

What can we gain from Space Research?

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Surrey Space Centre, University of Surrey

Science in Parliament, Invited Talk

19 June 2017 @ Portcullis House

Surrey Space Centre

35 Years Experience: Formed in 1979 at the University of Surrey to pioneer satellite research & applications with emphasis on low cost tech.

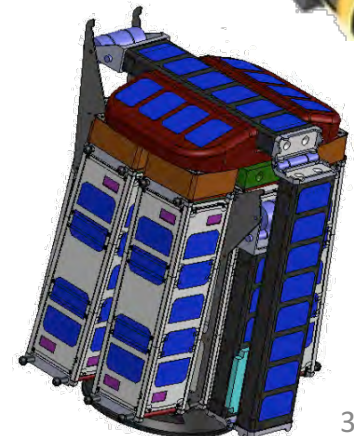
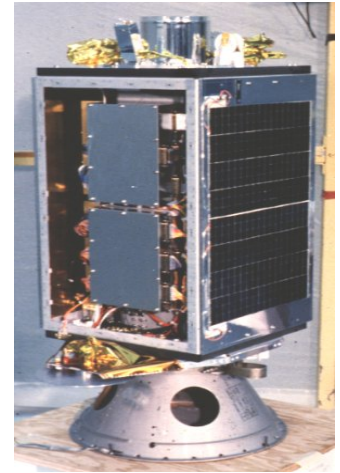
Largest U.K. Centre for Space Engineering:

90 people of Academics, Researchers, Support Staff, Part of Electronic Engineering Dept:

- 3rd Guardian (1st in 2015), 2nd The Times
- 17th Research Excellence Framework

Key Partnerships:

- Surrey Satellite Technology Ltd, Airbus Defence & Space, National Physical Laboratory



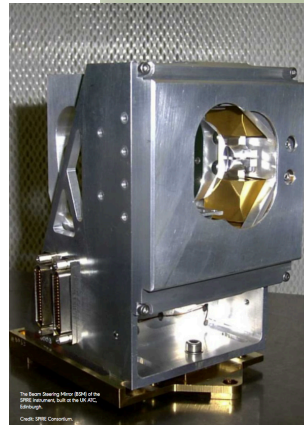
International Space Station (ISS)

Long heritage in spinning out R&D to industry:

- Growing high-quality protein crystals > pharma / electronics
- Medical:
 - Tracking eyes > laser surgery
 - Robotic arm tech > making inoperable tumors operable
- Monitoring disasters from space
- **Commercialising low-Earth orbit > deploying satellites**

Herschel

- Total Cost \$ 1 B
- SPIRE Instrument Lead
- UK Input: £ 16.5M
- Took 1998-2016, 10Y Lag
- ROI: £ 1.8:1 BUT
- 1700 papers > Strong future position for new work
- 20,000 Students
- Number 7 in Times 'Invention of Year'



The Herschel satellite being prepared for an acoustic test at ESA's space technology centre, ESTEC.

Credit: ESA.



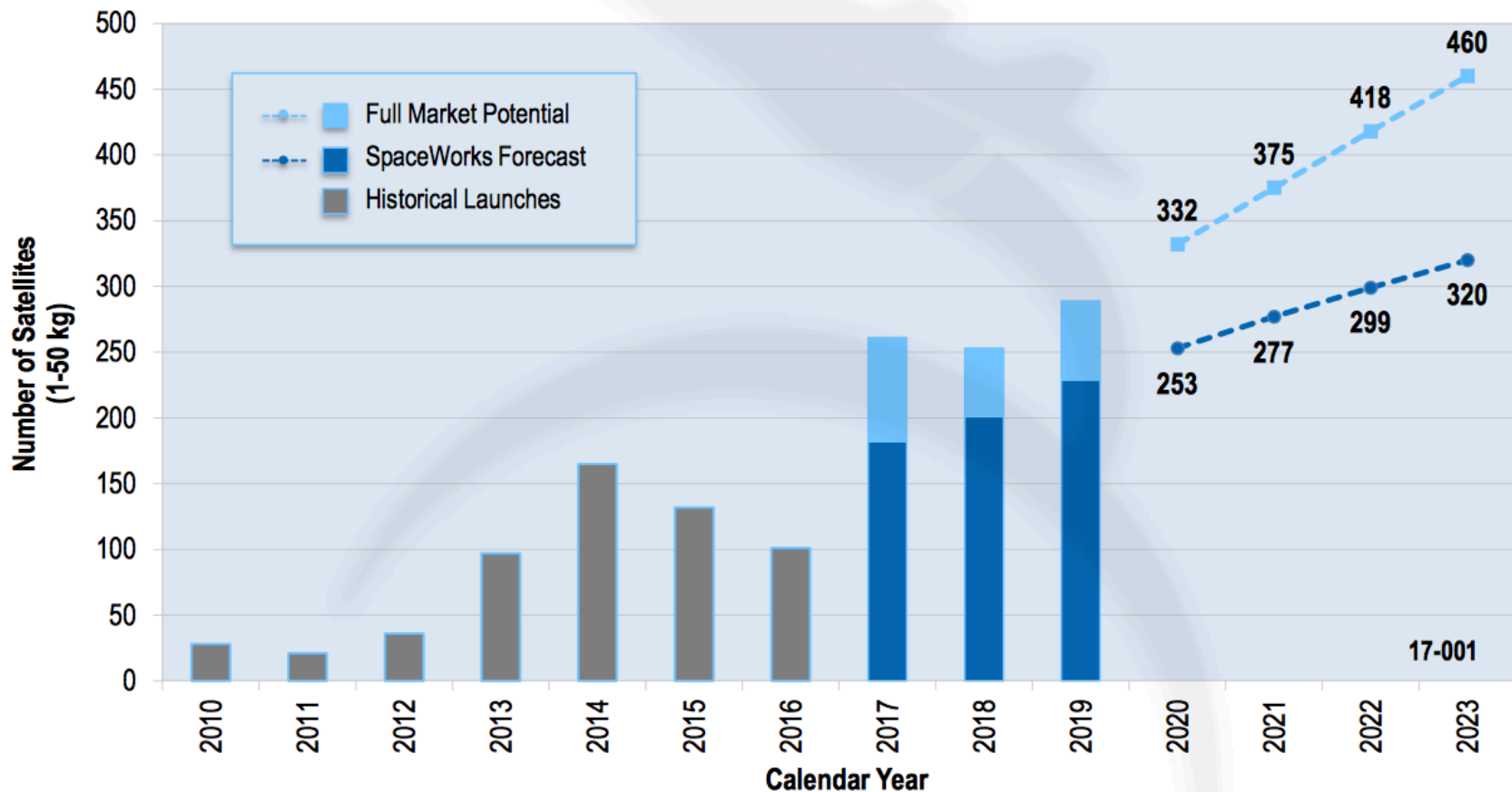
PSLV-C37 CARTOSAT 2 S MISSION

ONBOARD CAMERA

NANO SATELLITES P+ SIDE SEPARATION

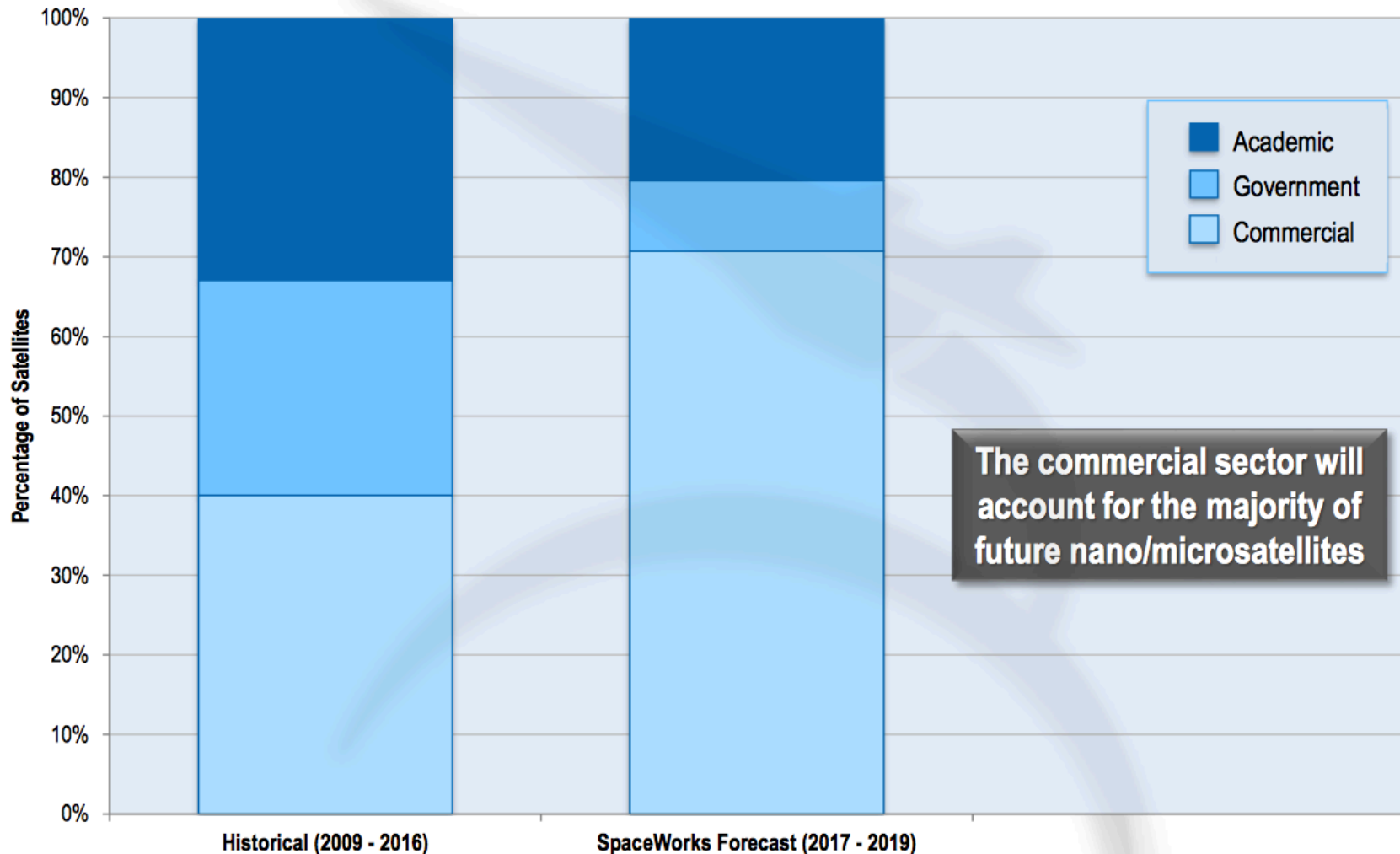
2017 Nano/Microsatellite Launch History and Forecast (1 - 50 kg)

Projections based on announced and future plans of developers and programs indicate nearly 2,400 nano/microsatellites will require a launch from 2017 through 2023



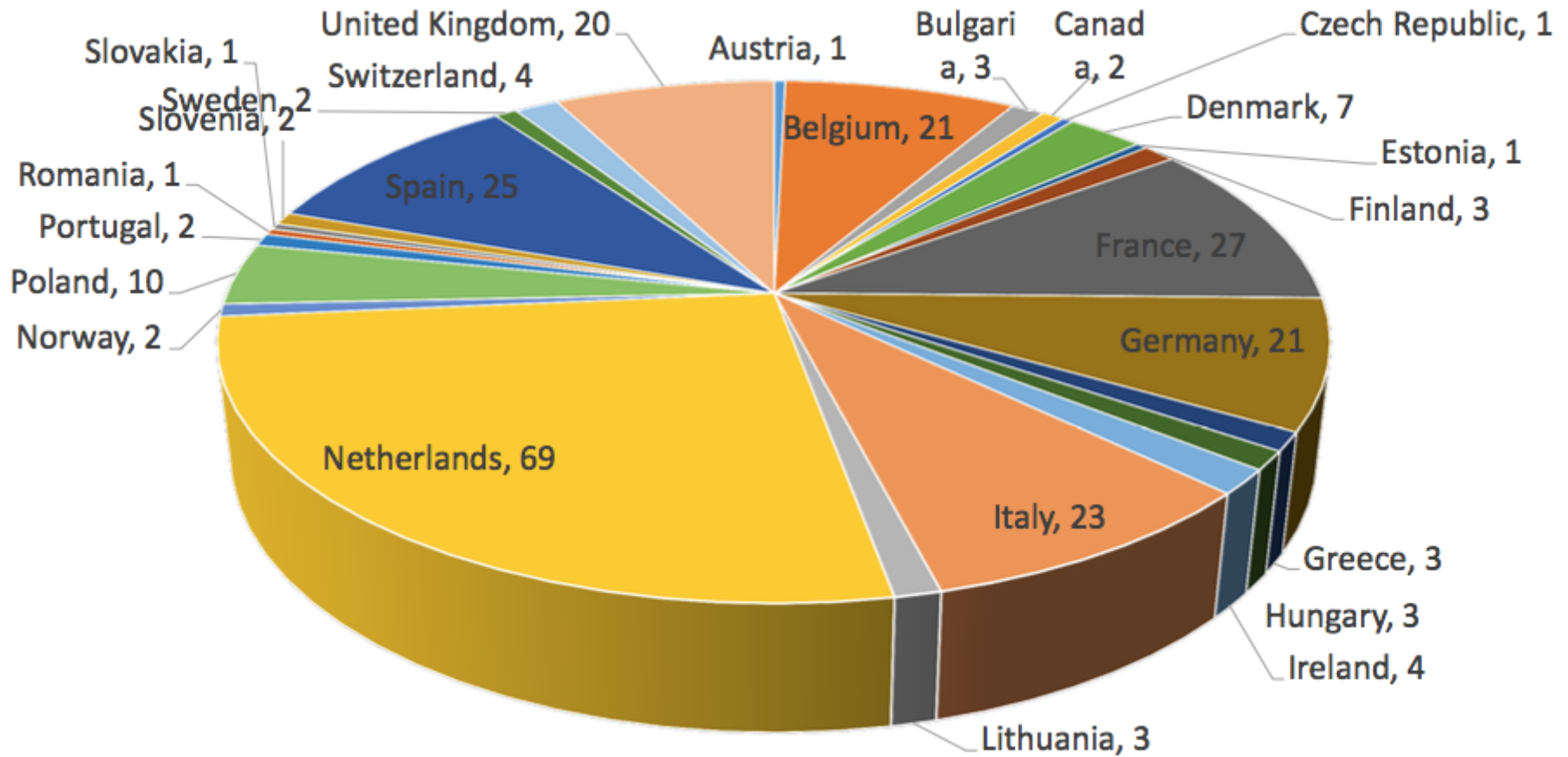
Nano/Microsatellite Trends by Sector (1 – 50 kg)

Ref: 2017 SpaceWorks
Enterprises



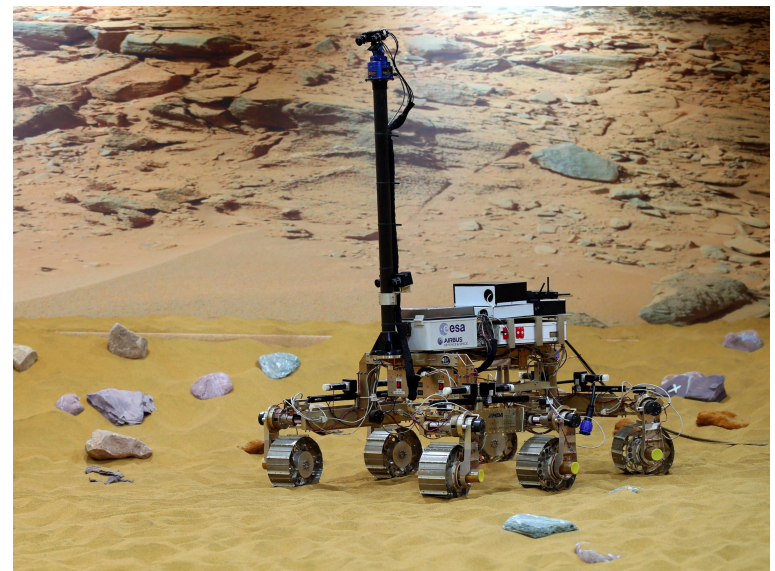
Even with large commercial sector growth, 2017 is expected to be a record year for academic satellites as the industry works its way through the current launch backlog

Under-represented at ESA

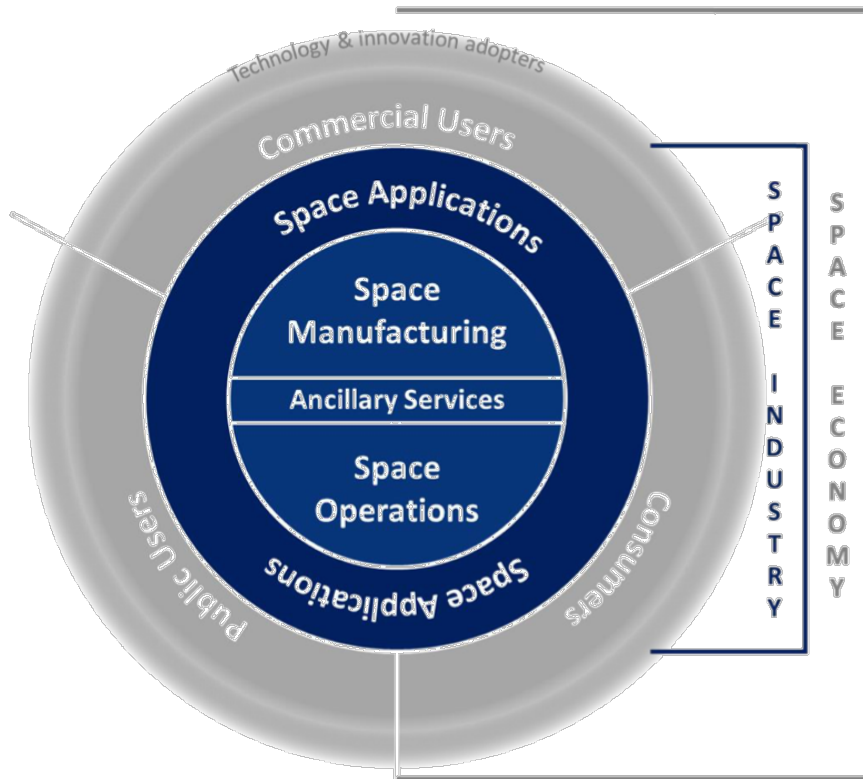


Breakdown

- Employs 38,500 high-skilled
- 2.7 x Average Productivity
- £ 756 M Cost / £ 13.7 B Return
 - ESA £ 351 M (Science!)
 - European Commission £ 65 M
- Target of £ 40 B by 2030
- Estimated UK ROI of £ 4:1
- 'Surrey' ROI £ 10:1



2017, Industrial Strategy



- UK has 1.7% GDP in R&D
- Increased £ 2 B for R&D by 2021
- **Welcomed 'DARPA' System**
 - **Allowed to fail!**

Industrial Strategy Challenge Fund:

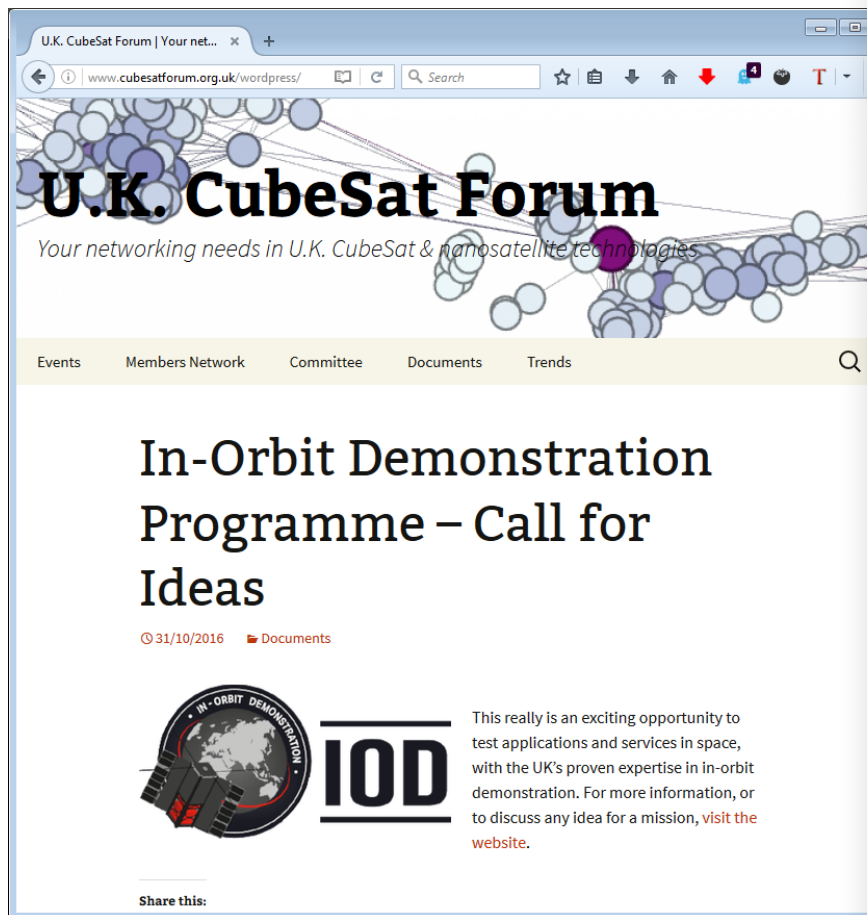
- Satellites & Space Technologies

"Industry driven" / "Highly R&D Oriented"

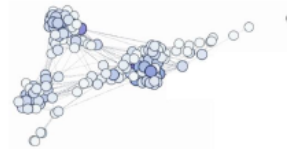
'Lifelong Training'

2013/2014, Views from Industry & Academia





2013, UKCF Online Network
2014, White Paper on
Regulations & Consultation



An output of the 2014 UK CubeSat Workshop:

White Paper on U.K. CubeSat Regulation & UKSA CubeSat Consultation

U.K. CubeSat Forum & Workshop Background:

The U.K. CubeSat Forum¹ held a one-day workshop meeting at the Harwell Science and Innovation Campus, Harwell, U.K. in May 2014. One objective of the workshop was for the U.K. CubeSat community – represented by the workshop delegates – to discuss the current and future context for gaining approval, i.e. U.K. government issued licence, to launch and operate a U.K.-registered CubeSat or nanosatellite². This discussion arose given the pre-workshop widespread U.K. community view that to do this within a U.K. context involved significantly more effort, resources and costs than in other countries and perceived to be disproportionate to the overall CubeSat philosophy of low-cost, low-resource and rapid implementation of missions. The workshop attendees (~120 delegates) were split into three parallel discussion groups to discuss this point. All the parallel discussion groups resulted in similar outputs that can be summarised as:

- For most workshop participants, there was a lack of consistent understanding concerning the current processes for, and the underlying reasons for, gaining U.K. government approval to launch and operate a U.K. CubeSat spacecraft.
- Furthermore, this included limited knowledge among the participants concerning the on-going government-led reviews to consider whether CubeSat-like missions could be defined as a special case and therefore subject to a less resource intense licensing regime when compared to larger spacecraft.
- Similarly, there was a lack of widespread understanding of the situation and processes involving in other countries to gain approval to launch and operate a CubeSat spacecraft although there was a widespread view that to obtain approval in other countries required significantly less resources for CubeSat missions than the U.K.
- Within the context of the preceding points, there was broad and wide ranging discussion that considered what a definition of a CubeSat mission, or subset of such missions, could be that would be viewed as "low" risk and therefore able to have a reduced resource route to obtaining a U.K. licence. Factors such as orbit parameters, ability to actively adjust orbit, time to de-orbit and presence of "non-standard" features and sub-systems were discussed.
- Similar parallel discussions (unrelated to the above) during the same event resulted in the publication of a "White Paper on Future Aspirations of the UK CubeSat Community"³

Objectives of this Paper on U.K. CubeSat Spacecraft

Given the preceding context, it was agreed by the U.K. CubeSat Forum Committee that this paper be produced on behalf of the U.K. CubeSat Forum that had the following objectives:

¹ <http://www.cubesatforum.org.uk>

² Throughout this document we use the term CubeSat to refer to those missions / spacecraft that adhere to the CubeSat specification and also to other similar nano-satellite or small-satellite mission which we define as having a mass for a single spacecraft of less than 10kg but typically > 1kg. This is also the case in much of the relevant official UK government documentation referred to in this paper where the term CubeSat is used more broadly than the narrow context of the formal CubeSat specification.

³ <http://www.cubesatforum.org.uk/wordpress/wp-content/uploads/2014/09/White-Paper-Aspirations.pdf>

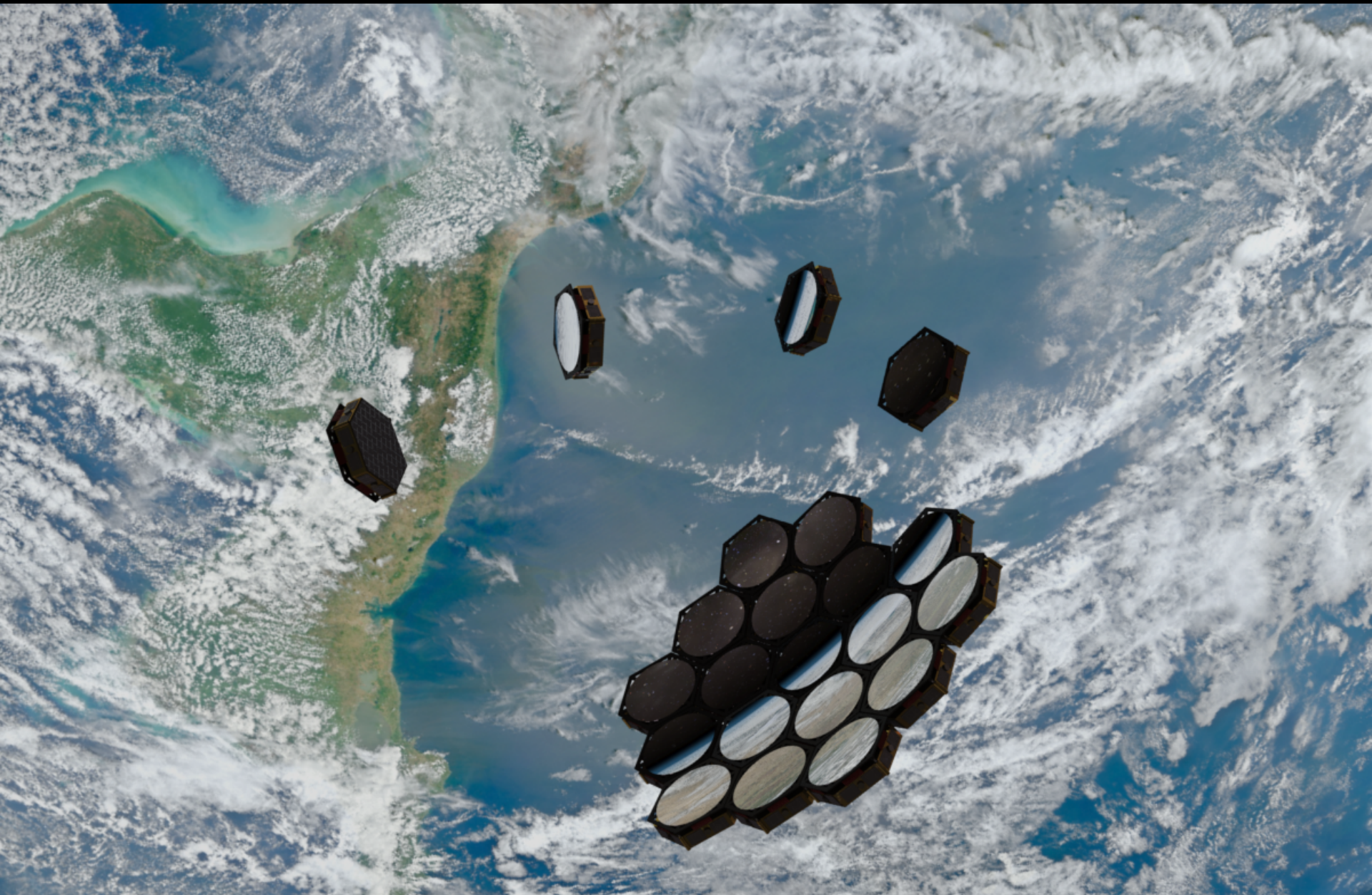
1. Future needs encouragement

- New multi-satellite missions from Planet & Spire
- Outer Space Act > Space Ports 2017 critical to future
 - Covers launch & operations for non-Earth orbits

Focus on long term ROI

Multi-constellation, Exotic Orbit & University
Compatible

Support & expansion of Regional Hubs & Clusters





Example: Joint UK Algeria Mission

“AISAT-1N designed, built & launched as part of the education programme SSC will deliver to Algerian students.”

- ✓ Strengthening relationships with new Space Nations (Key Intl. Obj.)
- ✓ UKSA offered flight competition to the UK community for selected self-funded payloads





2. Future can tap into Academia

Key UK USP is our World leading Universities!

Reliance on international workforce:

- Industry has issues in STEM recruiting > scaling up

“Indirect issues” or “not core business”

Acad. + Industry School/College Engagement
Royal Society, “Making Education Your Business”

3. Future is now

Continuation & Expansion of International Collaborations:

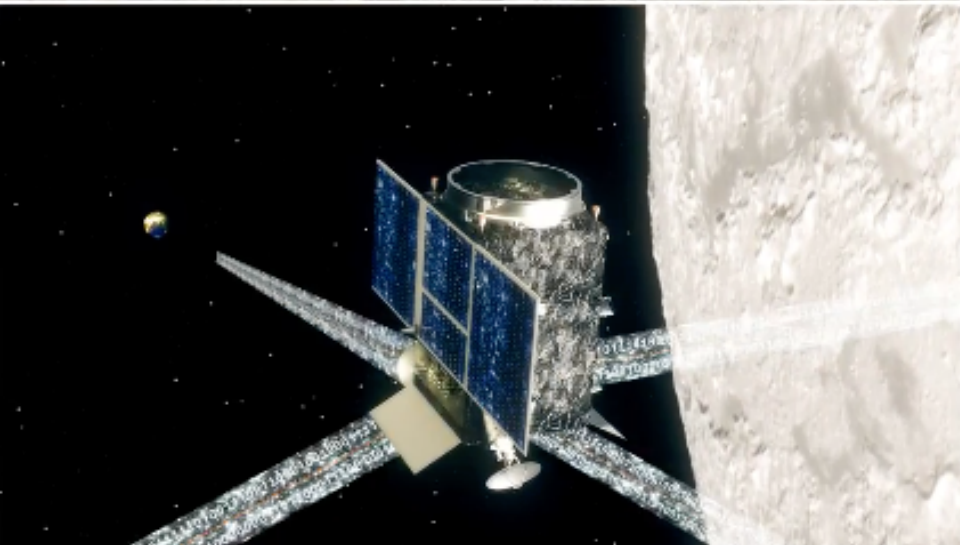
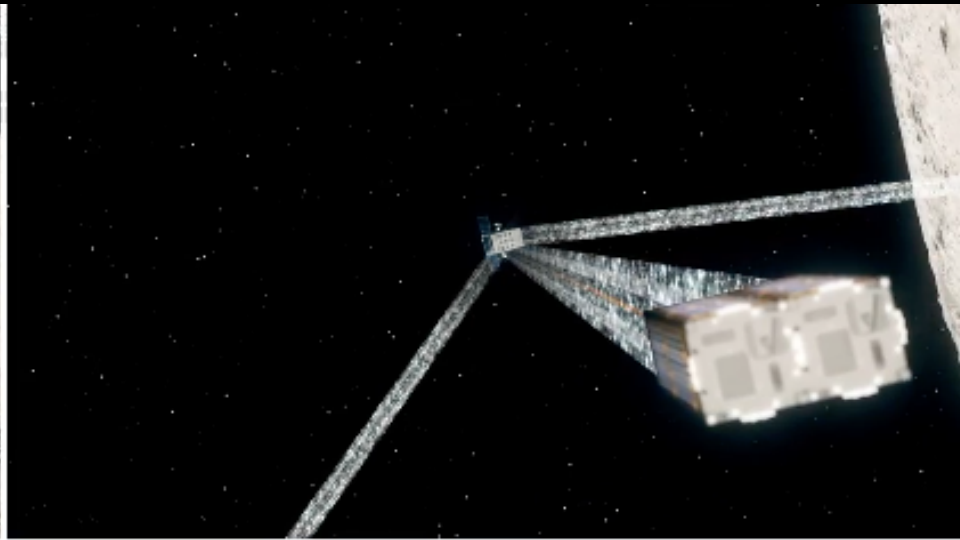
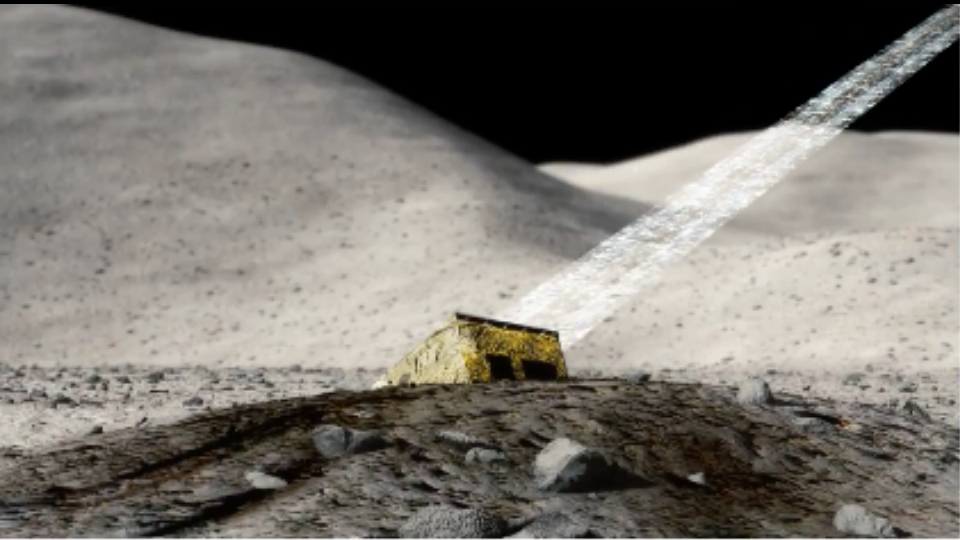
- ESA Subscriptions, ISS Utilisation, New Bi-laterals
- **“Application Focus”** GNSS £206B, Meteorological £169B, Telecom £117B, EO £89B = £ 581 B

Seed funding wins larger contracts

- Science funding & launch opportunities – latest space telescope cost \$ 8.7 Billion, \$ 2.6 T ‘carbon credit’ market
- Support in grander missions – Lunar Pathfinder

More engagement & evaluation on where UK takes part!

SSTL & Goonhilly, Lunar Communications Pathfinder



Summary

- UK gains Economically (4:1), Socially & In Prestige
- Expecting grander academic & industrial projects in new Grand Challenges from Industrial Strategy
- Avoid slow startup & new gains through:
 - Encouragement through revised regulations
 - “Making Education Your Business”
 - Expanding International Collaborations, Seed funding & further Public Engagement