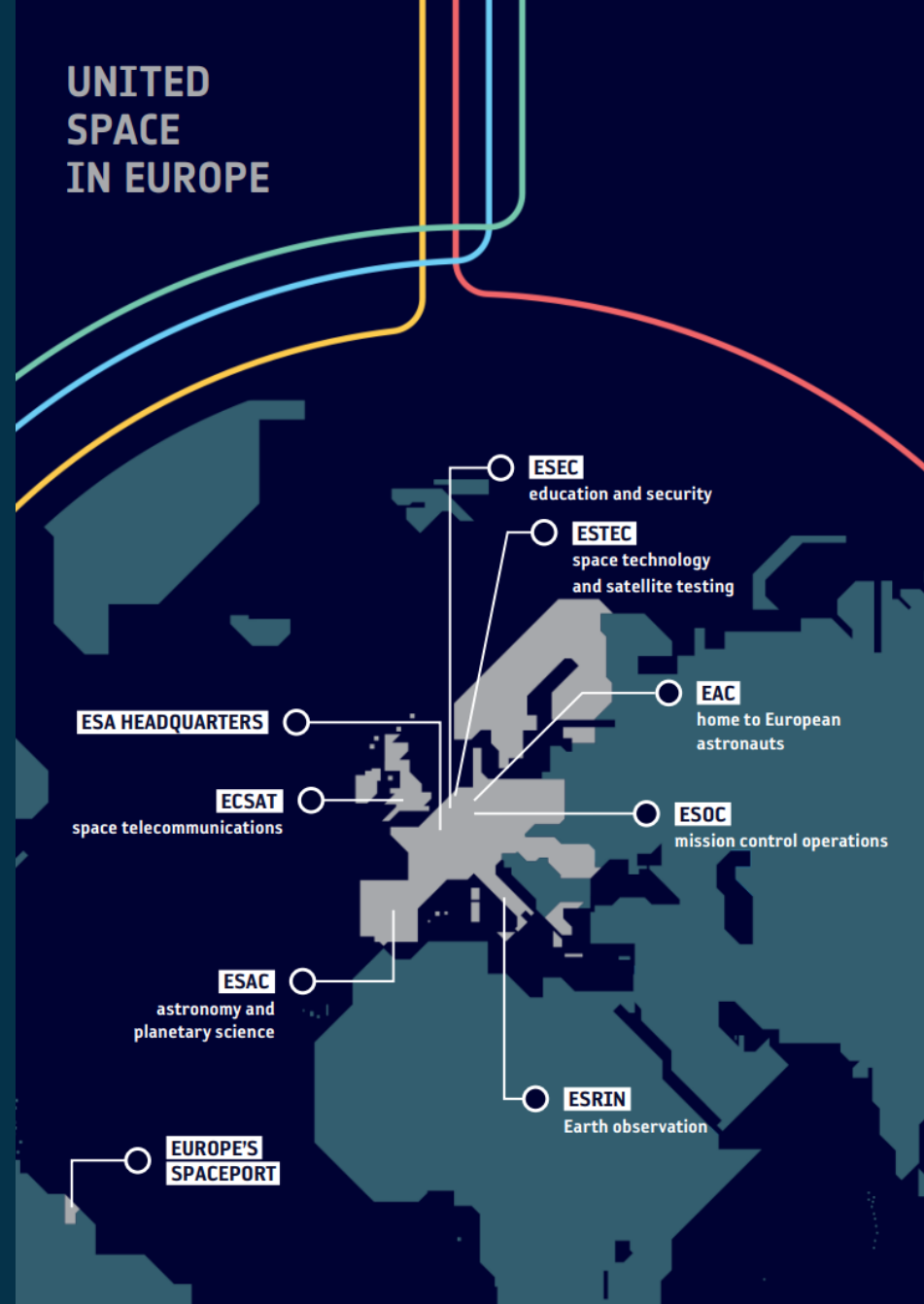
1. Introduction
2. European Space Agency
3. Business Applications Space Solutions (BASS) Programme
4. Commercial Applications of Space-Enabled Robotics
5. Guest Speaker – Eduardo Green (City of Amsterdam)
6. BASS Project/Study Examples
7. How to Apply
8. Q&A



# European Space Agency



- Europe's gateway to space
- Peaceful exploration and use of space for the benefit of everyone
- Established in 1975 - over 50 years of experience
- 22 Member States + Additional Associate & Cooperating States
- 8 sites across Europe and a spaceport in French Guiana
- Promote European scientific and industrial interests in space

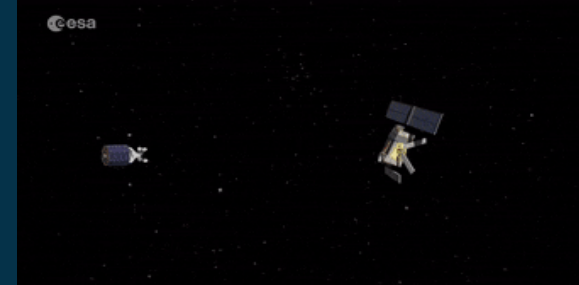
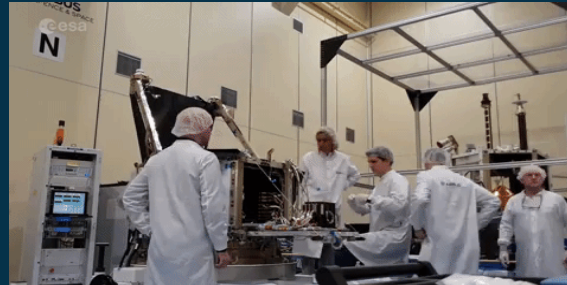
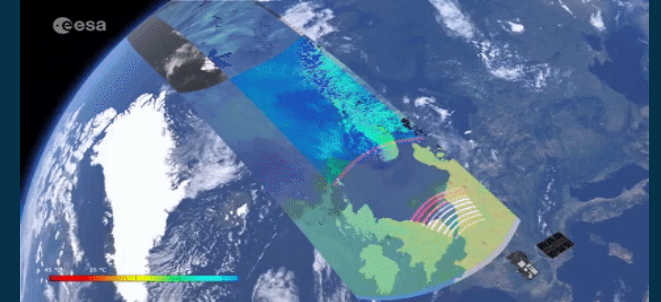
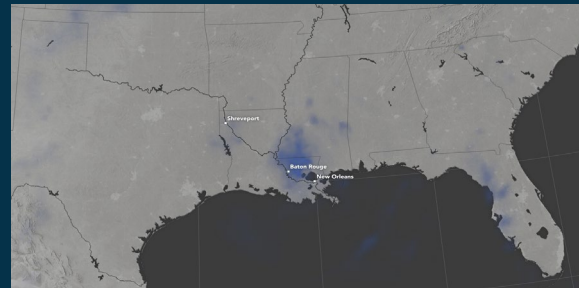
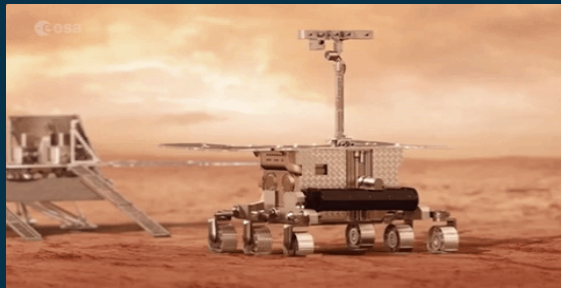
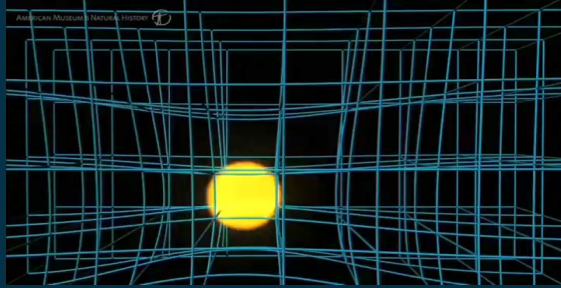


## Science and Exploration

## Enabling and Support

## Safety and Security

## Applications



## The largest space innovation network in the world

- The go-to place for great business involving space to improve everyday life.
- Supporting European start-ups and SMEs to develop businesses using space technology and data.
- Offering funding, business and technical support to help to generate successful business and create jobs.





# Space Improves Life on Earth



Space Technology...

X

... non-Space Technology...

=

... more applications, more value ...



Earth  
Observation



Satellite  
Positioning



Satellite  
Communication



Spaceflight  
Technologies



Space  
Weather

Big Data Analytics

VR/AR/XR

Artificial Intelligence

Distributed Ledger Technology

Robotics

Internet of Things

Digital Twins

Drones

Cloud Technologies

5G (<https://artes.esa.int/esa-5g6g-hub>)



Maritime



Agriculture



Environment



Healthcare



Financial



Transport



Education



Media



Energy



Aviation



# What can you do with Space Technology?

## Satellite Positioning



- Global Positioning
- Navigation
- Velocity
- Precision Timing
- Activity Tracking
- Route Optimisation
- Surveying
- Machine Control

## Satellite Communication



- Reliable and Secure Communication
- Remote Connectivity
- Backup to Terrestrial Infrastructure
- Broadcast to Widespread Users

## Earth Observation

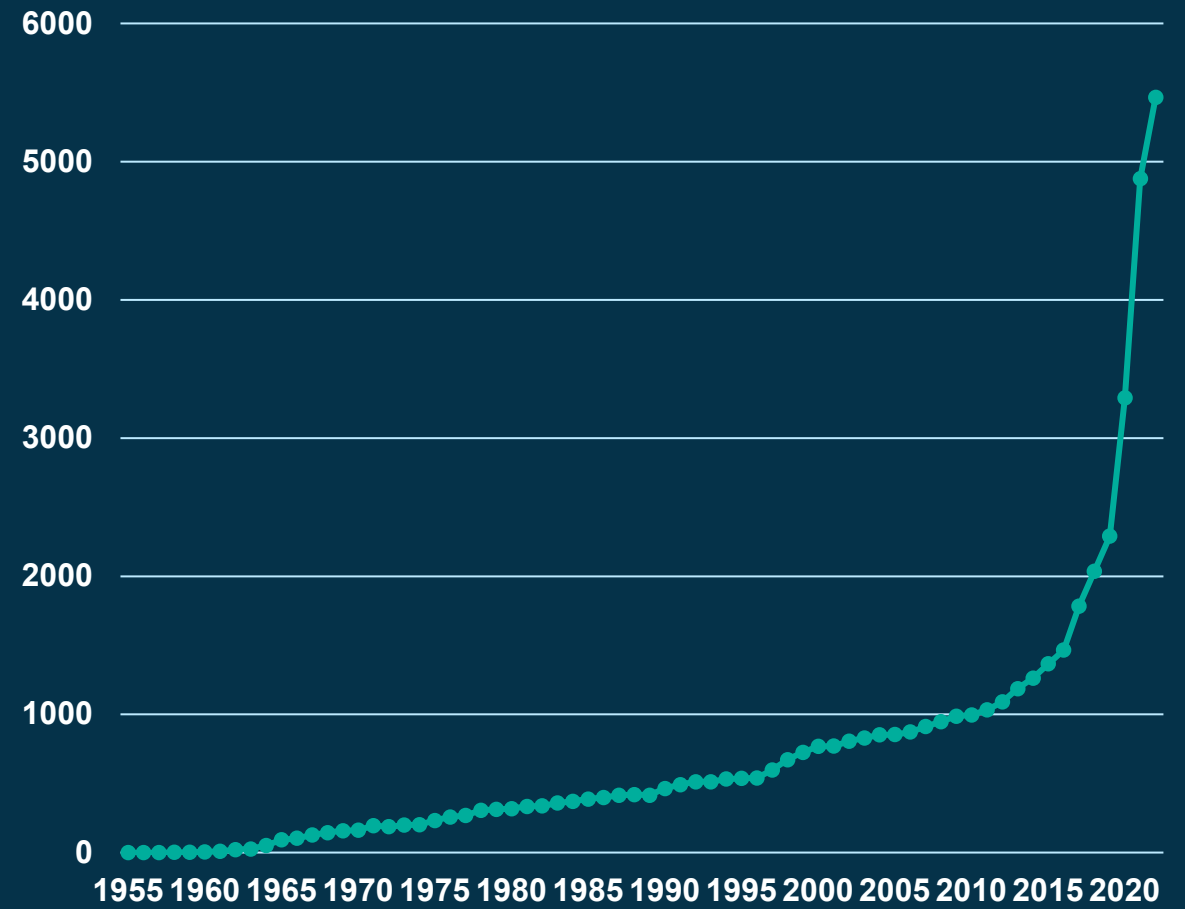
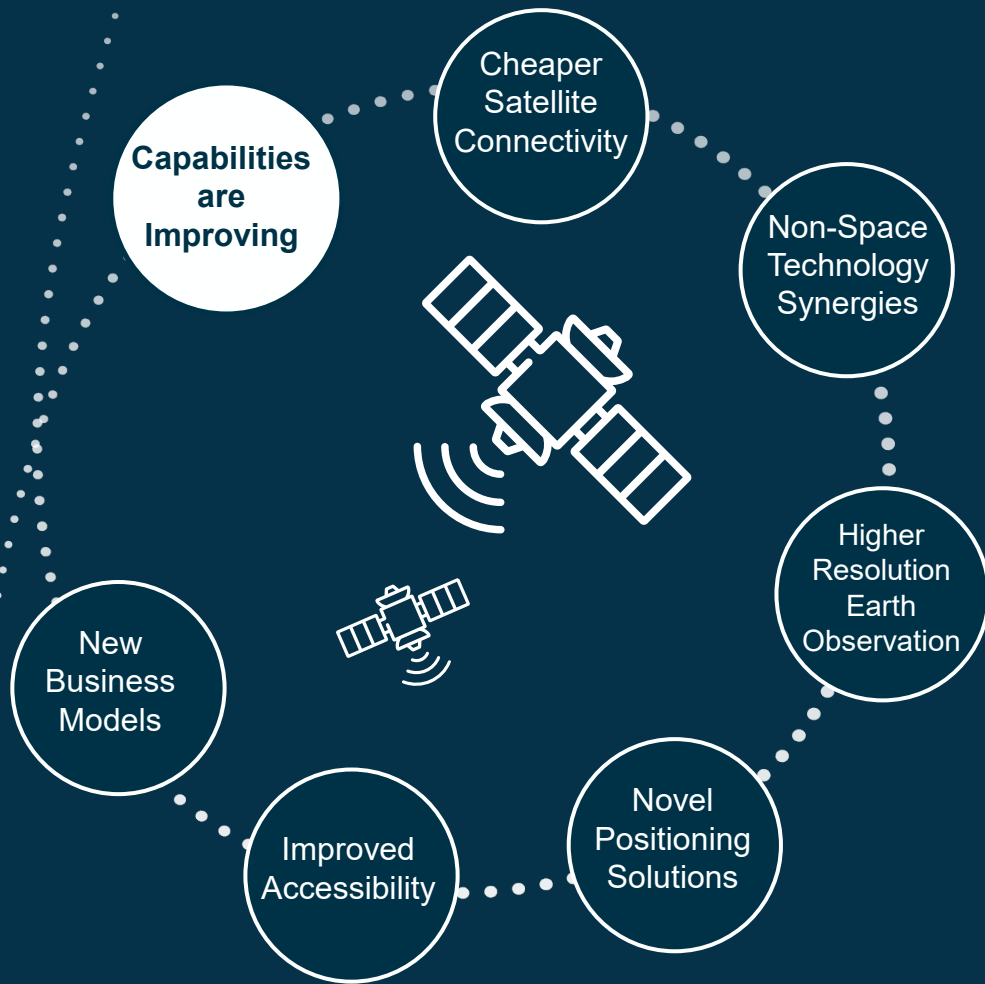


- Land, Sea, Air Monitoring
- Infrastructure Monitoring
- Resource Mapping
- Environment Sensing
- Change Detection
- Weather and Pollution Forecasting

## Human Spaceflight Technologies (Spin-Outs)



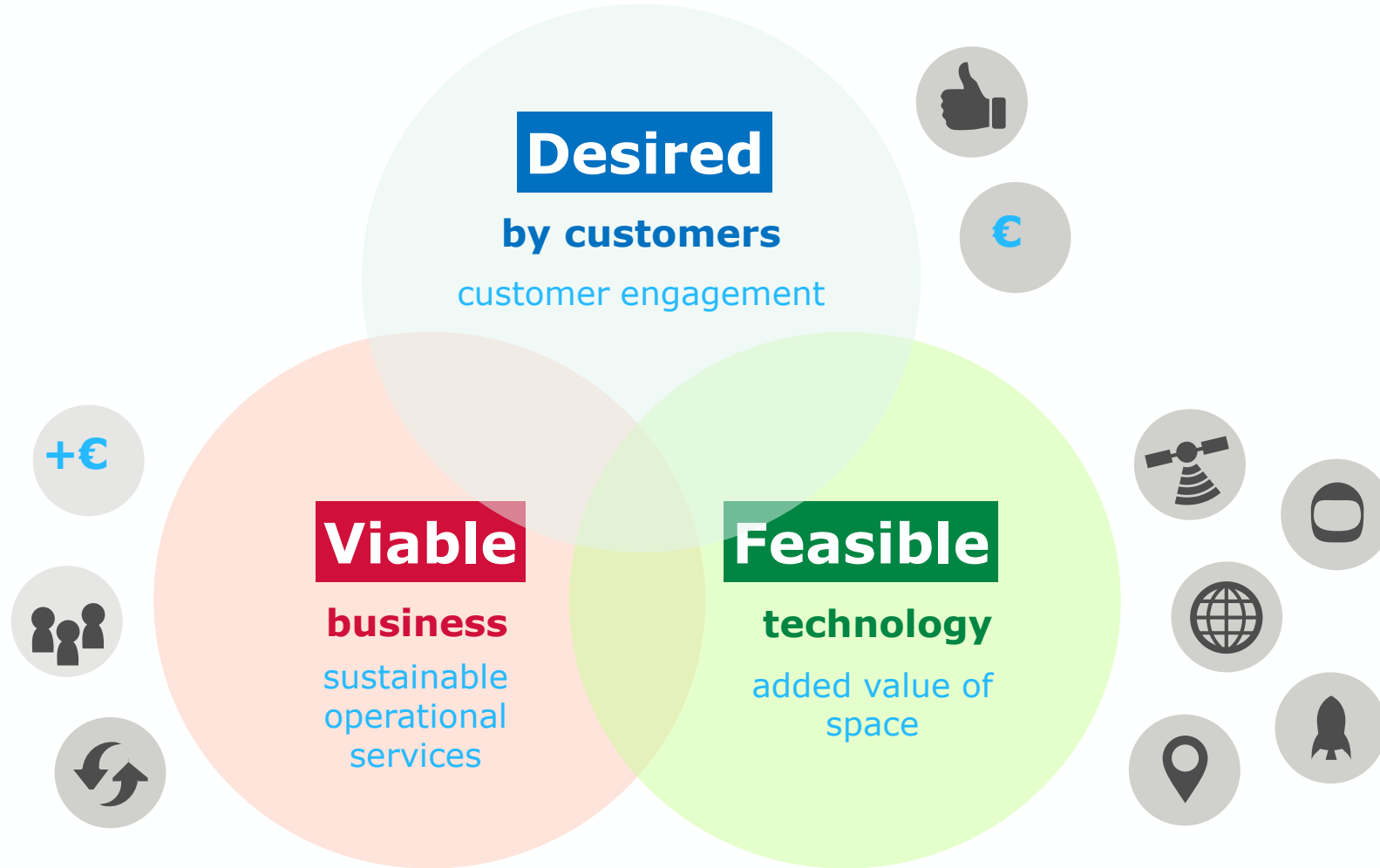
- Augmented Reality
- Health Sensors
- Procedures
- Big Data Processing
- Artificial Intelligence



Active Satellites in Orbit (© Statista 2022)

# What are we looking for?

Services that are...



# What ESA Space Solutions Offers...

Our aim is to work together to make your idea commercially viable, with:



Zero-Equity Funding  
(€50K-€2M+)



Tailored Project Management Support



Access to our Network and Partners



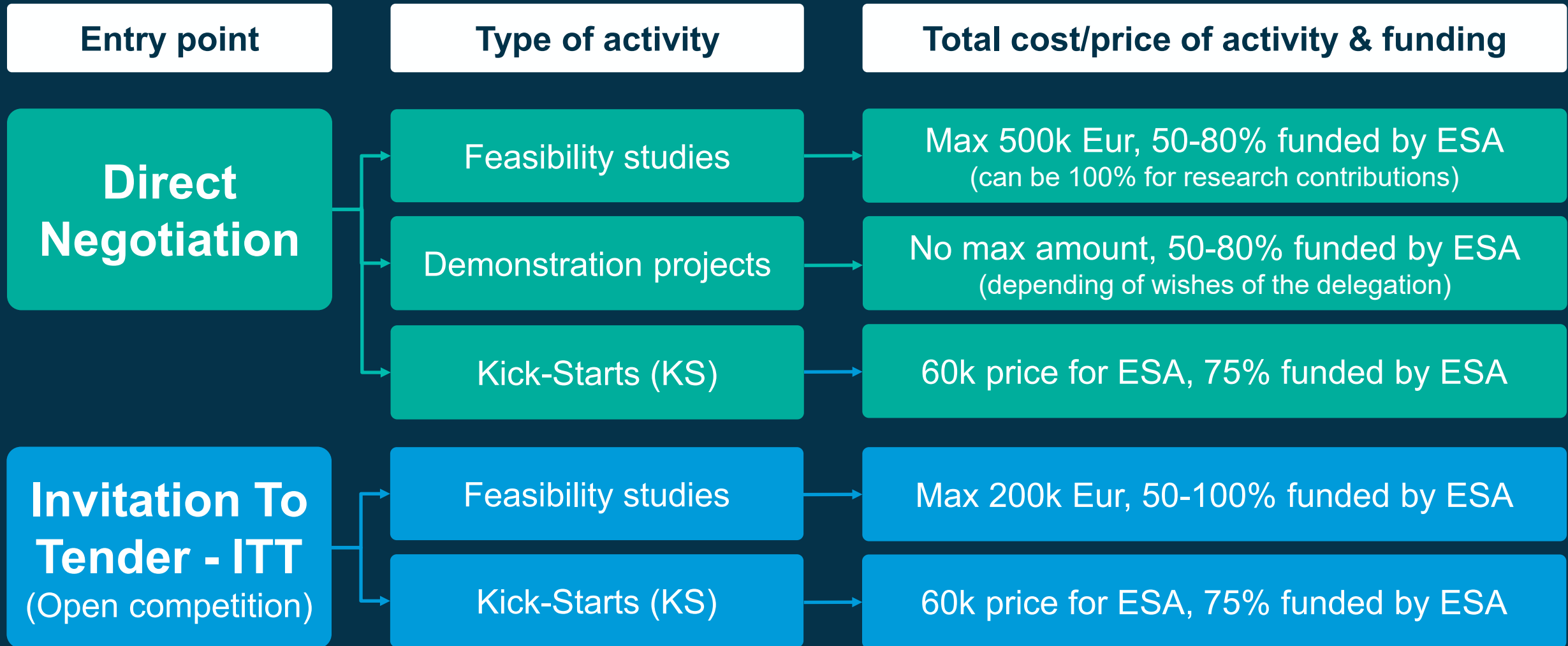
Use of ESA Brand for Credibility

**Demo projects:** Mature value proposition & business plan and demo your service with customers

**Feasibility studies:** Explore ideas, create a business plan & connect with potential users

**Kick-Starts:** Thematic activities





After market-entry ESA can provide support through access to an investor network and media promo

# What's in it for us?

## SOCIO-ECONOMIC IMPACT

Deliver social value and economic sustainability



## USE OF SPACE TECHNOLOGY

Expand the utilization of space in new markets and user communities



## INDUSTRY COMPETITIVENESS

Strengthen European Industry competitiveness on the global space and non-space markets



# Cooperations with Non-Space Stakeholders\*

\* These are entities who do not receive funding from ESA through the cooperation but have mutual objectives in running initiatives with ESA

### Aviation

### Smart Cities

### Energy

### ICT

### Health

### Food and Agriculture

### Infrastructure

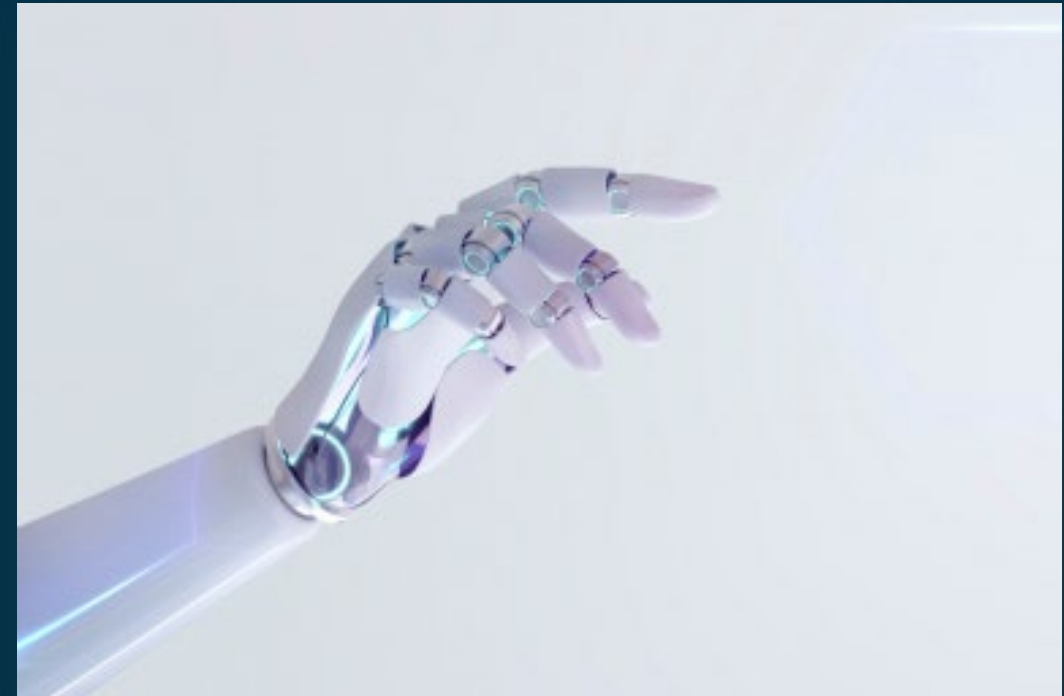
### Circular economy

### Cybersecurity



## Seeking innovative ideas at the intersection of robotic systems and space-based services...

- To exploit capabilities enabled by parallel advancements in robotics and space sectors (in terms of new technology, business models, and operational environments).
- 'Robotics' is here defined to include physical robots, autonomous drones, machines and vehicles, and precursory solutions or those that enable these (e.g. perception and navigation systems for autonomous vehicle services, connectivity solutions to enable tele-operated robotics, etc).
- Satellite technology/data can be integrated at the system or service level, or both.
- Open to feasibility studies and demonstration projects.







Sub-themes - create new services in key market verticals...



Smart Cities & Infrastructure  
7<sup>th</sup> March



Transport & Logistics  
26<sup>th</sup> April 2024



Energy  
May 2024



Health & Safety  
June 2024



Maritime  
September 2024



Agriculture  
October 2024



Integrating space data and innovative technologies



Space-Enabled Robotics



Satellite Communication



Satnav



SatEO



Artificial Intelligence



Autonomous Vehicles



Robotics



Autonomous Drones



Engaging with industry stakeholders to provide problem statements and use-cases

## Transport and Logistics (Optional) Use-Cases:

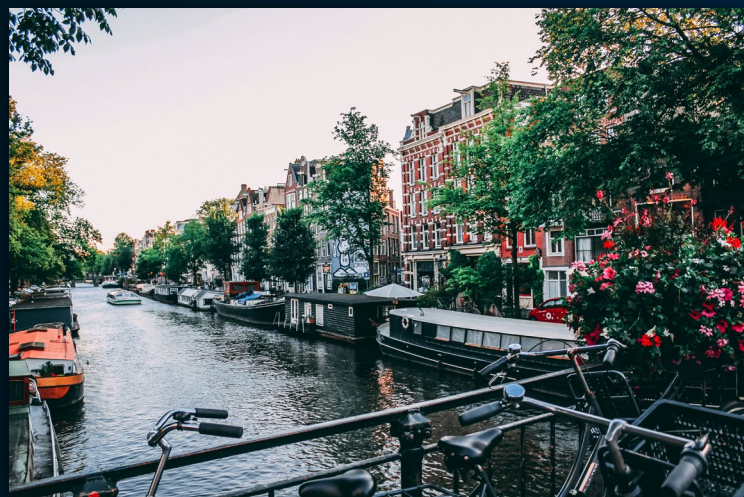
- City of Amsterdam
- City of Venice (VeniSIA)
- City of Torino

## Steps towards autonomy...

- Feasibility studies to **evaluate** technical, economic, operational, legal and regulatory **constraints and possibilities**. Demonstration projects to pilot solutions in **pre-operational environments with users**.
- Support the eventual uptake of autonomous vehicles, drones, robots, and watercraft in viable operational settings in which they offer **enhanced safety, sustainability, accessibility, and commercial competitiveness**.
- Targeted areas could relate to delivery services, public transportation, long-haul trucking, industrial settings, campus and controlled environments, short-sea shipping, inland waterway transport, and beyond.
- Autonomous services may relate to vehicles and robots on land, air, and sea.



## City of Amsterdam



**Autonomous transportation of passengers and goods on Amsterdam's canals.**

## City of Venice



**Automated drone delivery of medical supplies to remote regions.**

## City of Torino



**Last-mile delivery and waste collection in urban areas with fleets of robots.**

## Unnamed Multinational Energy Utility Company



**Automation of the  
transportation of large wind  
farm components from port to  
delivery field**

# The Power of Space Technology and Data



## Satellite Communications

- ❑ Rural, remote and offshore connectivity for robotic systems.
- ❑ Redundant communications to meet stringent connectivity requirements.



## Satellite Earth Observation

- ❑ Situational awareness to support navigation of a robot.
- ❑ Earth observation to inform, initiate, or halt deployment of an autonomous system.
- ❑ Air quality measurements, thermal heat signatures, optical, radar, meteorology, or combinations thereof.



## Satellite Positioning

- ❑ Positioning information for robots, vehicles, machines and drones,
- ❑ Time-synchronisation of networked machines, and/or determination of speed and heading.
- ❑ Hybrid positioning for difficult environments (indoor-outdoor, urban canyons...)
- ❑ Augmentation for high accuracy positioning.



**Eduardo Green**  
*Service Designer / Mobility Innovation*  
*Amsterdam Urban Innovation Team*

Eduardo is a Service Designer within the City of Amsterdam's Smart Mobility Programme, supporting projects and teams in designing data-driven strategic experiments to learn and scale innovations in achievement of the city's complex mobility goals.



# SMART MOBILITY 2019 - 2025

*ESA Call for Proposals,  
Space Enabled Robotics –  
Amsterdam's Challenges*

City of Amsterdam

Department of Innovation

Eduardo Green

Service Designer - Mobility Innovation





## Ambitions 2019-2025



#1

All Amsterdammers,  
visitors and goods travel  
cleaner and smarter.

#2

Amsterdam is influential in  
the digital mobility system.

#3

Amsterdam is Smart  
Mobility City number 1.





## Humans are the beating heart of a city

But without logistics, we don't have shops, supermarkets, restaurants, bars, postal services, hospitals, construction or renovation





# Transformations is needed... And happening...

But these practical solutions are not suitable for every business model and puts pressure on liveability and accessibility





# Reduce heavy vehicles on vulnerable infrastructure

Complex logistics, a fragmented industry (construction, HoReCa, e-commerce, health care etc.) and a lack of cooperation





# Autonomous Transport: Over water, Smart canals, New PT

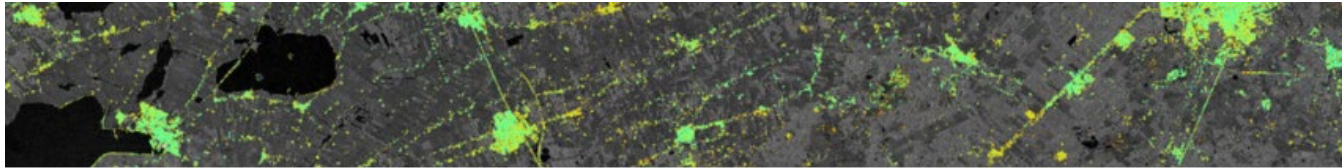
Amsterdam is 25% water – autonomous canal boats and new public transport models which make better use of canals and waterways





# Underwater, on water, on land, up in the air

Data is available, however we need to translate these towards innovations that demonstrate new human-centred models are possible



## APPLICATIONS

# Mapping that sinking feeling

01/06/2016 15486 VIEWS 154 LIKES

ESA / Applications / Observing the Earth / Copernicus / Sentinel-1





City of Amsterdam



# Thank you

[www.amsterdam.nl/smartmobility](http://www.amsterdam.nl/smartmobility)

# ESA Business Applications

## Project and Study Examples (Robotics, Drones, Autonomous Systems)



# Aito - TeleRetail

## Demonstration Project



**TeleRetail** Automated delivery service with courier robots for urban and sub-urban logistics, enabled by space  
Reduces the cost of transport by up to 90% while enabling **24/7** on-demand eco-friendly transport services

Satellite Earth Observation for mapping and path planning, satellite positioning for precise localisation



The robot **safely travelled >100km** of complex environments with narrow cycle paths, road crossings and interactions with cars, bicycles and pedestrians, and **delivered Coca-Cola products** to outlets across Alton Towers amusement park...





- Delivery of medical supplies and test samples by drones enabled by space-based technology
- Drone solution piloted remotely from the Operations Centre, and flies automatically, navigating through pre-set GNSS waypoints.
- Satellite communications between the Ground Control Station and the drone enables 100% communications coverage over the entire route – a crucial safety enabler.
- Solution demonstrated with users in Scotland with support from ESA

**NEWS**

Home | Coronavirus | Video | World | UK | Business | Tech | Science | Stories | Entertainment & Arts | Health

Scotland | Scotland Politics | Scotland Business | Edinburgh, Fife & East | Glasgow & West | Highlands & Islands

## Covid in Scotland: Drones to carry Covid samples

🕒 23 February

Coronavirus pandemic

SKYPORTS

# Darwin Autonomous Shuttle

## Demonstration Project

Autonomous passenger shuttle operating on the Harwell Science & Innovation Campus, Oxfordshire.



Satellite and 5G hybrid communications for seamless operations, LiDAR, cameras and odometry sensors to navigate around obstacles, with GNSS for positioning information

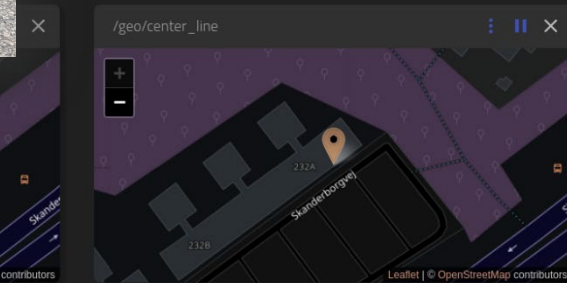
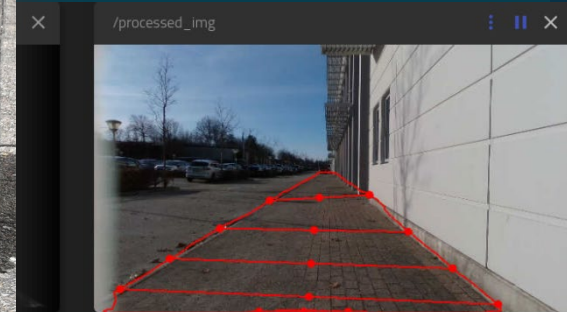


Autonomous electric vehicle paving the way towards autonomy on U.K. public roads.

## Mobile robot service for sidewalk data collection



Satellite-enabled precise GIS (Geographical Information System) maps of sidewalks, and quality assessments to inform need for urgent maintenance and help navigation of the visually impaired.



GNSS RTK and Visual-SLAM for navigation. IMUs, Camera and AI for sidewalk assessment



# How to Apply (1) – Documentation



## Register

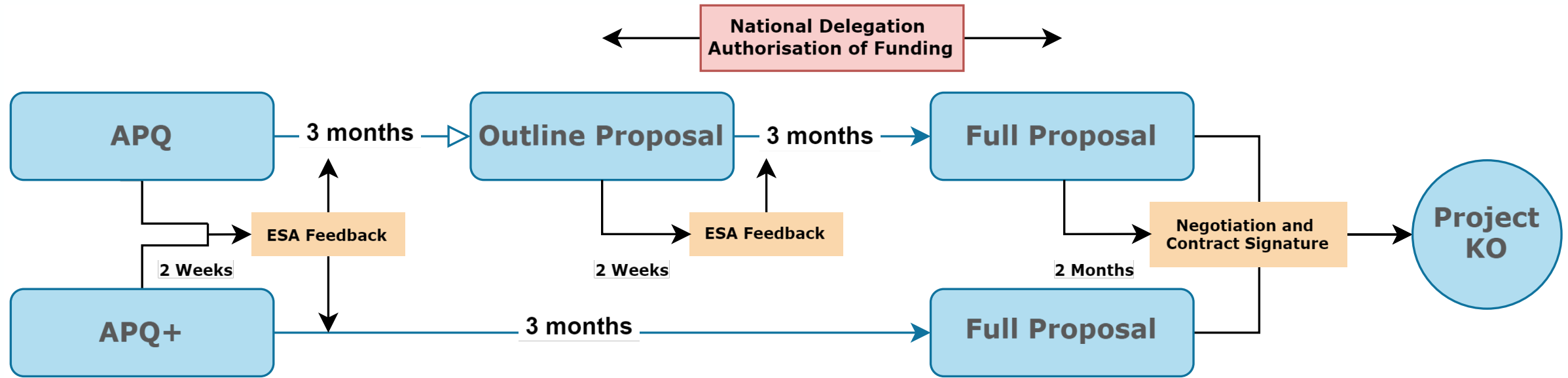
Register by completing online questionnaire on ESA-STAR Registration (minimum 'light registration') ([Doing Business with ESA](#))

## Download

Download the tender information documentation (Invitation to Tender) via the webpage [Commercial Applications of Space-Enabled Robotics \(esa.int\)](#) at the opening date (select the appropriate sub-theme link).

## Submit

Download the Activity Pitch Questionnaire (APQ/APQ+) template and submit your pitch as instructed in the Activity Pitch Questionnaire guidelines (<https://business.esa.int/apq-submit>) through the online form before the deadline, selecting this Robotics Initiative in the drop-down of the APQ.



**NB: Indicative Timelines are the Maximum Durations**

- ✓ Incremental procurement approach: APQ is the starting point – max. 8-page document with a standard template to present WHAT, WHY, HOW
- ✓ The APQ+ may substitute the outline proposal as an alternative entry point for **mature propositions only**
- ✓ Standard templates for proposals and deliverables before and during activity implementation
- ✓ Ambassador Platform available to guide companies in the process (<https://business.esa.int/ambassador-platforms>)

# APQ - 'Activity Pitch Questionnaire'



1. (WHO) Company Background Information
2. (WHAT) do you want to offer your customers and what is the added-value?
3. (WHY) Who are the target beneficiaries addressed by your offer, and what is the expected impact?
4. (HOW) How do you intend to implement?

## (OPTIONAL) APQ+ Fast-Track Questions

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### ACTIVITY PITCH QUESTIONNAIRE (APQ)

ESA-TIAA-PO-2017-1054 - V. 3.19

The Activity Pitch Questionnaire (APQ) allows you to present your business idea in a reduced, standardised pitch. It helps ESA to quickly take informed decisions on next steps, pointing you to the most appropriate activity stream in case the APQ is considered acceptable (e.g., additional preparatory work, training, teaming up with some other partners, go ahead targeting a Feasibility Study or a Demonstration Project).

Gated and incremental approach: The submission process is based on the following three stages: the Activity Pitch Questionnaire (this form), the Outline Proposal, and the Full Proposal. In case the APQ is accepted by ESA, the answers to the questions of this APQ will be directly integrated in the Outline Proposal and extended as needed. In a similar way, the elements of the Outline Proposal, if accepted by ESA, can be directly integrated in the Full Proposal.

**Prepare your pitch:**

- Make sure you use the **LATEST VERSION** of the [APQ template](#).
- Explanations of terminology used here can be found in the document '[Terminology used in ESA Business Applications](#)'.
- Some explanations on how to prepare the APQ are available in the presentation '[ESA Business Applications - Guidelines for APQ Preparation](#)'.
- Choose the appropriate Open or Thematic Call. For further details, visit '[ESA Opportunities for Open Calls](#)'.

Call:  Activity:

*"Please be aware, it's important to ensure you have selected the right options."*

**Submit your pitch:**

- Contact your National Delegation<sup>1</sup> as specific rules may apply depending on your country.
- Please note that for a given idea, **ONLY ONE** APQ submission is possible (no subsequent submission of revised APQ Form(s) is allowed).
- The APQ has a validity of **ONE YEAR**: in case of no draft of Outline Proposal is submitted within one year from the date of the APQ submission, the APQ will be considered by ESA as withdrawn.
- Your APQ shall be submitted using the **online web form submitter** accessible at '[APQ Submit](#)' Please note that only PDF formats are accepted.

**Activity Pitch Process:**

Upon submission of your Activity Pitch Questionnaire:

- ESA may provide this Activity Pitch Questionnaire to and discuss it with the National Delegations of the countries of your consortium.
- ESA will assess your pitch.
- ESA will provide written feedback typically within 10 working days from the date of the APQ submission.

<sup>1</sup> Contact details of the National Delegations can be found under: <https://business.esa.int/national-delegations>  
For Greek entities, please note that Greece does not support non-competitive bids, therefore Greek proposals are not admissible under in this call.

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**Important Note:**

- For optimal viewing and accurate completion of the template, please download and install the latest version of [Acrobat Reader](#), which is available for free.
- Click on " ? " for more information.

### Section AP.1 Background information

**AP.1.1 Idea name:**

Brand name:  Full name:

**Thematic market area**

Primary 1:  Subcategories 1:

Primary 2:  Subcategories 2:

Keywords 1:  Keywords 2:  Keywords 3:

**AP.1.2 Basic company information**

Name:  Website:

Address:  Country:  Phone:

Contact point name:  Email:

**AP.1.3 Company background**

Year of creation:  Revenues (Most recent figure in EUR) / Year:

Number of employees:  Industry / sector:

Coming from ESA BIC(\*):  (\*) If Yes, conclusion date of BIC contract: mm/yyyy

More details:

**AP.1.4 Have you had any previous activities within Business Applications?**

If Yes, indicate name of any previous activities and possible commercial outcomes

**AP.1.5 Are you applying with sub-contractors?**

If Yes, who are the other entities?

Name:	<input type="text"/>	Website:	<input type="text"/>	Industry:	<input type="text"/>	Country:	<input type="text"/>
Name:	--	Website:	--	Industry:	--	Country:	<input type="text"/>
Name:	--	Website:	--	Industry:	--	Country:	<input type="text"/>

Roles in Activity:



- The [authorisation from National Delegation](#) will be required for submission of full proposals under direct negotiation (the third step in the application process) thus it is a good idea to initiate a dialogue with your National Delegation early on.
- Please note that funding participation is open to groups, organisations and businesses which reside in ESA member states that have subscribed to the programme.
- To date, these countries include **Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece\***, Hungary, Lithuania, Ireland, Italy, Luxembourg, The Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain\*\*, Sweden, Switzerland and the United Kingdom.
- The contact information of the National Delegations can be found at <https://business.esa.int/national-delegations>

\*For **Greek** entities, please note that Greece does not support non-competitive bids, thus Greek proposals are not admissible under in this call.

\*\*For **Spanish** entities, please note that Spain has no budget left for this initiative under the programme.

Thank you!

For more information:

ESA Space Solutions

(<https://spacesolutions.esa.int/>)

Commercial Applications of Space-Enabled Robotics (esa.int)

[Christopher.Frost-Tesfaye@esa.int](mailto:Christopher.Frost-Tesfaye@esa.int)

