Defence and Security Accelerator

Autonomous sensor management and sensor counter deception Q&A Webinar

This event will start shortly

Defence and Security Accelerator

Welcome and housekeeping

Rachael Colling

DASA Delivery Manager

Defence and Security Accelerator

Housekeeping

- Please note your camera and microphone will be kept off
- Q&A session will take place after via Slido. To access, go to the website www.sli.do (on a separate tab or device) and enter the code #DASA
- Today's event will be recorded and the slides and recording will be made available afterwards. Q&A will posted to the competition page on the DASA Gov.uk site
- Discussions will remain at **OFFICIAL**

Defence and Security Accelerator

Agenda

Time	Description	Speaker
09:30 -10:05	Attendees to sign on to platform	
10:05-1010	Welcome and housekeeping	Rachael Colling DASA Delivery Manager
10:10-10:20	DASA overview	Tom Adamson DASA Innovation Partner
10:20-10:40	Competition overview	Competition Team
10:40-10:50	Break/ opportunity to submit questions to Slido	N/A
10:50-11:50	Q&A	All
11:50-12:00	Closing remarks	Rachael Colling DASA Delivery Manager
12:00	Event Close	

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Q&A

How to submit questions throughout today's session

Please submit or upvote any questions via slido

Scan above, or go to website sli.do and enter code #Sensor

Defence and Security Accelerator

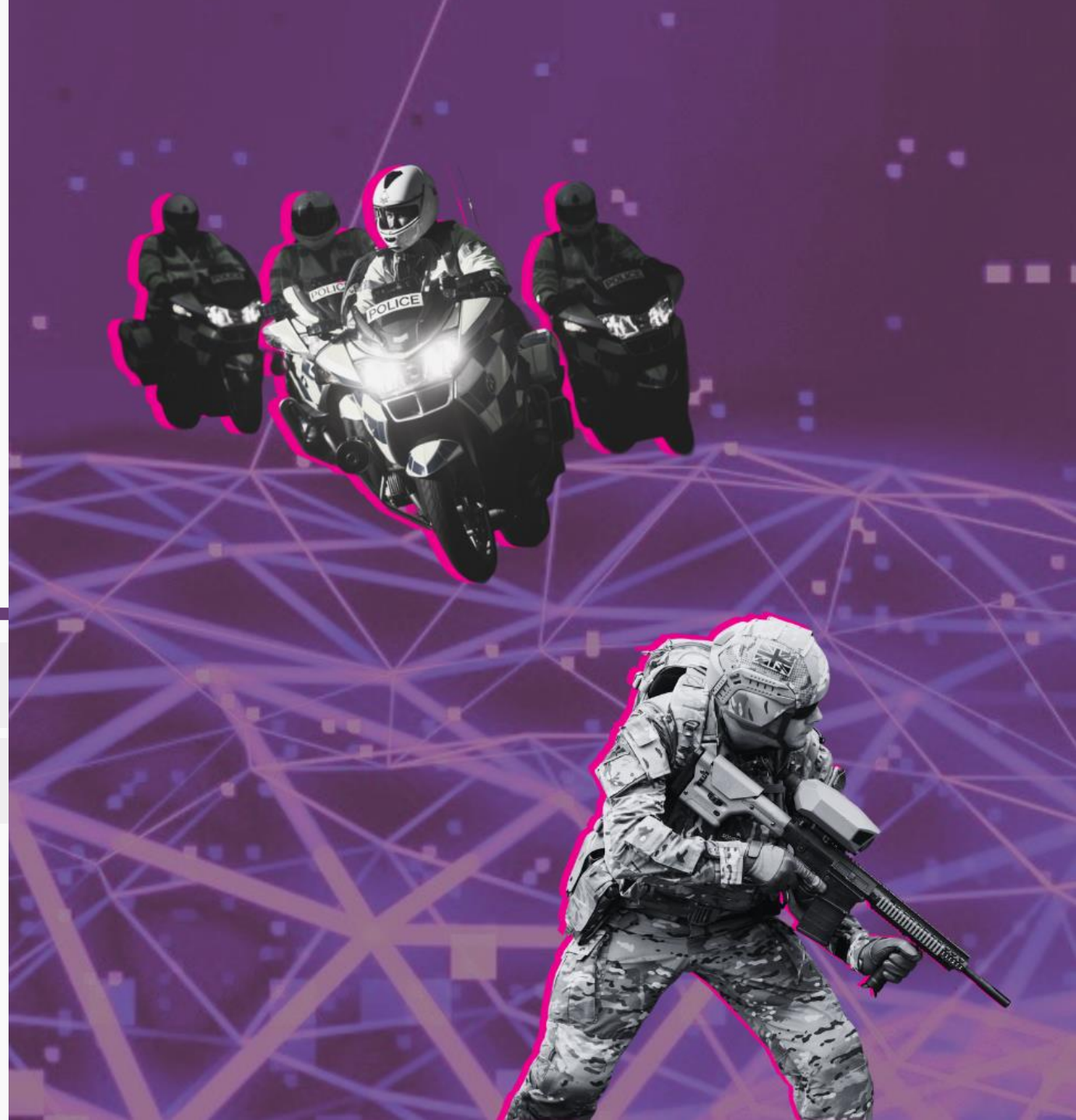
Defence and Security Accelerator Overview

Tom Adamson CEng MIMechE

Innovation Partner

@DASAccelerator

Defence and Security Accelerator

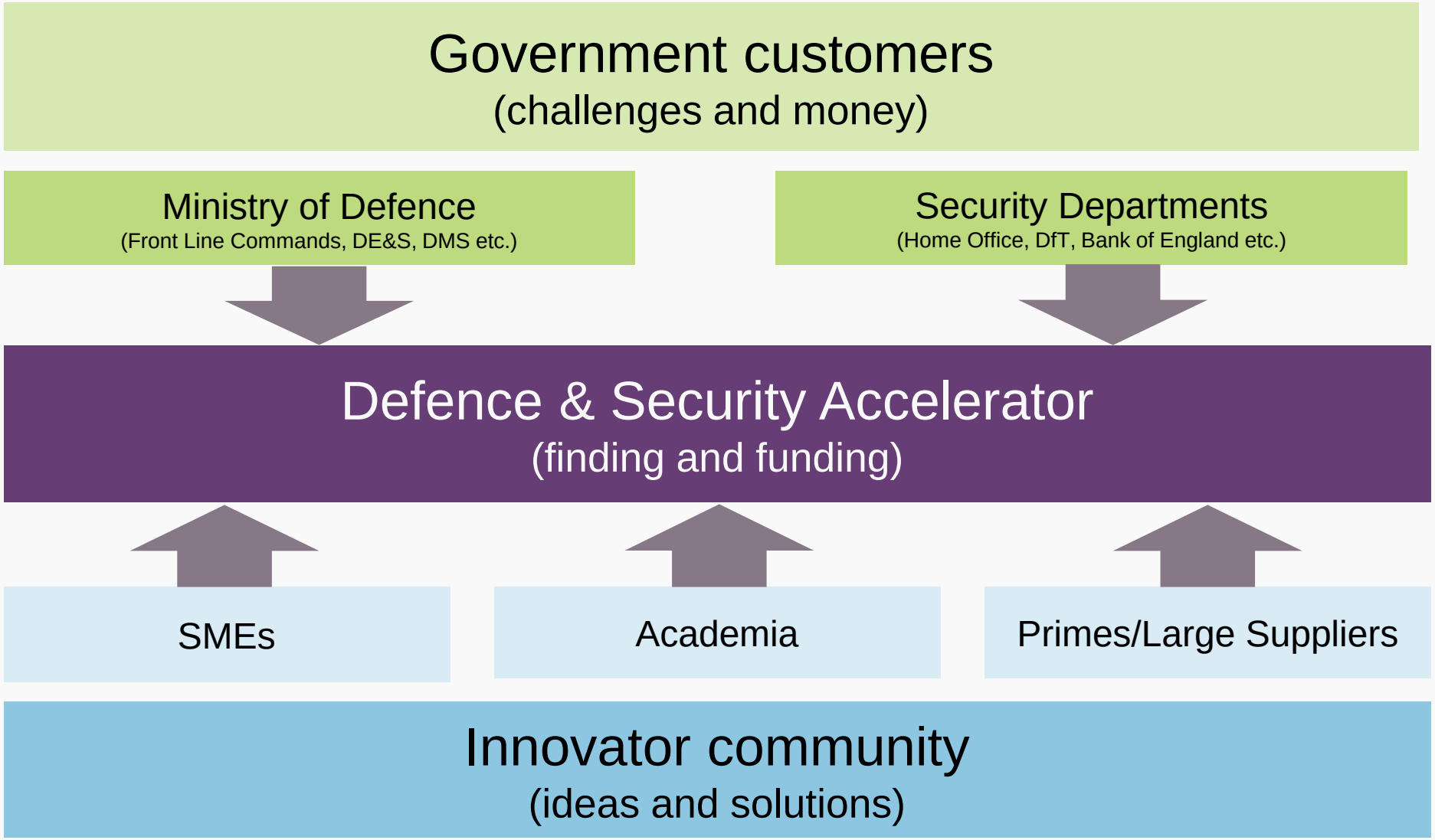


Our Mission

ABOUT US

We find and fund exploitable innovation to support UK defence and security quickly and effectively, and support UK prosperity.

How do we work?



107
Competitions

547
Innovators supported

1319
innovations accelerated

£234m
Invested in innovation

6969
Proposals Received

40%
of recipients are new to DASA

Our Offer

Finding Innovation:

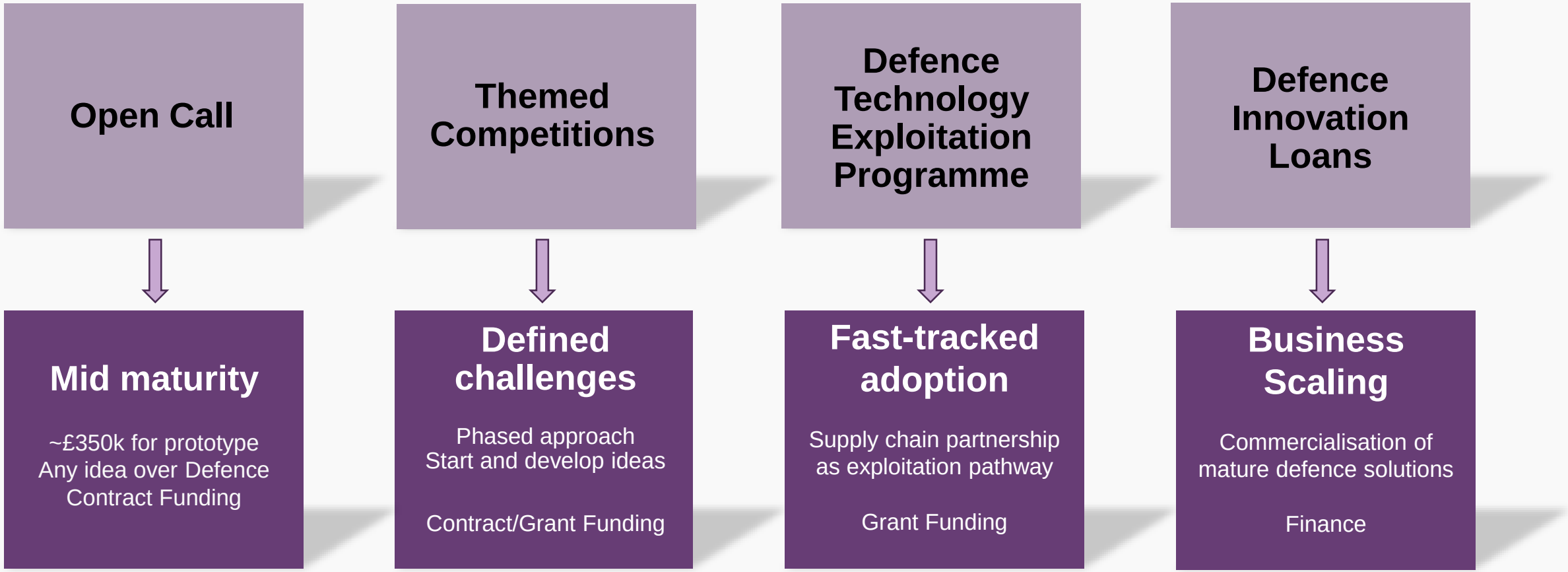
- Market Explorations
- Innovation Portal
- Innovation Outlines

Funding Innovation:

- Open Call for Innovation
- Themed Competitions
- Defence Technology Exploitation Programme
- Defence Innovation Loans

… plus **post-funding support** to help build the business

Funding Innovation



Meet the Team

Our Innovation Partners help innovators throughout the UK and abroad understand opportunities across the defence and security community.

How to contact us:

- Visit www.gov.uk/dasa and click ‘Get in touch with DASA’
- Submit an ‘Contact DASA’ form
- Attend regional outreach events
- Follow us on social media

Andrew Peaty
West Midlands

Clare Green
Yorkshire and Humber

Jas Shanker
East Midlands

Jonathan Jones
North West

Mike Madden
South West

Anna Taylor
North East

Paul Alderton
South East

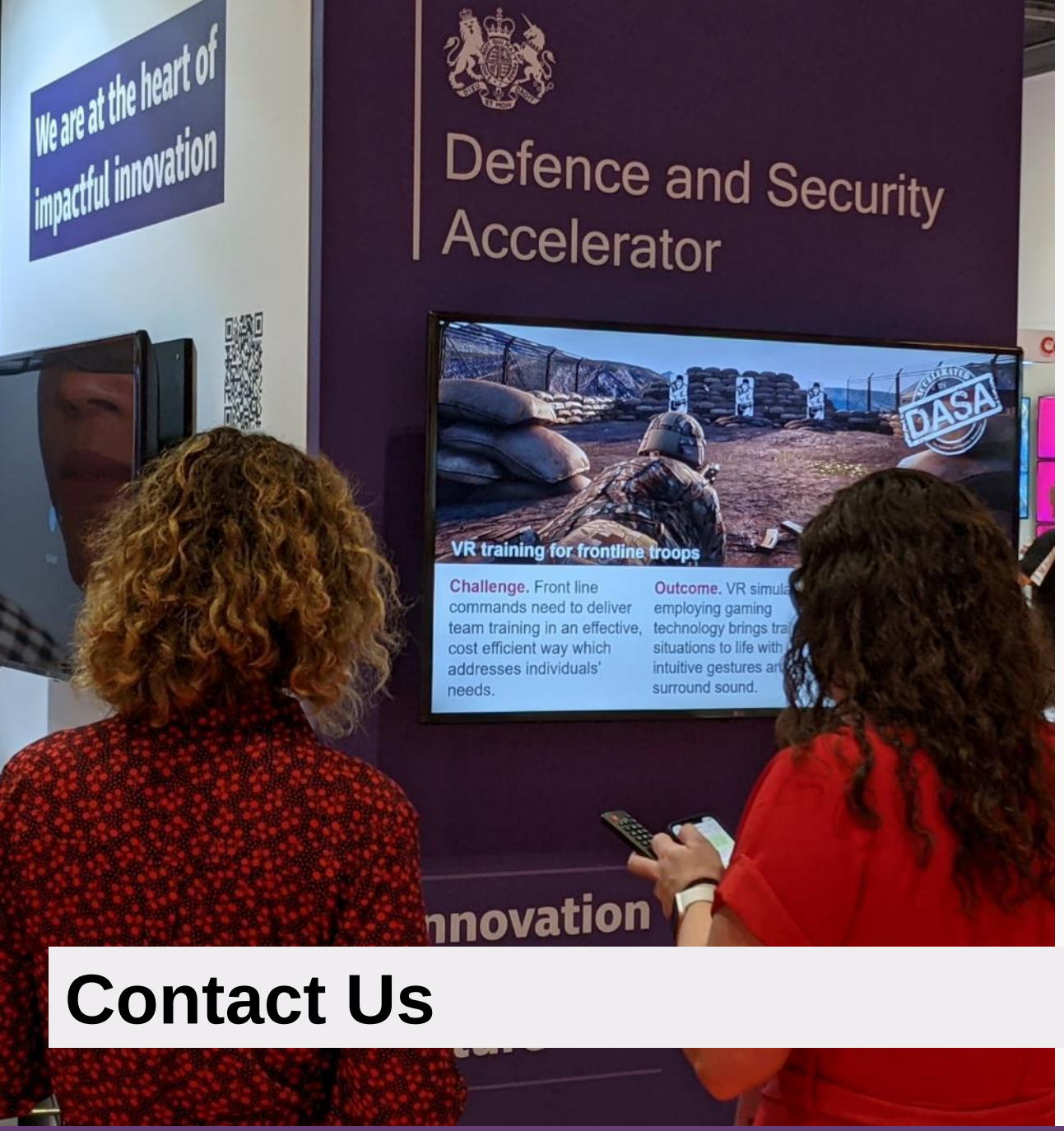
Ralph Wilkins
London

Vicki Savage
East of England

Tom Adamson
Wales

Deb Carr
Scotland

Linda Galloway
International



Contact Us

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[dstl] The Science Inside

Future Sensing and PNT Programme

Overview

Sam Wall

Ministry of Defence

Defence Science & Technology Strategy

5 Capability Challenges for S&T

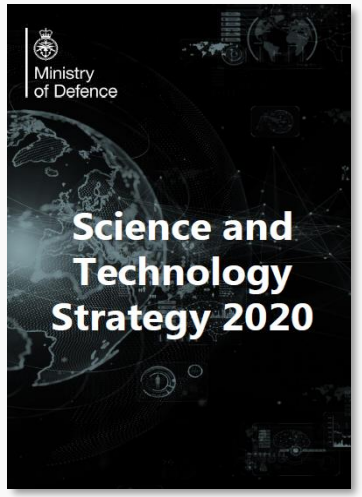
Respond to threats and opportunities of emerging technologies affecting our ability to conduct ISR in all domains and environments through affordable resilient solutions.

Develop the capability for multi-domain integration and ability to coordinate effects globally enabling us to execute joint operations against adversaries with well-integrated and resilient capabilities.

Improve the UK's ability to compete against adversaries below the threshold of conventional conflict and address our vulnerabilities, especially in the Information Environment.

Develop highly-capable systems to target adversaries in new ways across all domains; develop novel means of delivery of hard power and effective protection against highly capable adversaries.

Generate affordable, survivable capability responsive to rapidly evolving threats operated within a denied electromagnetic environment and be interoperable with our allies and partners.



Source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/927708/20201019-MOD_ST_Strategy_2020_v1-23.pdf

ISR Strategy: Multi-domain Integration

- **Integrated across all five operational domains** – space; cyber and electromagnetic; maritime; air; and land. This 'multi-domain integration' will change the way we operate and warfight, and the way we develop capability. We are moving beyond 'joint'. Integration is now needed at the tactical level of war – not just at the operational level where the term 'joint' applies. Effective integration of space, cyber and electromagnetic, maritime, air, and land achieves a multi-domain effect that adds up to far more than simply the sum of the parts – recognising that the overall effect is only as powerful as the strength of the weakest domain.

- have smaller and faster capabilities to avoid detection;
- trade reduced physical protection for increased mobility;
- rely more heavily on low-observable and stealth technologies;
- depend increasingly on electronic warfare and passive deception measures to gain and maintain information advantage;
- include a mix of crewed, uncrewed and autonomous platforms;
- be integrated into ever more sophisticated networks of systems through a combat cloud that makes best use of the mass of data;
- have an open systems architecture that enables the rapid incorporation of new capability, and rapid integration into the network;
- be markedly less dependent on fossil fuels and be more self sufficient;
- employ non-line-of-sight fires to exploit the advantages we gain from information advantage; and
- emphasise the non-lethal disabling of enemy capabilities, thereby increasing the range of political and strategic options.

Future Sensing and PNT Programme: Vision

Revolutionary novel Sensing and PNT concepts and underpinning technologies to deliver pervasive and resilient situational awareness, positioning, navigation and timing in congested and contested environments delivering freedom of action.

In 2022, Dstl flew an Apache E in a GPS denied environment (MOD Sennybridge) as part of the UK's PNT research Project.

Future Sensing and PNT Programme: Overview

Future Sensing and PNT Programme

Novel Sensing Concepts

- The Foundry
- EO Sensing
- Radar Sensing
- Quantum Sensing and Timing
- Sensing Materials Exploitation

Alt PNT

- Positioning Navigation and Timing
- QEPNT AUKUS

ISTAR in C2E

- Sensor Fusion and Management
- Electronic Surveillance
- Challenge Pipeline
- *Bright Corvus*

Key points to note

- Designed as 3+2 years
- Decision Gate Q4 FY24/25
- Enterprise delivery
  - External/Internal 65/35
- Extensive IRC links

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Challenge 1: Sensor Management

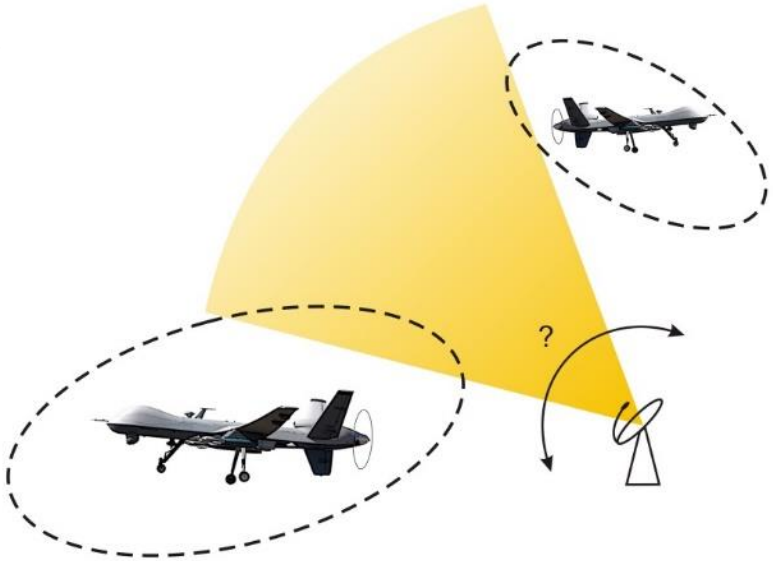
Nikki Perree

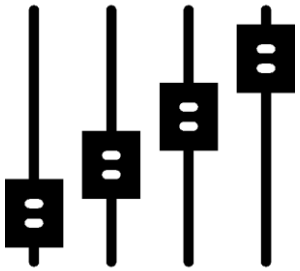
Ministry of Defence

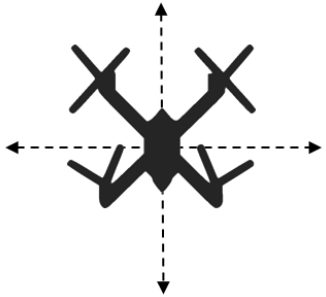
Autonomous sensor management

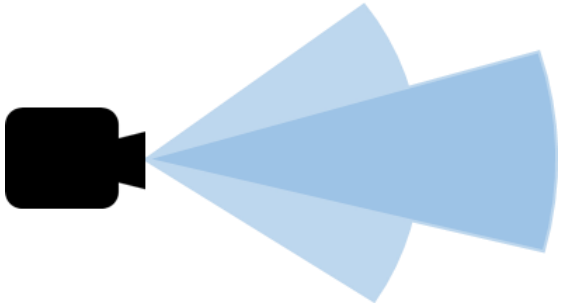
The process of deciding and executing the actions that a sensor (or group of sensors) will take in a specific scenario with particular objectives in mind.

- Current autonomous methods for positioning and pointing sensors are largely heuristic (i.e. rule based). Humans must anticipate new targets, sensors, environmental factors, tactics and context, etc.
- Sensor tasking can be very complex with multiple targets, sensors and increased autonomy
- Practical solutions are required for efficient evaluation of potential sensor tasking in order to select the best "actions" to take









Autonomous sensor management

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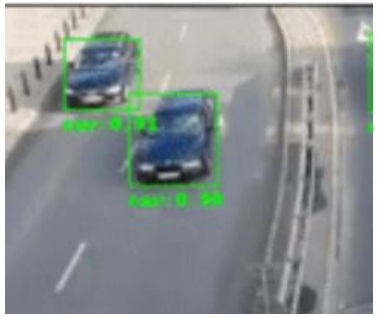
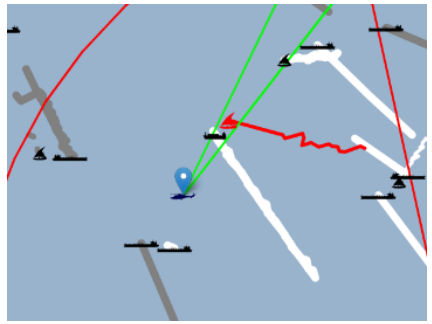
- Objectives…

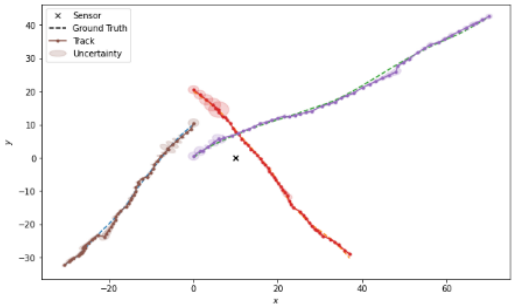
Search | Detect | Recognise | Identify

Track | Situational awareness | …





- Potential considerations
  - Horizon
  - Multiple objectives
  - Computational complexity
  - Contested, congested and/or constrained environments



Autonomous sensor management

- Aims
  - Algorithms for autonomous sensor management solutions
  - Demonstration of such algorithm(s) implemented in simulation
- Requirements
  - Object oriented Python
  - Solutions that can be integrated with or compared to the existing/developing capabilities in Stone Soup[1]
- Research areas
  - Information theory
  - Game theory
  - Reinforcement learning
  - …

[1]https://github.com/dstl/Stone-Soup

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Challenge 2: Sensor counter-deception

Jordi Barr

Ministry of Defence

Sensor counter-deception

Appropriate management of sensors and fusion of information will mitigate attempts at deception

- Aims
  - "Understand how military sensors are disrupted, denied, or deceived"
  - "Develop techniques to enable the understanding of the impact of deception and uncertainty"

- Context
  - SFM project
  - Focus on the information-theoretic aspects of the solution
  - No specific sensor in mind
  - Multiple sensor modalities preferred
  - Stone Soup as a developmental, experimental and test environment is strongly preferred

Sensor counter-deception

- Modelling deception
  - Whaley (1982), *Toward a General Theory of Deception**

Dissimulation (hide the real)	Simulation (show the false)
Masking	Mimicking
Repackaging	Inventing
Da	

*Barton Whaley 1982, Toward a general theory of deception}, The Journal of Strategic Studies, Volume 5(1), 178—192, Taylor & Francis

Sensor counter-deception

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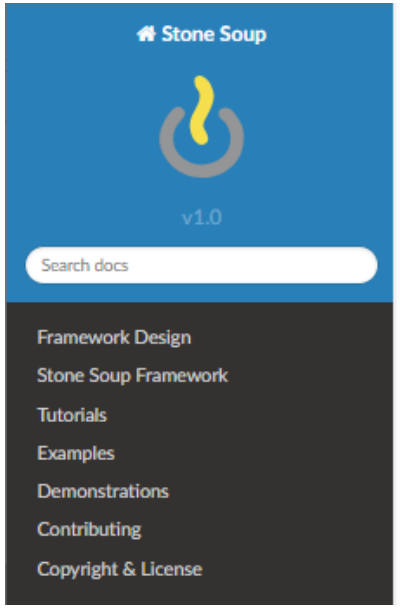
- Measuring deception

Metric		Definition
Completeness		The fraction of true objects that are included in the situational awareness picture and a function of a set of targets
Clarity	Ambiguity	The number of tracks as a fraction of the number of objects which are being tracked Perfect (non)-ambiguity yields a value of 1.0. Higher values indicate that there are more tracks than objects being tracked.
	Spuriousness	The fraction of tracks in the situational awareness picture which are not assigned to true objects. A spuriousness of 0 indicates all tracks are assigned to objects. A value of 1.0 is worst-case and suggests that no track is assigned to a real object.
Continuity	Longest track segment	Expressed as a fraction of the total time an object is in existence. A value of 1.0 indicates that the track is assigned for the full lifetime of the target.
	Assignment rate of change	The fractional number of unique assignment changes per target. A value of 0 indicates that only one track was ever assigned to a target. Higher values indicate more track switches.
Correctness		Synonymous with kinematic accuracy for kinematic states. How much does the assigned state deviate from the true state?

Sensor counter-deception

- Resources
  - Stone Soup
  - SIAP metrics
  - Toward a general theory of sensor deception (2023: NATO-R/O-S)
- Considerations
  - Engineered for future systems
  - Scalable
  - Modular
- (merely a few) Suggestions (no obligation)
  - Model intent
  - Data fusion
  - Game theory
  - ....



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Stone Soup

Steve Hiscocks

Ministry of Defence

Stone Soup

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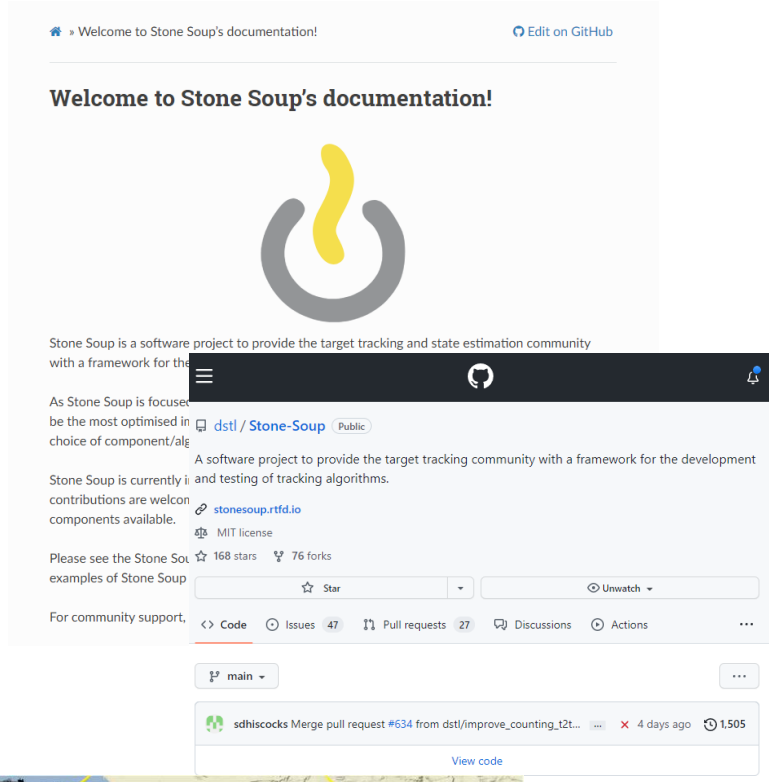
Stone Soup is a software project to provide the target tracking and state estimation community with a framework for the development and testing of tracking and state estimation algorithms

Key design principles

- Open source
  - Members of the tracking/state estimation community can contribute enhancements
- Modular/Interchangeable
  - Trackers are formed by assembling components, where the same type have identical interfaces
- Well documented
  - Documentation available at https://stonesoup.rtfd.io

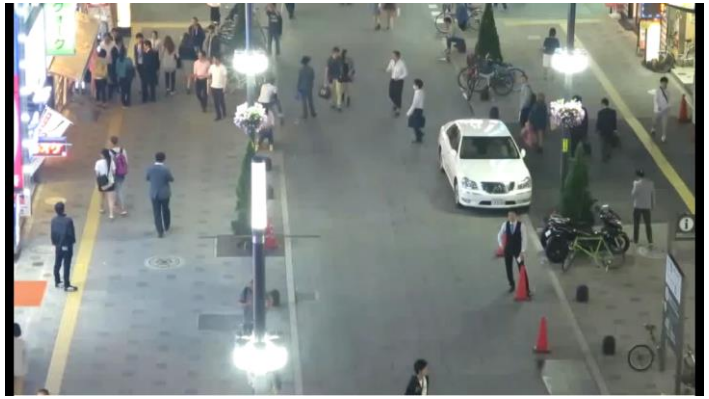
Goals/implications

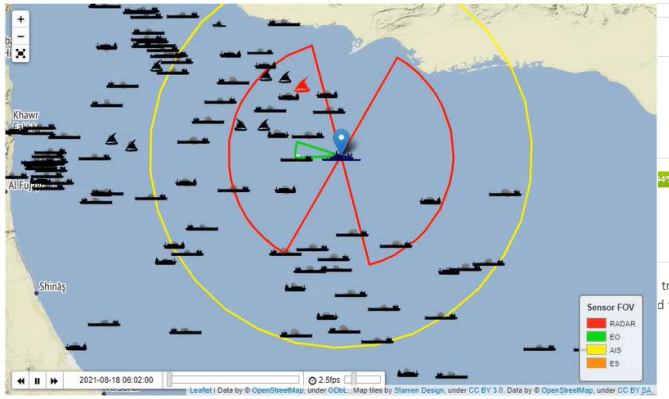
- ‘Snake oil’ filter for algorithm claims
- Rapid prototyping
- Accelerated Personal Development
- Algorithm ‘benchmarks’
- Repository of standard versions of algorithms
- Step towards a sharing culture
- Standard data sets



Applications

- Air, land, sea and space platform tracking
- Automated sensor management
- Classification/identification
- Multi-senor fusion, various modalities
- Use with real sensors, real data, or use simulation capability.





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Discover more

Defence and Security Accelerator

Q&A

Website sli.do
Code #Sensor
Or scan →

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Closing remarks

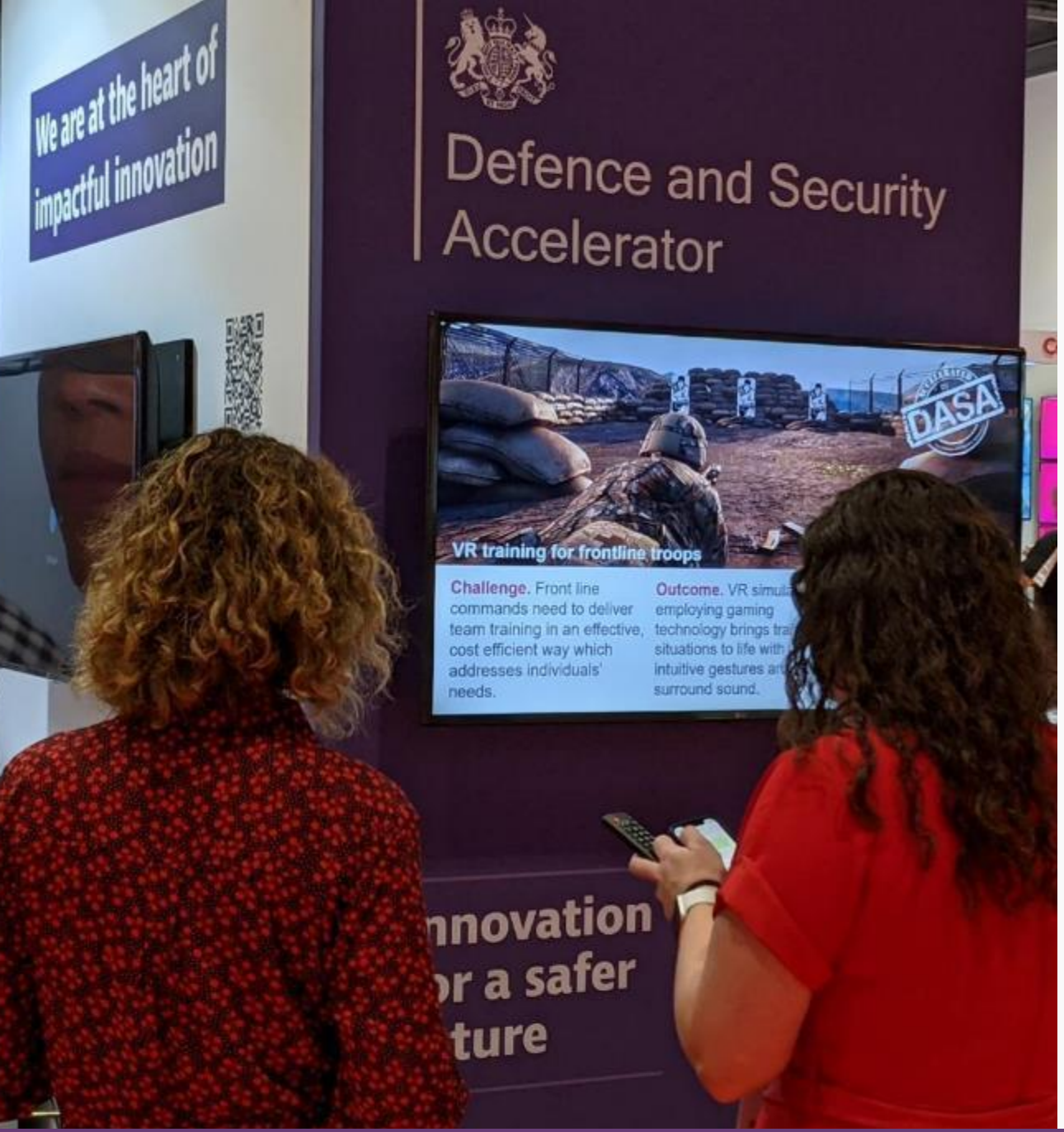
Rachael Colling

DASA Delivery Manager

Defence and Security Accelerator

Closing remarks

- Thank you for attending this Q&A event
- The slides from today's event will be sent to you. Q&A responses will be shared on gov.uk
- Help is available from DASA Innovation Partners



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