



## **Report from Space Academic Network Dual Use Workshop**

**University of Leeds 5<sup>th</sup> December 2022**

**Compiled from inputs from Mark Sims, Anna Hogg, Kate Robson Brown, Peter Roberts, Simon Garrington, Anthony Dunne and attendees at workshop**

**Edited by Mark Sims**

**Version 1 15<sup>th</sup> December 2022**

### **Introduction**

SPAN notes that MOD, DSTL, BEIS are interested in dual use. The need to improve government cross academia collaboration along with academia wanting to deepen its industrial and MOD partnerships and the fact that for the first time in UK history there is a coherent dual use policy for all to convene around led to this workshop. Example and known mechanisms for dual use funding include DSTL, and EPSRC DTCs.

The following notes are compiled from the various inputs and discussions at the workshop held at th University of Leeds on the 5<sup>th</sup> December 2022 and attempts to summarise both the key points as well as some more detailed points. It is clear further discussions are needed to examine the potential of dual use however all parties (MOD, BEIS, UKSA, Industry and Academia) are interested in the concept. This workshop was seen as the first step in a discussion about dual use. SPAN will be looking at a follow-up workshop or discussion meeting(s) in early 2023.

Due to attendance discussions focussed mainly on EO and Space Situational Awareness. Attendees included academia, Sat Apps Catapult, Midlands Innovation, UK Space, UK Space Agency, DSTL, MOD Strategic Command, MOD Space Directorate, BEIS Space Directorate, British Antarctic Survey, UK Space Industry.

Annex A gives the agenda for the workshop.

### **Notes and Raised Points from Workshop**

#### **Part 1 Technical**

- Academia are interested in dual use for flight of technology, data analysis and applications.
- It was noted that MoD are looking for a number of demonstrator missions, and will only do demonstrators where they have aspirations to operationalise the technology
- The TerraSAR-X/TanDEM\_X model used in Germany was frequently quoted as way to enable dual use where it is believed (but TBC) 30% of TerraSAR is available for commercial and academic use.
- It was noted that there is likely to be less tension in scheduling of use of assets between academia and MOD than with commercial users.
- To enable missions as quickly as possible small sats and subsequent constellations were believed to be the most promising route forward.
- By using civil funding alongside defence funding there is an opportunity to build initial small constellations of spacecraft (2+) rather than one off demonstrators and enable an earlier operational status.
- In a similar vein civil missions could be used for demo's for defence tasks

- Academia are interested in development and use of C, L, X bands SAR, phase sensitive, coherent multi-wavelength or hyperspectral SAR along with optical/NIR hyperspectral, optical video and thermal imaging EO missions. It was noted that Interferometric SAR has many civil uses. UK demonstrators or actual missions for these technologies would be welcome by academia. In some cases there is a clear potential overlap with known planned defence missions e.g. SAR Project Oberon, Video Carbonite 2 (Tyche), hyperspectral (Sycorax).
- Applications for dual use from academic point of view include city monitoring and planning, land monitoring and use including agriculture, maritime surveillance, monitoring climate change. Disaster management and humanitarian relief are clear cases where military and civil agencies will work together.
- Academia recognise there may be different requirements in terms of orbital coverage, resolution, swath width etc. between civil and defence applications. It was noted that one way round security aspects might be to provide degraded resolution data for civil use. Alternatively information could be supplied rather than data.
- It was noted that common sensor systems e.g. spectrometers, imaging detectors may be possible with different front-end systems e.g. optics enabling different swaths and resolutions for the different uses.
- The issue of hosted payloads on defence or civil missions was raised.
- There is clear need for data bank of EO data that can be used by all and along with co-ordinated data analysis systems. Defence imagery may be declassified and added as time elapses and actual defence use and capability retreats into the past. Noting the trade-off between timeliness and transparency in terms of the data. It is noted that there may need to be a hierarchy of data access. Could DSTL enable not defence access to data sets?
- It was noted that long-term data sets are often needed for Government and academic use.
- Use of commercially provided data was noted alongside any sovereign Government/MOD based derived data or system.
- There needs to be an agreement (if possible) on metadata standards.
- It was noted that terrestrially based duplicate of an in-orbit payload could be very useful for terrestrially based work on aircraft, drones, land and sea vehicles
- Academic research in data related technologies such as edge computing, AI, super resolution imaging etc. are relevant to dual use, along with digital twin techniques.
- Academic research in engineering technologies such as new materials, electric propulsion etc. are relevant to dual use,
- Consideration needs to be given to quantum technology (e.g. communications) and cyber security.
- Use of very low Earth orbiting spacecraft was mentioned only briefly in the workshop, input post workshop highlights possible advantages of this approach and technologies involved. See Annex B below.
- Space Situational Awareness 1: Detection in GEO.  
It was noted that Jodrell Bank are part of NATO RGT with Dstl, US and Germany and others working on GEO targets. This is at a proof of concept stage now providing range, doppler mapping, velocities etc. with a position resolution of 10-100m<sup>2</sup> radar cross-section. This utilises a research network of telescopes using a very highly synchronised (optical fibre network). This as a research network is not practical as an operational tool given other use of the assets.
- Space Situational Awareness 2: Space Traffic Knowledge and Space Debris  
MOD requires wider knowledge than just location, state vector etc. Information required includes what are they and what are they doing, what are they linked to, where is the ground station, is the country linked to another one. So it is a multi-source problem including cyber.

- Space Situational Awareness 3: Space Weather
- There is a common interest in Space Weather. The CIRCE mission by DSTL and NRL was highlighted as defence demonstrator mission, but is essentially pure science. The link to civil assets such as ground-based radars, space based systems both existing and future missions e.g. Vigil, SMILE was highlighted.
- Space Situational Awareness 4: Detection systems. The need for Infrared sensors, RF sensors, radar based sensors was highlighted and ideally the need to for a distributed network which may be able to piggyback on research network and capabilities. Possible use of IR in asteroid detection and characterisation was noted.
- There is a common interest in skills development between MOD, Government, Industry and Academia. Efforts should be made where possible to maximise skills development within the available budgets looking for commonality etc. The role of the separate Space Universities Network (SUN) was noted along with the need to involve them.

## Part 2 Issues

The following issues that need to be resolved were highlighted in the discussions:

- What is the actual definition of dual use?
- Risk Ownership in a dual mission i.e. who owns it, see also below.
- Creation of and need for a robust tasking mechanism for a dual mission
- Academic collaborators will need to be aware of the implications of association with military actions. Including possibility of becoming a target for example for cyber-attack. Suggested way round is this is a co-ordination agency (TBD who) acts as the owner and provides barrier to non-defence (and security) users and developers.
- Typical defence funding timescales (3-6 months) are not compatible with academic research timescales (in particular employment). Regular and/or longer-term funding opportunities are required.
- Funding mechanisms, who funds probably not UKRI?
- How are detailed requirements drawn up?
- Ability of academia to software code to operational status, along with timescales of software turnover. Is Proof of Concept done in academia and then passed to MOD for implementation? It is noted however that routine operational data services are available from academia (as well as industry)
- Licensing of a dual use system
- Question over whether operationally responsive space missions will ever be possible in UK?
- Prioritisation if technology (changes) influence Defence and change risk factors
- Export Controls versus overseas markets
- Government Departmental capability choices
- Residual security costs
- What missions need to be sovereign and which can be in partnership with other countries?

## Annex A: Workshop Agenda

### Meeting Agenda

SPAN Dual Use Workshop 5th December 2022 (draft)	
Time	Session
10:00 - 10:30	Arrival Window - Tea/Coffee Networking
	<b>Introduction and Context</b>
10:30 - 10:35	Welcome to Leeds: Anna Hogg University of Leeds
10:35 - 10:45	Welcome to Workshop, Format, Aims and Objectives: Mark Sims University of Leicester SPAN Co-Chair
10:45 - 11:05	National Space Strategy and UKSA Corporate Delivery Plan: TBA UKSA
11:05 - 11:25	UK Space Defence Strategy: TBA MOD
11:25 - 11:35	DSTL and Defense and Security Accelerator (DASA): Gemma Attrill DSTL, Anna Taylor DASA
11:35 - 11:55	Open Discussion on Opportunities for Dual Use mediated by a panel
11:55 - 12:00	Comfort Break
	<b>Workshop*</b>
12:00 - 13:00	<i>Workshop Session 1: Initial Thoughts "Brainstorm" type discussions</i>
	Group A: Dual Use Missions
	Group B: Dual Use Technology and Techniques including Software
	Group C: Applications of Dual Use, Science from Dual Use
13:00 - 13:45	<b>Lunch and Networking</b>
13:45 - 14:45	<i>Workshop Session 2: Prioritisation and Summary</i>
	Group A: Dual Use Missions
	Group B: Dual Use Technology and Techniques
	Group C: Applications of Dual Use, Science from Dual Use
14:45 - 15:00	<b>Tea/Coffee Break and Networking</b>
15:00 - 16:00	<b>Conclusions</b>
	Open Discussion and Overall SPAN View
	Next Steps
16:15	<b>Wrap Up/End of Formal Meeting</b>
16:30 - 17:30	Networking Opportunity
	Note: * There will be some overlap between group discussions but this is welcome and is unavoidable

## Annex B

### Inputs to SPAN Dual Use Workshop Report – Peter Roberts University of Manchester

In addition to identifying and developing technologies that can directly impact key application areas, such as remote sensing or communications, technologies which improve the cost efficiency of platforms and payloads also need support.

One example of these are technologies which enable the commercial use of very low Earth orbits (VLEO). The benefits of using VLEO for remote sensing include increased resolution, or smaller optical systems for the same resolution, and for both radar and lidar the reduced line of sight to the imaging target means significantly reduced space losses<sup>1</sup>. Similarly the power required and antenna sizes can be reduced for communications applications, whilst latency is minimised due to the reduced path lengths<sup>2</sup>. In addition, the residual atmosphere in these low orbits both ensure end-of-life removal due to increased drag, minimises the debris collision risk, and reduces the intensity of the radiation environment. However, drag must be minimised and countered during the active operations of any system.

Enabling technologies for this orbital regime include a new class of aerodynamic materials which, combined with appropriate satellite geometries, can reduce the drag experienced by a satellite. The highly rarefied flow environment means that aerodynamics is driven by the direct interaction of individual gas particles, predominantly atomic oxygen VLEO, with spacecraft surfaces. The nature of this interaction is largely determined by surface physics and chemistry, and these new materials aim to scatter the gas quasi-specularly, minimising the momentum exchange onto surfaces at shallow angles to the flow. Such materials have the potential to significantly reduce drag, with proof of concept already demonstrated, but with a new for further validation activities.

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<sup>1</sup> Crisp N, Roberts P, Livadiotti S, Abrao Oiko VT, Edmondson S, Haigh S et al. [The Benefits of Very Low Earth Orbit for Earth Observation Missions](#). Progress in Aerospace Sciences. 2020 Sep 9;117. <https://doi.org/10.1016/j.paerosci.2020.100619>

<sup>2</sup> Berthoud, L., Hills, R., Bacon, A. *et al.* Are Very Low Earth Orbit (VLEO) satellites a solution for tomorrow's telecommunication needs?. *CEAS Space J* **14**, 609–623 (2022). <https://doi.org/10.1007/s12567-022-00437-0>

## Annex C Announcement of Workshop

### SPAN Dual Use Workshop

#### First Announcement

Location: University House, University of Leeds

Date: 5<sup>th</sup> December 2022

Start Time: 1000 for 1030 start

End Time: 1615 with networking to 1730

Meeting Type: In Person Only

Government and MOD now has its own Space strategy and organisation Space Command. Space Command and MOD are interested in collaborating with academia. This collaboration may include development of technology and techniques for dual use (i.e. both civil and security use) along with potentially dual use missions. **It is hence timely for SPAN to discuss dual use via a workshop of SPAN members.** The meeting includes hardware, software and applications.

The outputs from this SPAN workshop will feed into a UK Space Partnership meeting on potential UK EO programmes planned in early 2023 and will also be used to inform Government policy as the Department of Business, Energy and Industrial Strategy (BEIS) continues to evolve the Government's EO and Space strategy. Further workshops and discussions with Space Command etc. will be organised as appropriate once this initial "kick-off" type meeting is held. Key personnel from BEIS, MOD, UK Space Agency etc. will attend the SPAN workshop.

Dual Use Areas to be considered in Workshop are:

Intelligence, Surveillance and Reconnaissance (ISR)

Secure and resilient satellite communications

Position, navigation and timing (PNT)

Space domain awareness (SDA)

Aerospace medicine and human spaceflight support to MOD and Space Command will need to be discussed separately by UKSpaceLABS.

*To allow discussion at the SPAN workshop we are requesting that all attendees at workshop think about dual use, or if possible discuss dual use in SPAN working groups, before attending the workshop (based on this announcement and publically available documents, see references below) to maximise output from the meeting.*

The agenda is given in the table below.

### Dual Use Workshop Aims

Aims to answer following questions:

Are members of SPAN in favour of dual use projects? % or majority?

What missions and attached science might suit a dual use development? Is there one or more key missions that would advance both science and security? What type of missions are needed, small, integrated, constellations etc.?

What technologies and techniques developed by academia (and where appropriate in conjunction with industry) might suit dual use? Ideally a priority list of 5-10

What if any are the SPAN members' reservations regarding a dual use approach?

What spectrum of mechanisms of funding etc. need to be in place to enable dual use?

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## Proposed Workshop Attendees

SPAN Members

MOD/Space Command

DASA

UKSpace Representatives

Satellite Applications Catapult Representatives

UK Space Agency Representatives

BEIS Representatives

## Attendance Details

If you are interested in attending the workshop please use Eventbrite to book your place.

<https://www.eventbrite.co.uk/e/span-dual-use-workshop-tickets-461708862637>

A charge of £18 is being made in order to provide teas, coffees and lunch for attendees along with the room. The cost of the meeting is being subsidised by SPAN at the level of ~60-70% of the total cost. Please note that Eventbrite charge an additional admin fee of £1-99, which is non-refundable in case of cancellation. Hence overall cost per person for attendance is £19-99.

People will be contacted prior to the meeting regarding any special dietary requirements.

The meeting is being held in the Great Woodhouse room in University House, University of Leeds, Woodhouse Lane, Woodhouse, LS2 9JT.

For those staying overnight on 5<sup>th</sup> after the workshop a dinner (personal payment) with continuing discussion is being investigated.

### **Publically Available Relevant References for Use by Workshop Attendees**

Please look through these prior to the workshop if possible.

UK National Space Strategy

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1034313/national-space-strategy.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1034313/national-space-strategy.pdf)

UK Space Agency Civil Space Strategy

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/286219/uk-space-agency-civil-space-strategy.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/286219/uk-space-agency-civil-space-strategy.pdf)

UK Defence Space Strategy

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1051456/20220120-UK\\_Defence\\_Space\\_Strategy\\_Feb\\_22.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1051456/20220120-UK_Defence_Space_Strategy_Feb_22.pdf)

Commentary on this

<https://rusi.org/explore-our-research/publications/commentary/uk-defence-space-strategy>

UKSA Corporate Delivery Plan

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1091933/6192\\_UKSA\\_Corporate\\_Plan\\_CB\\_v9a\\_Bb.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1091933/6192_UKSA_Corporate_Plan_CB_v9a_Bb.pdf)