# CEOI-2020
# EO Technology Strategy

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# EO Technology Strategy - Rationale

**Objective**

– Guide investment of the UKSA EO technology funding

– Identify global EO opportunities and prepare UK technology teams for ESA, Eumetsat, Copernicus and export EO business

– Develop common understanding between CEOI, UKSA and ESA of UK technology capabilities and priorities

– Identify potential benefits from application of EO technologies into other applications (space and terrestrial) to maximise growth

# Current CEOI Strategy

## Technology

- Support development of lower TRL innovative technologies and future EO mission concepts

- Raise technology TRL to an appropriate point for future mission opportunities; TRL, SRL, price point...

- Support bench, airborne and In-Orbit Demonstrators as enablers and precursors to flight opportunities

- Invest in EO technologies for new and growing markets

## Capability

- Nurture and grow the EO instrumentation community to strengthen established areas of UK capability

- Encourage integration and development of non-space expertise into EO

- Continue to encourage academic/industrial partnership to pull through innovation

# Enacting the Current CEOI Strategy

**What does the CEOI do currently to implement this strategy?**

- Setting themes within its Technology Calls
  - E.g. EO10 Call themes on Raising TRL through airborne demonstration

- Directed support funding
  - E.g. EO9 Call to support the development of UK led bids into ESA EE9

- Informing UKSA and OGD's
  - But CEOI is not writing government strategy

- Informing ESA
  - Brief ESA on behalf of UKSA and supported by inputs from the UK EO community

# CEOI Strategy – Enablers and Barriers

## Enablers

- National/Bilateral missions
- Airborne and IOD demonstration
- Academic/industrial partnerships

## Perceived Barriers

- Insufficient national funding compared with main competitors
- State aid intervention rates
- Lack of a national programme to provide early flight demonstrations
- Lack of flight heritage discourages ESA take-up of UK technologies
- Infrequent opportunities through ESA
- International partners not aware of UK strategy
- Maintaining a skilled work force

# EO Technology Strategy – Development Activities

**On-going strategy development activities**

- Identify potential space-flight opportunities and the technologies required; drawing on:
  - CEOI Indicative missions list
  - National/bilateral missions
  - ESA catalogue of missions
  - Copernicus evolution
  - Export opportunities
- Undertake a capability assessment to determine where the UK has strengths in EO technology
  - Audit of UK technology landscape
  - Areas and depth of strength
  - Peer standing & assessment of competitive landscape
- Community consultation
  - Inputs to the strategy evolution – engagement activities at the Emerging Technologies workshop
  - Validation of draft strategy
- Strategy presented to, and endorsed by, UK Space Agency

# EO Missions - Typical Characteristics

**Science missions (Institutional)**
- Objective is to enable scientifically significant new or improved measurements
- Typically one-off mission, limited lifetime in orbit
- May have high scientific risk and require innovative technologies
- Higher cost and long development programme
- Driven by science data needs

**Operational missions (Institutional)**
- Objective typically to provide long term continuity of consistent, accurate data
- Typically requires a series of identical spacecraft
- Slow technology evolution, proven instruments and science method
- Higher cost and long development programme
- Driven by public service data need, open data access

**Commercial missions**
- Highly competitive, possibly more speculative missions
- Fast implementation and short technology development timescales
- Design driven by cost and time to market, financial return on investment in limited timescale
- Driven by commercial sale of data

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*Support candidate mission concept development*
*Prove via Bench/Airborne/In-Orbit Demos as*
*gateways to ESA Phase A's*

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– Slow technology evolution, proven ... science method

– Higher cost and long development p. gramme

– <u>Driven by public service data need, open data access</u>

*Development of fit for purpose technologies*
*Driven by quality and long term reliability*

**Commercial missions**

– Highly competitive, possibly more speculati

– Fast implementation and short te

– Design driven by cost and time to ... .nvestment in limited timescale

– <u>Driven by commercial sale of data</u>

*Support technologies that are low cost and can*
*be matured quickly*
*Accelerated technology development to capture*
*a commercial opportunity*

# UK EO Capability Assessment

- **Initial short strategy assessment**:
  - Drawn from CEOI Leadership Team knowledge
- **Accepted limitations:**
  - Core information is based on CEOI funded projects
  - Supplemented by sensing projects managed by CEOI in NSTP2

# UK EO Capability Assessment – by theme

| Technology Theme | Technology Lines of development | Organisations involved | Breakdown by type | | | |
|---|---|---|---|---|---|---|
| | | | Large Enterprise (Industry) | SME | Academic | Government/ Institutional |
| Passive Microwave | 27 | 16 | 2 | 6 | 6 | 2 |
| UV/Visible | 22 | 13 | 3 | 1 | 6 | 3 |
| Radar | 19 | 9 | 3 | 1 | 3 | 2 |
| IR | 12 | 10 | 4 | 2 | 2 | 2 |
| LIDAR | 4 | 2 | 0 | 1 | 1 | 0 |
| Support technologies | 7 | 6 | 3 | 1 | 1 | 1 |

# UK EO Capability – Geo-distribution
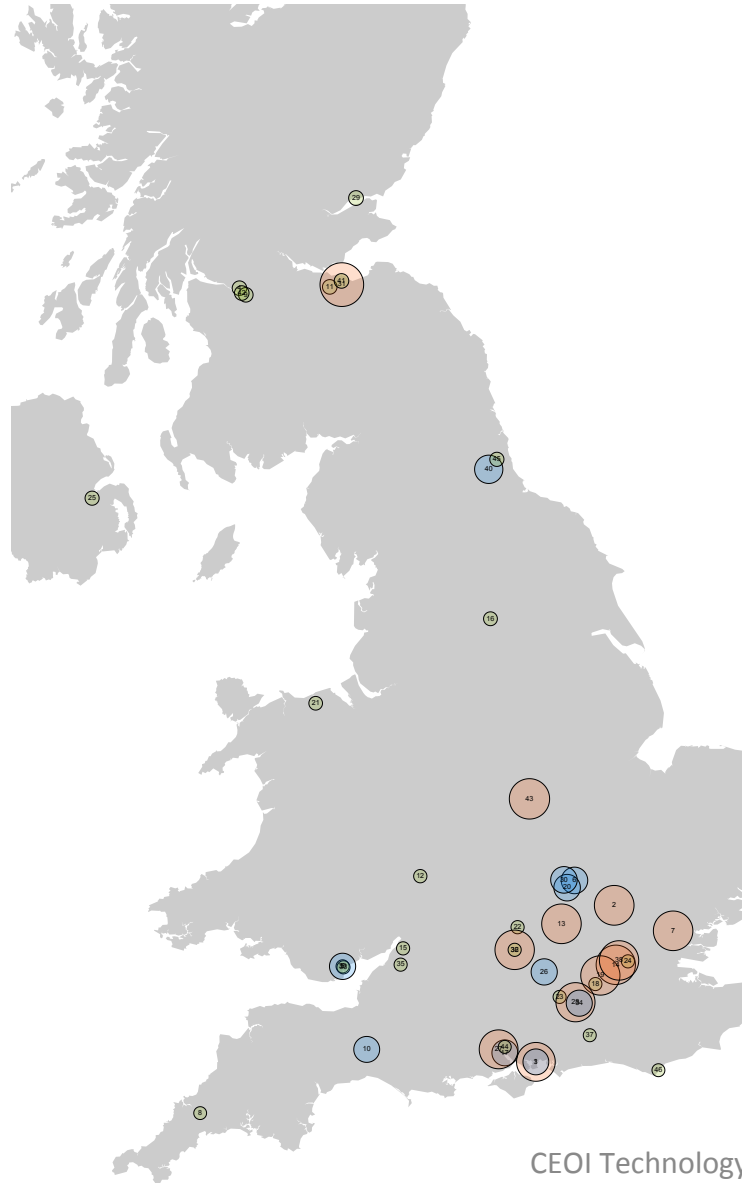


1 Airbus DS
2 Airbus DS
3 Airbus DS Ltd
4 Amethyst research LTD
5 Cardiff University
6 Cranfield University
7 e2v Ltd
8 Flann
9 Fraunhofer UK
10 Gooch and Housego Ltd
11 Herriot-Watt
12 HollowGuide
13 Honeywell
14 Imperial College London
15 JCR Systems
16 Leeds University
17 National Oceanographic Centre
18 NavTech
19 NPL
20 Open University
21 OpTIC
22 Oxford
23 Qinetiq
24 QMC London
25 Queens University Belfast
26 Reading University
27 Selex / Leonardo
28 SSTL
29 StarDundee Ltd
30 STARLAB
31 STFC ATC
32 STFC RAL Space
33 Stratium
34 Surrey Space Centre
35 TAS UK Ltd
36 TeraTech
37 Thomas Keating
38 University College London
39 University of Cardiff
40 University of Durham
41 University of Edinburgh
42 University of Glasgow
43 University of Leicester
44 University of Southampton
45 Viper
46 Zinir Ltd

# UK EO Technology Capability

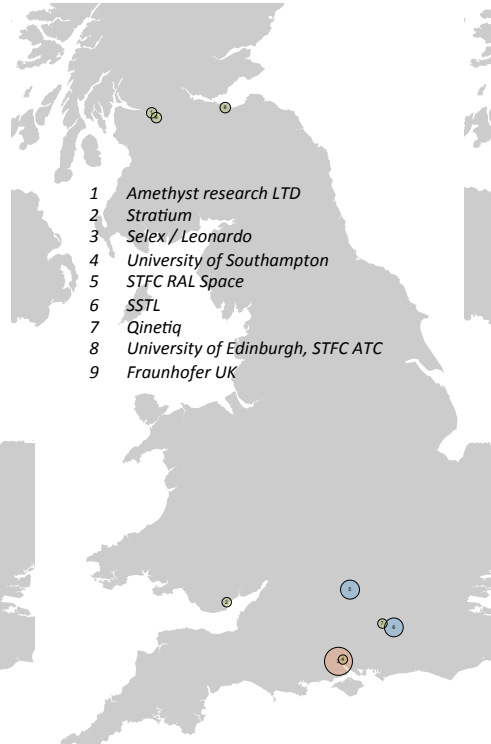## Microwave
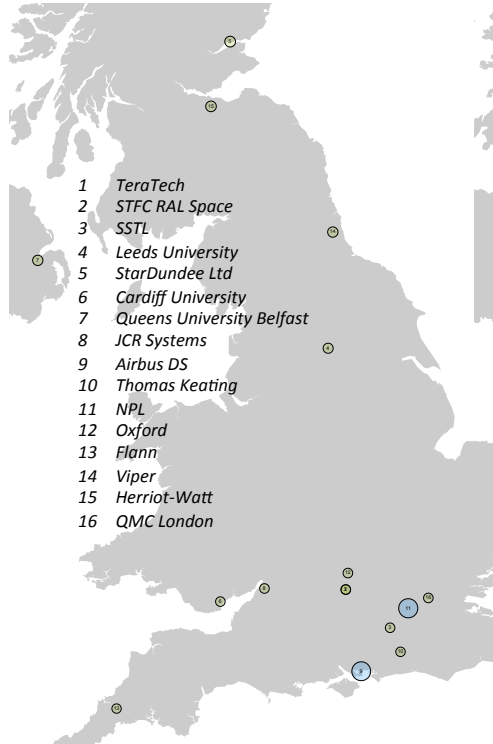
1. TeraTech
2. STFC RAL Space
3. SSTL
4. Leeds University
5. StarDundee Ltd
6. Cardiff University
7. Queens University Belfast
8. JCR Systems
9. Airbus DS
10. Thomas Keating
11. NPL
12. Oxford
13. Flann
14. Viper
15. Herriot-Watt
16. QMC London

## Infra Red

1. Amethyst research LTD
2. Stratium
3. Selex / Leonardo
4. University of Southampton
5. STFC RAL Space
6. SSTL
7. Qinetiq
8. University of Edinburgh, STFC ATC
9. Fraunhofer UK

## UV & optical
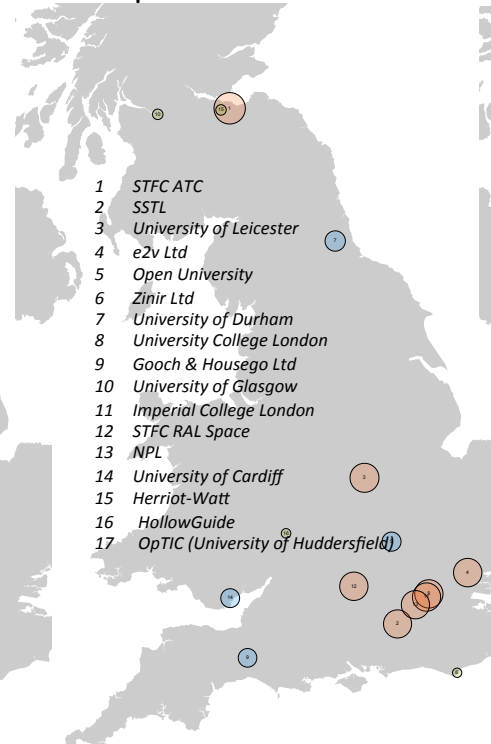
1. STFC ATC
2. SSTL
3. University of Leicester
4. e2v Ltd
5. Open University
6. Zinir Ltd
7. University of Durham
8. University College London
9. Gooch & Housego Ltd
10. University of Glasgow
11. Imperial College London
12. STFC RAL Space
13. NPL
14. University of Cardiff
15. Herriot-Watt
16. HollowGuide
17. OpTIC (University of Huddersfield)

## Support

1. Star Dundee Ltd
2. Airbus DS Ltd
3. STFC RAL Space
4. Surrey Space Centre
5. TAS UK Ltd
6. SSTL
7. NPL

## Radar
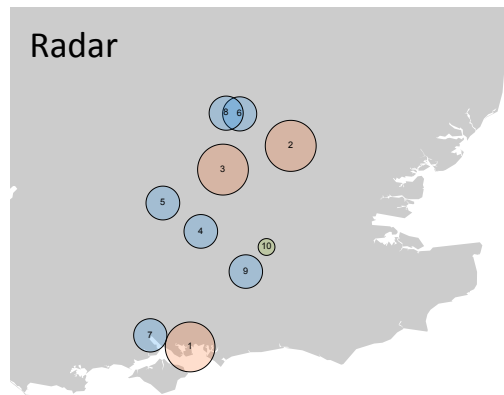
1. Airbus DS (Portsmouth)
2. Airbus DS (Stevenage)
3. Honeywell
4. Reading University
5. STFC RAL Space
6. Cranfield University
7. National Oceanographic Centre
8. STARLAB
9. Surrey Space Centre
10. NavTech

# Assessment of UK Strength vs Market

| Technology Theme | UK Strength | Market Trend | Strategic Response | Rationale |
|---|---|---|---|---|
| SAR | ✓✓✓ | ✓✓✓ | Strong support | Excellent and established UK capability; Significant commercial/operational markets |
| Passive microwave | ✓✓✓ | ✓✓ | Support | Excellent and broad UK capability; Ongoing operational/science markets |
| Optical imaging | ✓✓✓ | ✓✓✓ | Strong support | Excellent and established UK capability; Significant commercial/operational markets |
| Optical spectroscopy | ✓✓✓ | ✓✓✓ | Strong support | Excellent and established UK capability; Significant commercial/operational markets |
| IR imaging | ✓✓ | ✓✓✓ | Strong support | Growing UK capability; Growing commercial/operational markets |
| IR radiometry | ✓✓✓ | ✓✓✓ | Strong support | Excellent and broad UK capability; Ongoing operational/science markets |
| IR spectroscopy | ✓✓ | ✓✓✓ | Support | Growing UK capability Ongoing operational/science markets |
| LIDAR | ✓ | ✓✓ | Reactive | Limited UK capability; Viability of space-based LIDAR sensing to be established |
| Radar Altimeter | ✓ | ✓ | Reactive | Limited UK capability; Strong competition within Europe |
| UV spectroscopy | ✓✓ | ✓ | Reactive | Good UK capability Limited user pull |

# Community Consultation - Town Hall Summary (1)
## "4. What gaps in skills, technology are crucial?"

- What needs to be done?
  - Improve training in STEM subjects to drive technology
  - Develop more effective methods to redeploy existing specialist skills
  - Improve software engineering skills of graduates
  - Improve salaries in government roles
  - More speedy development of spacecraft and missions
  - More effective programme/project management
  - Better business planning skills
- Why?
  - Insufficient skilled workforce coming through
  - Difficulty in recruiting technically skilled post-docs
  - To improve transfer of research between industry and academic

# Community Consultation - Town Hall Summary (1)
## "4. What gaps in skills, technology are crucial?"

- How?
  - Education
    - Join up all STEM campaigns across government
    - Build technology and engineering into education
    - Add space-related elements to curriculum to increase awareness
  - Training
    - More funding for EO technology studentships
    - Structured internship programmes
    - More cross-disciplinary training
    - Build industrial placements into academic training programmes
    - More modern apprenticeship schemes
    - Mentoring schemes, training workshops
    - Develop a mechanism to enable current generation to upskill the next
  - Other Industry and Government Action
    - Carry out skills audit to identify gaps and future needs
    - Support the transfer of researchers & PhD students into industry
    - Develop hubs of expertise
    - Improve status for technology and engineering professions; better pay
    - Embed business expertise into space projects at an earlier stage
    - Database of EO/space professionals to act as visiting professors

# Community Consultation - Town Hall Summary (1) "4. What gaps in skills, technology are crucial?"

- Who needs to act?
  - All stakeholders
    - Govt on skills training
    - Research Councils
    - UKSA/NERC/STFC/CEOI on studentships
    - UKSA/CEOI training schemes
    - Businesses on engaging with schools

# CEOI Strategy Development – Next steps

- Initial strategy **√**
  - Based on CEOI Leadership Team audit of UK EO Community Capability

- Strategy evolution (Apr-Oct 17)
  - Community consultation at the CEOI Emerging Technology Challenge Workshop May 17
  - Inclusion of wider UK EO technology community from Sensing Roadmap
  - High level assessment of competitive position
    - For technologies and systems
    - CEOI initial assessment – community to review
  - Draft circulated to EO Community
  - New community endorsed CEOI EO Strategy Sept 17

- Technology road mapping
  - KTN leading on update of EO technology roadmaps for CEOI
  - Harmonised with NSTP roadmaps
  - Migrate EO roadmaps to SharpCloud

# Discussion

1. **What is the role of technology demonstrators?**

   – Do HAPS or airborne offer better opportunities than Cubesats?

2. **Should EO technology funding be segmented/pre-allocated?**

   – By TRL, by markets or strategically; or is open competition best?

   – Can we join forces better with other funding sources?

3. **Should we continue to invest in technology for EO science missions?**

   – Are Earth Explorers too uncertain?

   – Can we better exploit technologies developed for EO science for other opportunities?

4. **What are the highest potential commercial/export opportunities?**

   – Are there specific technologies ripe for development?

5. **How can we fill the growing skills gaps for upstream technologies?**

   – How can we map comprehensively UK capability and competition?

   – How should we respond?