

# Commercial Applications of Space-Enabled Robotics

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## *ESA Business Applications Space Solutions*

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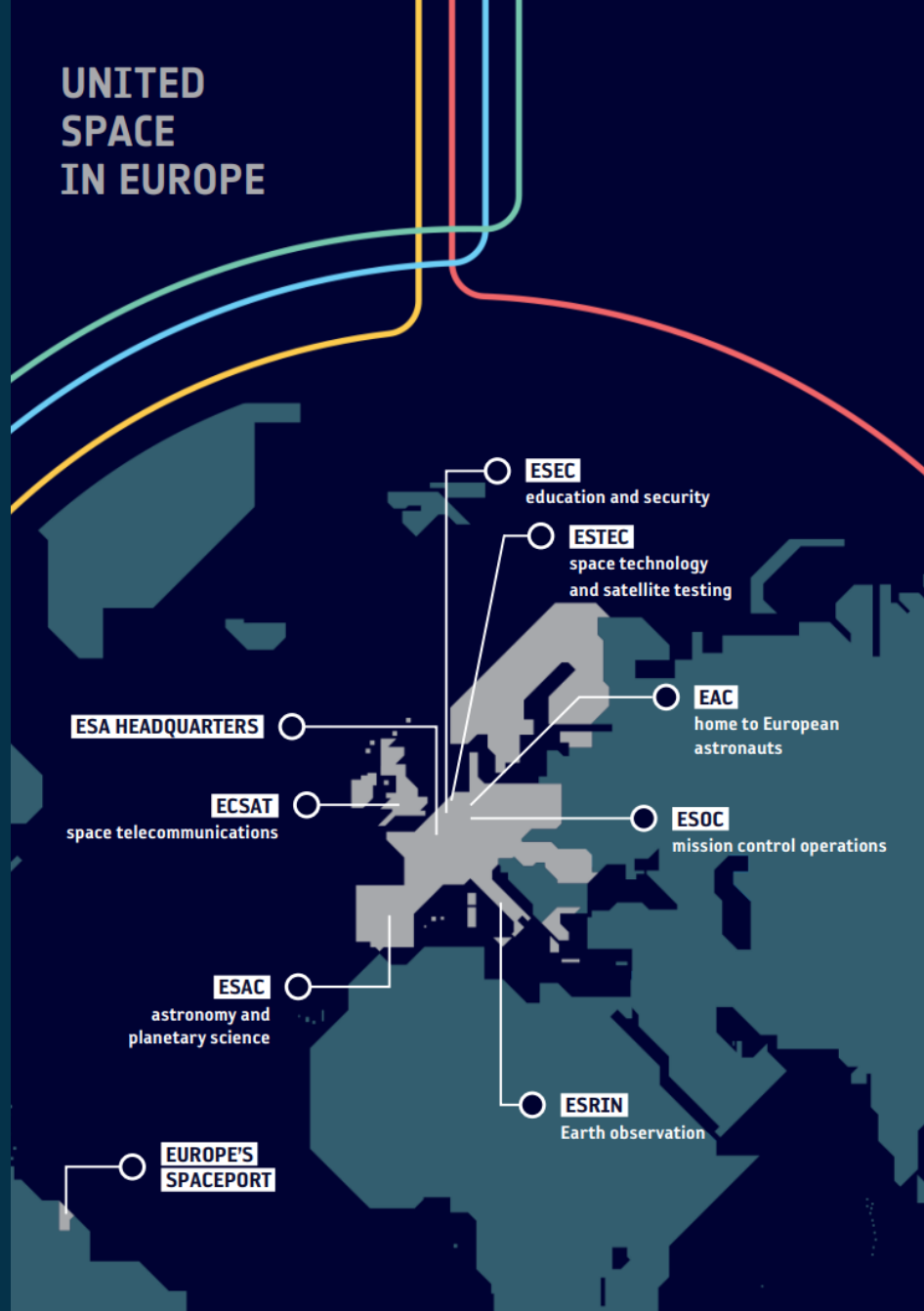
[Chris Frost-Tesfaye | LinkedIn](#)

# Agenda

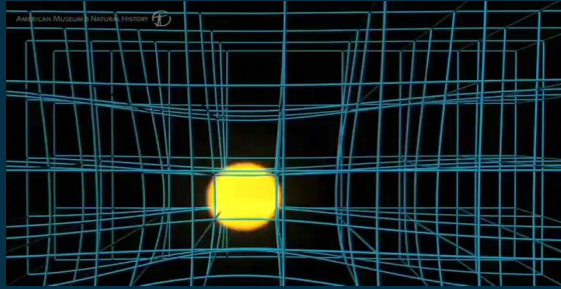
1. Introductions
2. European Space Agency
3. Business Applications Space Solutions (BASS) Programme
4. Commercial Applications of Space-Enabled Robotics
5. BASS Project/Study Examples
6. Guest Speaker – Antje Vogel, TeleRetail / Aitonomi
7. How to Apply
8. Q&A

# 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



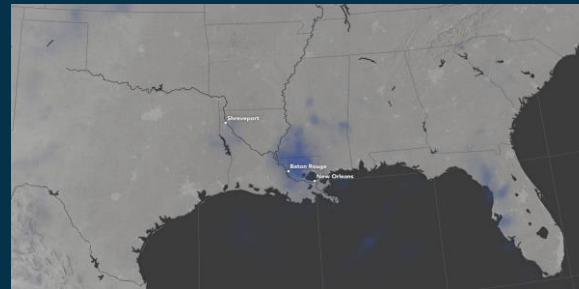
## Science and Exploration



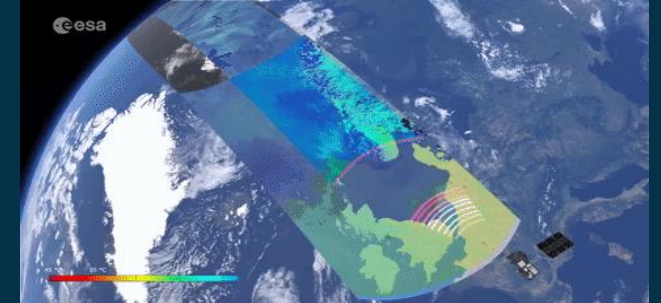
## Enabling and Support



## 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



Environment



Financial



Education



Energy



Agriculture



Healthcare



Transport



Media



Aviation



# What can you do with Space Technology?

## Satellite Navigation



Global Positioning  
Navigation  
Velocity  
Precision Timing  
Activity Tracking  
Route Optimisation

## Satellite Communication



Reliable and Secure  
Communication  
Remote Connectivity  
Backup to Terrestrial  
Infrastructure

## Earth Observation

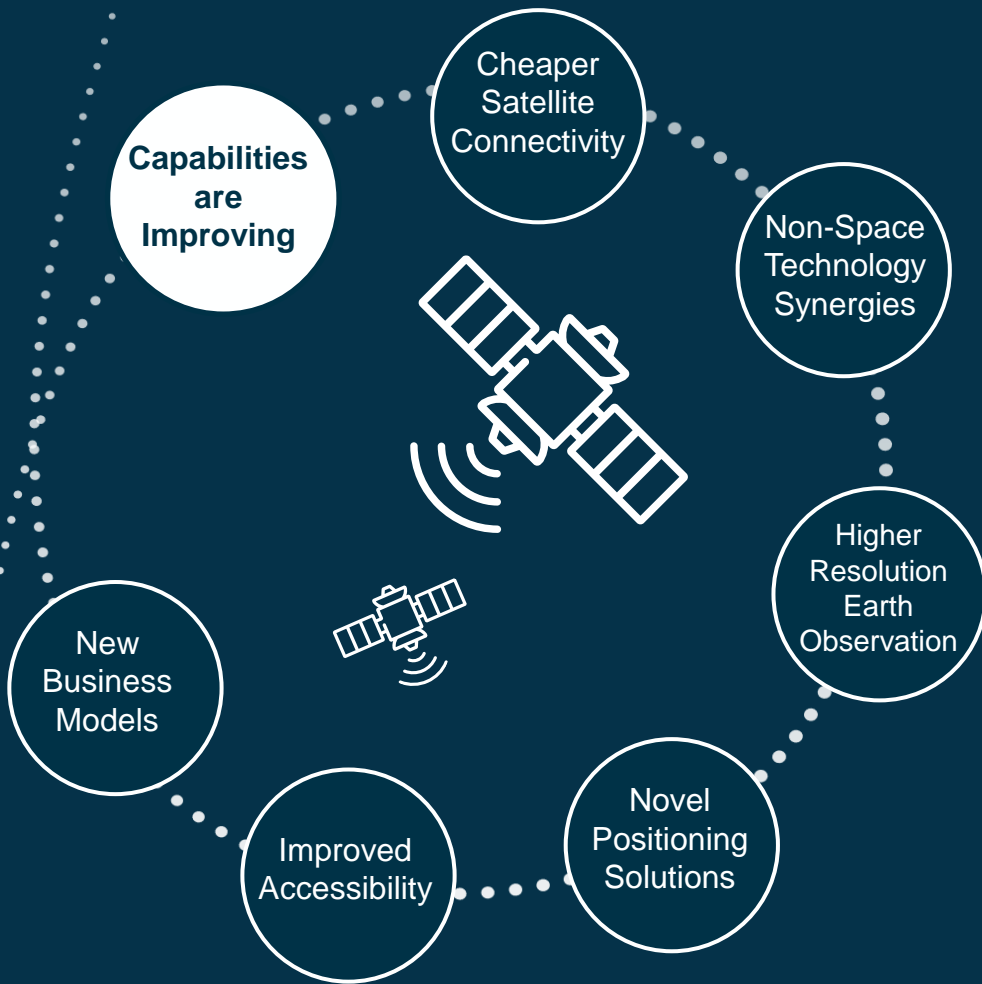


Land, Sea, Air Monitoring  
Infrastructure Monitoring  
Resource Mapping  
Environment Sensing  
Change Detection  
Weather and Pollution  
Forecasting

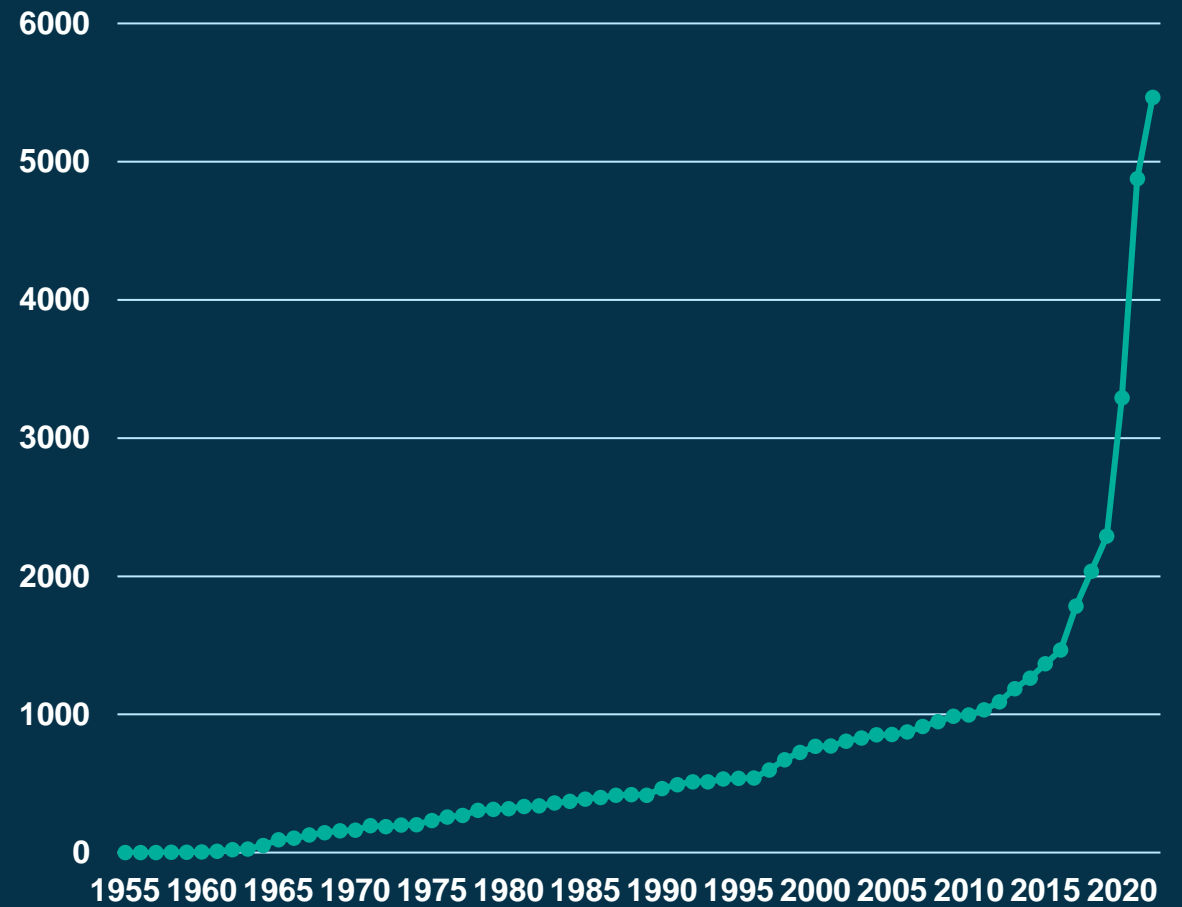
## Human Spaceflight Technologies (Spin-Outs)



Augmented Reality  
Health Sensors  
Procedures  
Big Data Processing  
Artificial Intelligence



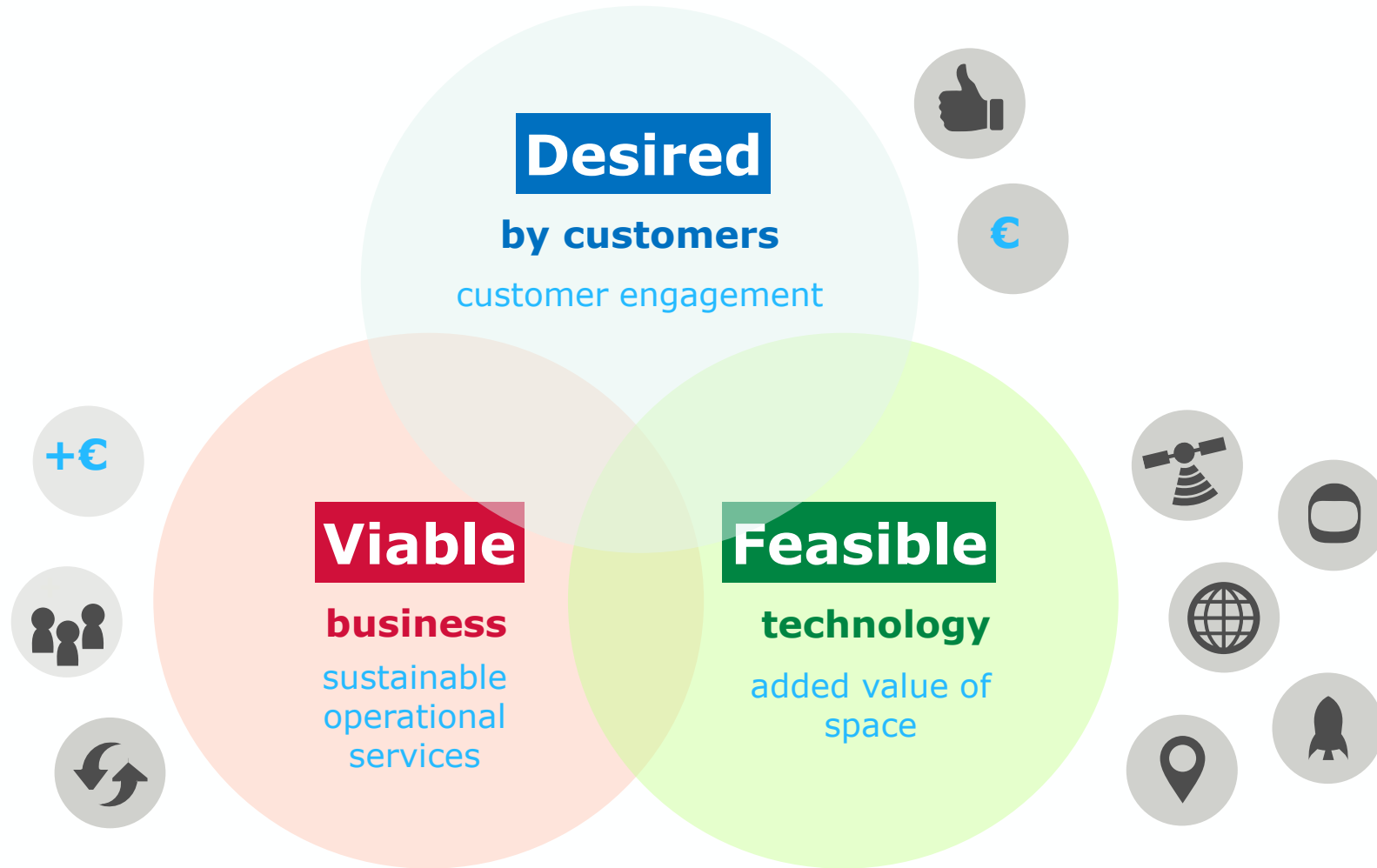
The amount of infrastructure in space is increasing → the number of space-based services and associated users are increasing...



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



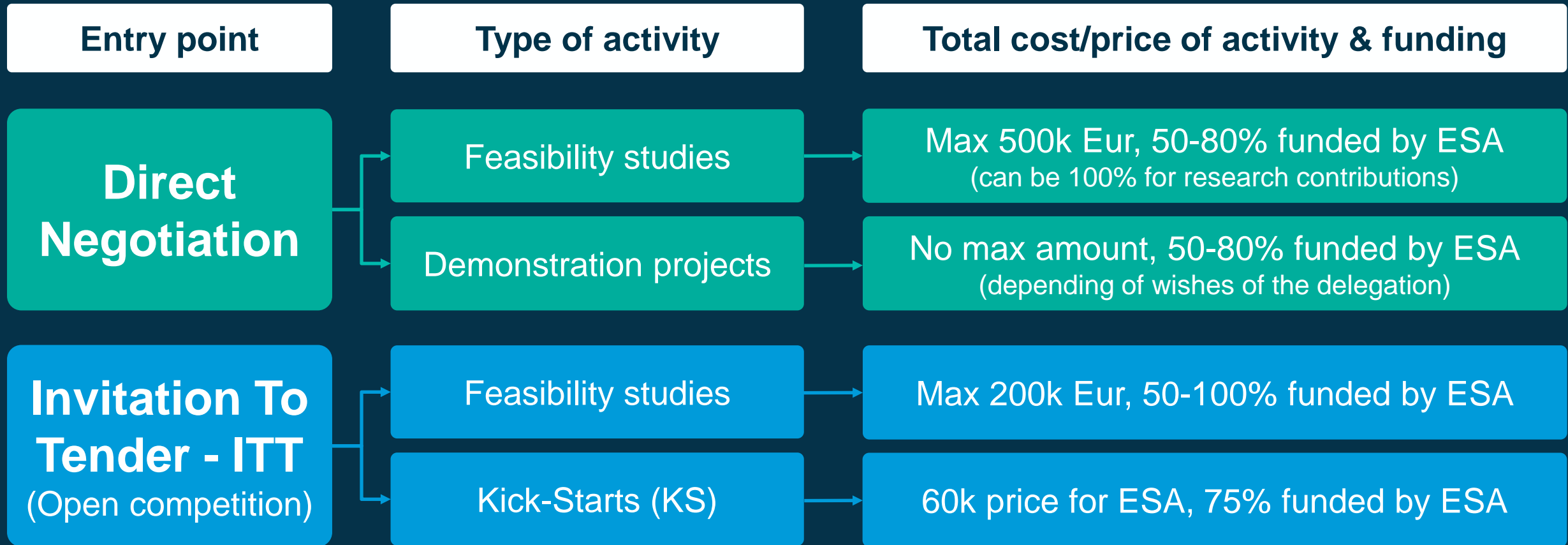
Use of ESA Brand for Credibility

**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



- Thematic Call for Proposals in Direct Negotiation
- **Robotics**: here defined 'autonomous and semi-autonomous physical robots, drones, machines and vehicles, and solutions that enable these (e.g., perception systems for autonomous vehicle services, tele-operated systems)'
- **Satellite Technology/Data** integrated at the system or service level, or both.
- **Mechanisms**: Feasibility Studies and Demonstration Projects
- **Timelines**: Opening 1<sup>st</sup> March 2024 – 1<sup>st</sup> December 2024 with sub-themes.
  1. Smart Cities and Infrastructure: 1st March 2024 – 1st May 2024
  2. Transportation and Logistics 1st April 2024 – 1st June 2024
  3. Energy and Utilities: 1st May 2024 – 1st July 2024
  4. Health and Safety: 1st June 2024 – 1st September 2024
  5. Maritime: 1st September 2024 – 1st November 2024
  6. Agriculture: 1st October 2024 – 1st December 2024





# Sub-Themes

## Robotics, Drones and Autonomous Systems for...



### Smart Cities

Construction site survey, inspection and monitoring – construction robotics and vehicles – waste collection and street cleaning – autonomous deliveries – entertainment and tourism – other...



### Transportation and Logistics

Autonomous services and precursors – delivery services – long-haul trucking – public transportation and beyond



### Energy and Utilities

Energy infrastructure/asset inspection, monitoring and maintenance – environmental monitoring, detection, mitigation, remediation and restoration – installation and operations of energy infrastructure – autonomous transportation of energy assets...



# Sub-Themes

Robotics, Drones and Autonomous Systems for...



## Health and Safety

Search and rescue - drone-deliveries of medical supplies – robotic social support – coastal surveillance and border control – event security – industrial surveillance – disaster response – hazardous/CBRN environments



## Maritime

Autonomous mapping and collection of oceanographic data – hydrographic and bathymetric surveys – inspection and maintenance of marine infrastructure – upkeep and cleaning of maritime vessels – port automation and data collection – aquaculture operations



## Agriculture

Precision farming – autonomous harvesting – agri-field monitoring and cultivation





## Satellite Communications

- ❑ Extend robot, drone and autonomous system capabilities to rural, remote and offshore regions, and/or to support with redundant communications for applications with stringent communications or resilience requirements. Novel solutions such as Low-Earth Orbit broadband satellites may be explored.



## Satellite Earth Observation

- ❑ Complementary or enabling datasets to support the activities of the robots.
- ❑ Air quality measurements, thermal heat signatures, optical, radar, meteorology, or combinations thereof.



## Satellite Positioning

- ❑ Provide positioning information to robots, vehicles, machines and drones, operating in outdoor spaces, for navigation, geo/time-stamping of collected data, time-synchronisation of networked machines, and/or determination of speed and heading.
- ❑ Combined with non-space technology to support ubiquitous positioning or marine robotics, respectively.
- ❑ Augmentation solutions can be leveraged for high accuracy positioning – Galileo HAS (High Accuracy Service), RTK (Real-Time Kinematic) systems...

# 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

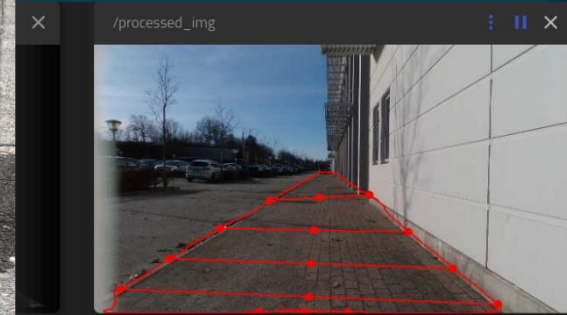


The robot **safely travelled >100km** of complex environments with narrow cycle paths, road crossings and interactions with cars, bicycles and pedestrians, and **delivered Coca-Cola products** to outlets across Alton Towers amusement park...

## 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





- 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

The screenshot shows a BBC News article from February 23, 2020, titled "Covid in Scotland: Drones to carry Covid samples". The article is categorized under "Coronavirus pandemic". It features three images: a close-up of the drone's nose with "esa space solutions" and "skyports" branding; a drone flying over a hilly landscape; and a person in a pink uniform and face mask loading supplies into the drone on a checkered mat. The Skyports logo is visible in the bottom right corner of the article image.

### Harvesting tractor for strawberries



Study of autonomous tractor with robotic arms intended to identify ripeness of strawberries, carefully pick and place them into baskets



Differential GNSS for robot navigation and geofencing of the perimeter for safe operations



# 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.



## Antje Vogel

Senior Project Manager, TeleRetail GmbH

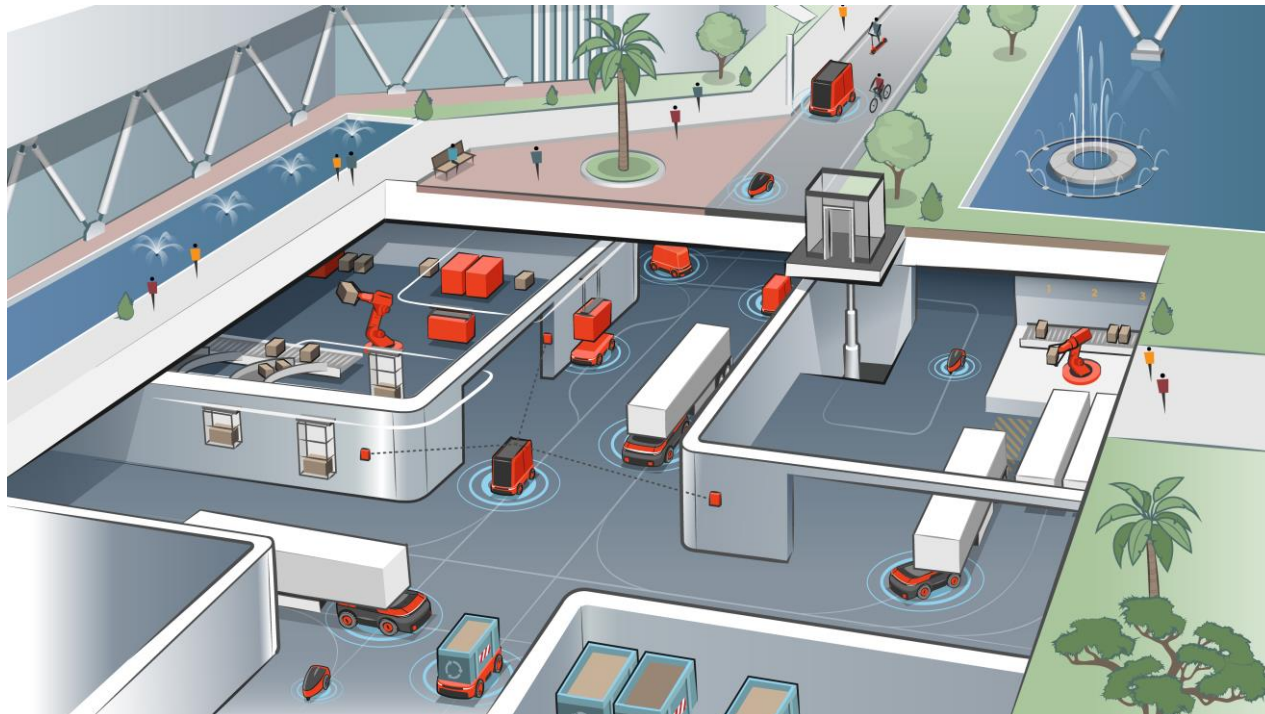
Autonomous Transport Solutions

*Antje has extensive experience in space-based applications both at ESA and in industry and currently works on innovative solutions in autonomous transportation at TeleRetail GmbH.*

*TeleRetail GmbH completed a demonstration project with ESA Business Applications developing and demonstrating an autonomous delivery robot service that utilises satellite positioning and earth observation.*

TeleRetail GmbH, a German SME with headquarter in Dusseldorf, belongs to world leading developers of autonomous driving transport robots for outdoor environments (according to CB Insights study (2020)). TeleRetail GmbH (DE) is part of Aitonomi AG Holding (CH).

The in-house developed, modular Aitonomi AutoPilot software navigates vehicles with a payload up to 50 tons.



## Solving Core Transport Problems:



*Safety Certified*



*7/24/365 availability*



*0 Emissions*



*Smart Navigation with AI*



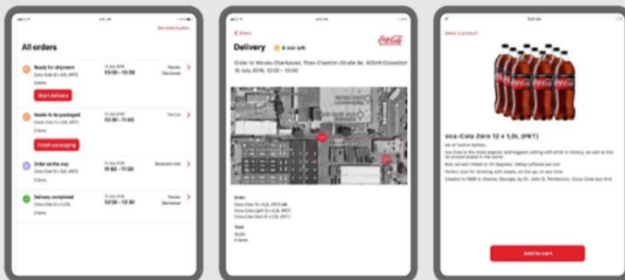
*Cost Efficient*



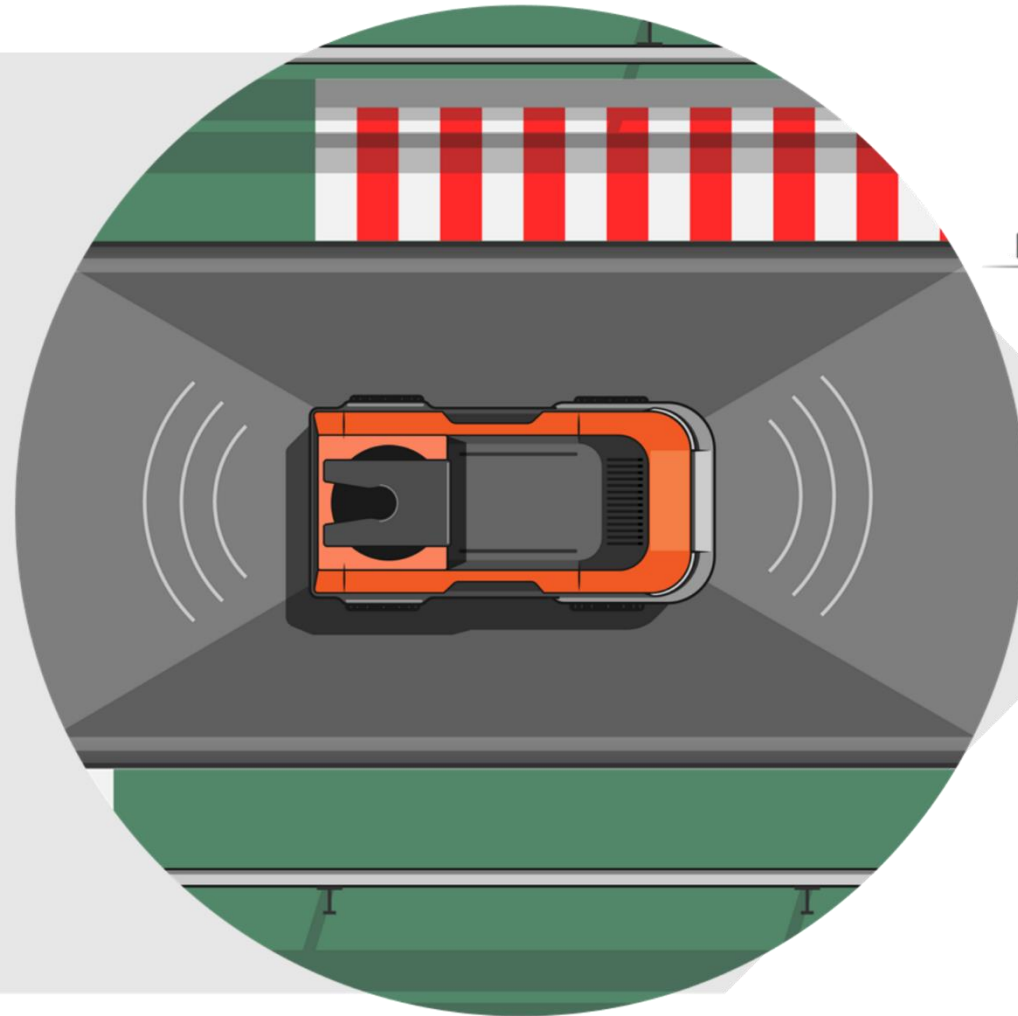
Cloud platform

**Fleet Management Module**  
**Access Module**  
**Delivery Module**

APIs



**Customizable User Apps**  
**Third Party Apps**



L



M



XS



OEM Manufacturers



- Automated On-Demand Courier Service

Service for automation of logistics tasks in industrial and urban environments using a fully autonomous driving transport system

### Automation applications:

- Industrial Logistics (delivery service on industrial sites with seamless transition outdoor/indoor)
- Last Mile Logistics (autonomous transport of elevator servicing parts)

### Main technical challenges:

- Precise localization and navigation in complex environments
- communication with infrastructure
- Mixed traffic conditions & traffic rules



### Project consortium:



TeleRetail GmbH



TK Elevator

Elevator Integration



Fraunhofer Institute for Manufacturing Engineering and Automation IPA

## Satellites

Optical and radar satellite images for autonomous navigation, GNSS for precise localisation

## Cloud infrastructure

Fleet management, Maps for navigation, Access to infrastructure, GNSS correction

## On-board data processing

GNSS  
Lidar  
Computer Vision  
Radar  
Odometry  
Inertia  
Ultrasound



Satellites



Rover and base station



User Interfaces

# Award-winning AutoPilot automates logistics



Largest self-driving electric cargo transporter



# How to Apply (1) – Documentation



## Register

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

## Download

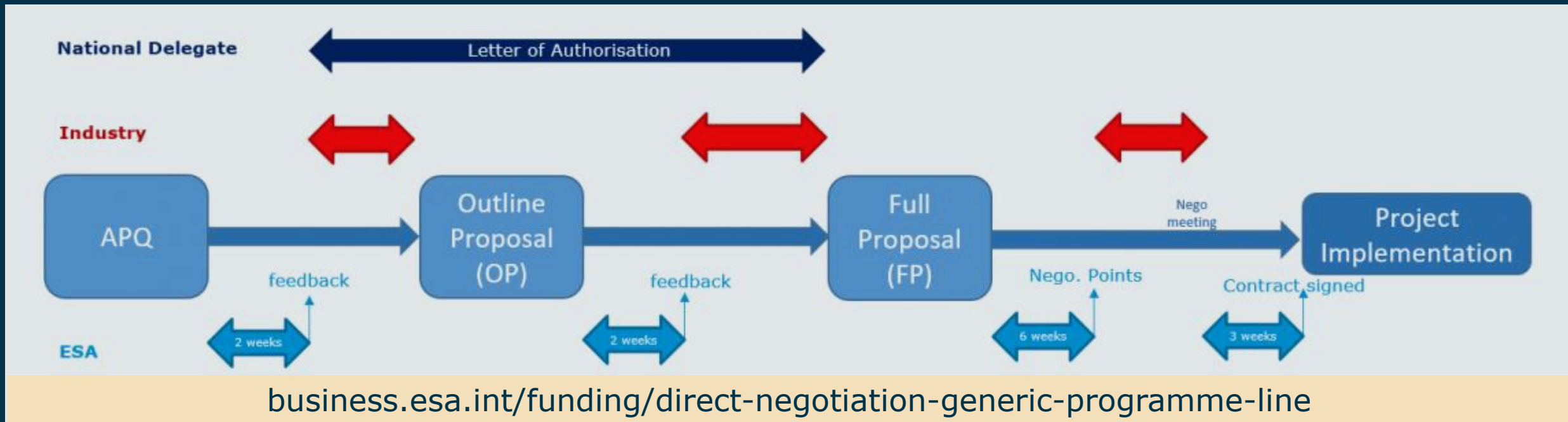
Download the tender information documentation (Invitation to Tender) via the webpage [Commercial Applications of Space-Enabled Robotics \(esa.int\)](#) at the opening date.

## Submit

Download the Activity Pitch Questionnaire 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.



# How to Apply (2) - Procurement Process in Direct Negotiation



- ✓ Incremental procurement approach: APQ is the starting point – max. 8-page document with a standard template to present WHAT, WHY, HOW
- ✓ 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: <input type="text"/>	Website: <input type="text"/>	Industry: <input type="text"/>	Country: <input type="text"/>
Name: <input type="text"/>	Website: <input type="text"/>	Industry: <input type="text"/>	Country: <input type="text"/>

Roles in Activity:



# Authorisation from National Delegation

- 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 program.
- 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, **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 only has budget allocated for Safety and Security activities under this initiative.

# SPACE INNOVATION: OPPORTUNITIES FOR THE INDUSTRY OF TOMORROW

Date: 6 March 2024

Time: 10:00 – 17:00 (GMT)

Location: ECSAT Conference Centre,  
Fermi Avenue, Harwell,  
Didcot OX11 0FD

PLUGANDPLAY



SPACE SOLUTIONS



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)

