

43rd International Symposium on Military Operational Research

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Abstracts and Biographies

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KEYNOTE

Artificial Intelligence has entered warfare — but has warfare become more intelligent?

Artificial Intelligence (AI) is now deeply integrated into everyday life and is increasingly shaping warfare. Leveraging its potential has never been more important, particularly given the growing complexity of contemporary conflicts. AI offers clear added value in multiple ways, including enhancing ISR capabilities, extracting patterns from vast and complex datasets, and supporting command and control as well as intelligence analysis.

At the same time, the growing availability of AI technologies makes them accessible both for legitimate public use and for exploitation by adversaries. AI can be misused to generate, tailor, and amplify misinformation and disinformation at scale, undermining sense-making, eroding trust, and distorting the information environment in which military and political decisions are taken. Moreover, AI not only supports the detection of fragilities in ICT systems but also facilitates the orchestration of increasingly advanced cyberattacks.

This dual-use nature of AI also increases the risk of over-reliance on technological solutions, potentially at the expense of human expertise, contextual understanding, and critical judgment. As a result, the growing use of AI does not automatically lead to more intelligent warfare; instead, it changes how intelligence, decision-making, and responsibility are shared between humans and AI systems.

Prof. Dr. Ana Barros, Principal Scientist at TNO (Netherlands Organisation for Applied Scientific Research)

Prof. Dr. Ana Barros is a principal scientist at TNO and applied research professor intelligence of the Netherlands Police Academy as well as endowed professor data science and AI in the field of organized and subversive crime at the Tilburg University and Jheronimus Academy of Data Science (JADS). After her master's degree on Operational Research and Statistics, she obtained a PhD degree at the Erasmus University Rotterdam in 1995. In the last thirty years she has been actively involved in a wide scope of international and national defence and security projects in the areas of intelligence, subversive crime, operational analysis and complex systems modelling as well as artificial intelligence applications for intelligence analysis, operational planning and policy evaluation. She acts as scientific advisor the National Police Intelligence organization, is associated editor, among others, of the NATO Science and Technology journal and scientific advisor of several EU projects. She has been recognized with several awards, including the NATO STO 2026 Von Kármán Medal, NATO Service Award for her contributions to the NATO OR&A community (2024), the NATO Collaboration Science Office and Science and Technology (STO) appreciation honor (2020), and the INFORMS Best Dissertation on Location Analysis of 1995 award for her PhD thesis titled "Discrete and Fractional Programming Techniques for Location Models".

RONNIE SHEPHARD ADDRESS

Professor Ronnie Shephard was one of the pioneering figures in post-war British military operational research and the founder of the International Symposium on Military Operational Research (ISMOR), established in 1984. Shephard joined the British Army's Army Operational Research Group (AORG) in 1942 during the Second World War. He later became Chair of OR at the Royal Military College of Science at Shrivenham. He remained engaged with ISMOR until his death in 1995.

This memorial address at ISMOR continues the tradition of senior figures sharing their wisdom with the community.

Nicola Morrill, Dstl

Nicola is a Chief Analyst at Dstl and joint head of profession for OR within UK Ministry of Defence (MOD). She has worked in Defence OR for around 25 years in a range of roles spanning individual technical, technical leadership, assurer and formal leadership roles. She served on the board of the OR Society as its diversity champion and is currently an Associate Director of MORS. Nicola has an MSc OR, is a Fellow of the OR Society and recently secured an MSc Psychology. Nicola is married with two daughters and two dogs, which keeps her very busy!

MORS' EUGENE VISCO PRIZE-WINNING PRESENTATION

Established in 2019, the Visco Prize recognizes early-career analysts for their excellence in research quality, contributions, and presentation. Named for Mr. Eugene P. Visco, FS, the prize seeks junior or early-career analysts conducting impactful, technically rigorous, and original research that advances the field of national security operations research. This is awarded at both the US Military OR Society (MORS) conference, and at ISMOR. The US winner of the MORS' Eugene Visco Prize is invited to present at ISMOR.

Scaling the Modeling Pyramid: Lessons Learned from Integrating Physics-Based Models into Large-Scale Operational Simulations

Large-scale military operations represent both physics-based effects and human decision making. While advances in physics-based modeling have enabled new opportunities, incorporating these models into high-level simulations, such as in campaign analysis, remains challenging due to computational constraints. To overcome this challenge, models can be simplified and run within simulations or executed offline and their results pre-processed, aggregated, and queried during runtime. This presentation surveys strategies for integrating physics-based models into high-level simulations and documents tradeoffs among varying implementations. Lessons learned from the author's experience modeling orbital debris for military campaign analysis are included within this survey. This work aims to highlight current methods for improving traceability across multiple levels of the modeling pyramid, enabling analysts to better understand model assumptions, characterize sources of uncertainty, and select an appropriate level of fidelity for studies in question.

Ioannis Nikas, Independent Researcher, 2025 Winner

PANELS

Synthetic Environments

Synthetic environments (SEs) and simulators have been used for many years for training purposes. Recent technological developments and modern engineering practices mean that they are now increasingly being used to providing users with 'sandbox' capabilities to demonstrate, experiment with and engineer a wide range of solutions more rapidly and cost-effectively. On the morning of Day 2 of the conference, an OR Society 'round-table' will draw-together subject matter experts from across Defence to explore the state-of-the-art and direction of travel related to the employment of SEs for non-training purposes. Outputs and findings will be reported-back through the OR Society for the benefit of the OR community. This session provides an initial back-brief of the round-table and an opportunity for Q&A and wider discussion.

Chair, **Matthew Harrison**, Sirius Analysis

Closing Discussion

This closing panel reflects on the key themes, insights, and challenges emerging from the conference. Drawing on discussions across the programme, panellists will offer their perspectives on the current state of the discipline, the evolving role of analysis in defence decision-making, and the opportunities presented by new methodologies and technologies. The session will explore what has been learned, what remains uncertain, and how the OR community can better support future military operations. Concluding the conference, the panel aims to synthesise key messages and highlight priorities for research, collaboration, and practice in the years ahead.

Chair, **Matt Bunn**, Catalyze

Lt Col Taylor Leonard, U.S. Air Force Academy Department of Mathematical Sciences

Carly Porrett, UK Ministry of Defence

Pip Pepper, Lockheed Martin

PRESENTATION SESSIONS
Session 1a: General OA (A) | Chaired by Geoffrey Chapman, Dstl
1a.1
Army Warfighting Experiment (AWE) on Robotics and Autonomous Systems (RAS)

The Army Warfighting Experiment on Robotics and Autonomous Systems in 2026 provided the UK, US and AUS through the AUKUS partnership the opportunity for the participants to test and share their national capabilities to conduct missions. This provided an opportunity to conduct in-the-field observations on the technology, the human-autonomy teaming and mission success. Roke delivered observations on the technology stacks in place covering: the autonomous platforms; their control through autonomous systems and response to automatically detected targets; and their integration and interoperability through the Tactical Assault Kit Communication Information System (CIS) infrastructure. The insights generated from these observations provide clear guidance and focus for future development within the UK and our allies.

Anthony Wilder & Beth Freeland, Roke Manor Research Limited

1a.2
Naval force modelling through commander taskings to subordinates employing tactics, techniques and procedures

Ongoing operational research modelling has objectives to complement physics-based simulations and permit rapid exploration of parameter spaces for a naval force across the above water and underwater domains. In an all-digital simulation, the challenge is capturing the decision making and control of force elements, particularly given the variety of capabilities that need to be represented. This presentation reviews work which examined an overall orchestration of force elements achieved through commander taskings via a command hierarchy to subordinates, who then employ tactics, techniques and procedures for resolution of engagements. This model is also being considered to reconstruct naval wargame results, where decision making for commanders is performed by human players for scenarios spanning days with discrete time steps. Player moves can be imported and used to generate and explore alternative move sequences in the game tree. The game state from a position in the game tree can then be used as initial conditions for a more detailed simulation of opposing force interactions and engagements. The work will support analysis of future force structure options for the Royal Canadian Navy.

Peter Young, Defence Research and Development Canada / Canadian Forces Maritime Warfare Centre

Session 1b: Engineering Capability Assessments | Chaired by Pip Pepper, Lockheed Martin

1b.1

NATO SACT: Force Lethality Enhancement for Combat Engineering

Techmodal delivered one pillar of NATO SAC Transformation's Force Lethality Enhancement (FLE) program – Combat Engineering. Techmodal enabled NATO to assess current Combat Engineering equipment capabilities against emerging technology and concepts to examine how NATO Allies could enhance mobility, counter-mobility and survivability in high-intensity operations.

NATO needed to compare capability options credibly and consistently within a 3-month window, meaning traditional and data-hungry approaches would not be feasible. Techmodal delivered an iterative repeatable analysis-led study through 3 phases: Discovery & Definition, Qualitative Analysis, and Quantitative Analysis.

The project delivered structured evidence-based assessments of current and emerging combat engineering capabilities, supported by a clear and traceable analytical framework, including tabletop exercises with Subject Matter Experts (SMEs). This project allows NATO to inform the development of new capabilities and technologies to combat engineering.

Joe Riley, Techmodal

1b.2

Chry5alis: Exploring the feasibility and benefit of emerging communications technology

Effective command and control is dependent upon reliable communication. Military communication networks are routinely denied, degraded, intermittent or bandwidth limited, so it is imperative that these networks can respond and adapt to changes in real time to maintain command and control.

MOD has developed a suite of low-mid TRL (Technology Readiness Level) information services, networking and transport technology. The aim of Chry5alis is to assess the feasibility and address the challenges of integrating these technologies and to characterise the integrated capability, including its potential value to the military end user. The task will enable MOD to determine how and whether these technology concepts can be matured into operationally deployable systems.

In this talk we discuss how existing techniques such as network modelling, synthetic experimentation and benefits mapping are combined to create a complete methodology to test the feasibility and benefit of emerging communications and networks concepts.

Dr Andrew Barwell, QinetiQ

Session 2a: Uncrewed Systems | Chaired by Alex Ward, Arke Ltd

2a.1 A computational framework for optimal task assignment in uncrewed underwater vehicle fleets

We present a computational framework that enables Uncrewed Underwater Vehicles (UUV) fleets to allocate and update tasks autonomously while maintaining mission continuity even in the case when communication with a command & control node is intermittent or degraded. Our system uses a mixed-integer linear program to optimally allocate the right asset to the right task in a dynamic and complex environment, and embeds this optimisation tool in a decentralised peer-to-peer coordination model. Each UUV independently computes and updates its task allocation via this optimisation model using locally available information, while maintaining mission coherence through intermittent peer communications. This approach facilitates efficient use of assets in dynamic environments and is adaptable to changing mission demands. We provide some illustrative simulations via a specially developed mission visualisation tool. In total, our software enhances autonomy, resilience, and operational effectiveness for defence users.

Anthony Dunn, Decision Analysis Services Ltd

2a.2 Analysing How to Counter the Threat from Combined Uncrewed Systems

A Combined Uncrewed System (CUxS) involves two or more platforms operating in pursuit of a shared goal. They may function in coordination or independently within a unified command structure. Examples range from basic (e.g. multiple Unmanned Aerial Vehicles (UAVs) conducting Intelligence, Surveillance and Reconnaissance (ISR)) to elaborate (a mix of uncrewed surface vehicles and uncrewed underwater vehicles guided by UAVs to attack a port facility). Deployment of CUxS by state and non-state threat actors represents an emerging challenge area, with such systems able to exploit cost and scale asymmetries and operate across domains in a distributed and sometimes autonomous manner. Sagentia Defence proposes to introduce the OR methodology used to research likely future manifestations of this threat on a recent Dstl/NATO task, covering “archetype” construction and generation of corresponding high-level counteractivities. This will lead on to covering our workshop-based assessment, then move to information synthesis, concluding with general reflections on CUxS.

Matthew Hodge, Sagentia Defence

Session 2b: Simulation Modelling | Chaired by Ed Aubrey, BAE Systems

2b.1

Integrated Surgery Scheduling and Post-Surgical Bed Planning in a Military Hospital

This work presents an Operational Research approach for integrated surgery scheduling and post-surgical bed planning in a hospital environment. The model considers multiple recovery pathways, including stays in Intensive Care Units (ICU) and Semi-Intensive Care Units (SICU), enabling decision makers to allocate beds while respecting maximum lengths of stay and resource constraints. The approach aims to reduce surgery cancellations caused by limited downstream resources and support planning by analysing the balance between surgical demand and available capacity. Computational experiments based on data from the orthopaedic department of a military hospital were conducted to evaluate the model. Results show that optimized allocation improves resource utilization while maintaining feasible occupancy levels.

Gustavo Carneiro, CASNAV - Brazilian Navy

2b.2

When Does the Budget Break? Agent-Based Modelling and Generative AI for Royal Navy Corridor Planning Under Compound Uncertainty

Royal Navy Type 45 destroyers depend on five maritime corridors - GIUK, Red Sea, Arctic, Hormuz, and Dover. Standard cost planning models treat the risks to each corridor as independent. They are not: Arctic ice melt affects Russian behaviour in the North Atlantic; Red Sea disruption overloads Hormuz. When corridors interact, a single closure can cascade into a fleet-wide cost crisis. We build a simulation model of all five corridors and show that standard scenario sampling misses the worst outcomes - because it cannot represent the order in which crises unfold. We then test whether a large language model, prompted with real geopolitical history, generates crisis sequences that find failures the standard approach misses. Preliminary results show costs spiking 6.8 times above normal, with £217M excess cost against the optimal plan. Budget failure only occurs when three conditions coincide - a finding invisible to conventional methods.

Neha Singh, University of Strathclyde

Session 3a: General OA (B) | Chaired by Mari Troskie, QinetiQ

3a.1

Analytic Support to Military Adaptation

Military organisations have found adapting to surprising developments in conflict challenging. In the past, operations research has sometimes been employed to support military adaptation in conflict. The NATO Research Task Group SAS (System Analysis and Studies) 188 have been studying how analysis can be employed to support military adaptation. We have looked into historical cases of analytic support to military adaptation, as well as future opportunities. Analysis in support of adaptation will have to take place near decision-makers, in order to understand problems and shape orientation. Future analysts will have to be skilled in critical thinking, facilitation, abduction, hypothesis testing, statistics and interpretation of data. Analysts should be deployed in teams to provide a sufficient breadth of skills and sufficient endurance.

Jan Frelin, Swedish Defence Research Agency

3a.2

Typhoon Pilot Training Wargame Modelling

In support of a training pipeline wargame, we repurposed an existing simulation model to assess surge capacity, identify resource constraints, and ways to increase the readiness of experienced but non-current personnel.

The established model was built in Simul8 and Excel as a generic training pipeline simulation model. We incorporated updated resource data, training syllabuses, and student input to generate statistics on utilisation, bottlenecks, course durations and overall flow. Workshops with Subject Matter Experts (SMEs) developed realistic scenarios aligned to the wargame’s objectives.

The analysis informed the customer’s wargame, providing evidence on course completion times, student throughput, and resource use; all used as reference for the wargame’s scenarios and questions. The customer highlighted the unexpected depth achievable within tight timescales. The project demonstrated the value of reusing and adapting existing models to deliver timely, decision-ready support for military training planning.

Gabriella Deevoy, Techmodal

Session 3b: Digital Twins | Chaired by Geoffrey Chapman, Dstl

3b.1 Artificial Intelligence-Extended Reality (AI-XR) and Digital Twin Architectures for Resilient Defence Decision-Making Across the Capability Lifecycle

Operational Research for defence increasingly addresses complex, interdependent socio technical systems operating in uncertainty, with contested information, under time pressure. This presentation demonstrates how a distributed resilience architecture that combines AI-enabled analytics, immersive extended reality (XR) interfaces, and digital twins could support defence decision making across capability planning, acquisition, training, and in service operations. Once validated with established OR methods, the framework proposed would provide a practical, repeatable and measurable contribution to resilient military capability development, sustainment, and operational effectiveness, thereby directly supporting future defence analysis challenges addressed by the ISMOR community.

Adrian Snook, PAULEY Interactive

3b.2 Digital twins with multi-objective optimisation in defence

Defence infrastructure presents complex, interdependent operational challenges that resist single-objective solutions. This presentation introduces a bespoke digital twin framework, developed and validated in collaboration with the Royal Navy, designed to support operational decision-making through embedded multi-objective optimisation. The framework treats a high-security maritime base as a holistic system, integrating infrastructure, logistics, personnel, and services within a layered architecture that enables multiple optimisation problems to be addressed concurrently.

Two distinct logistical problems are demonstrated and both employ multi-objective optimisation, with Pareto-front visualisation enabling non-technical decision-makers to interrogate trade-offs interactively. The framework offers a generalisable platform for decision support across complex defence and critical infrastructure environments.

Dr Joseph Ross, Rossnet Consultancy

Session 4a: OA Drawing on Historical Data | Chaired by Kieran Rowley, Sagentia Defence

4a.1

Morale and Combat Effectiveness

We report the initial results of an OA study using historical data to explore the relationship between levels of morale (willingness to fight) in an army and combat effectiveness. Using the case study of the Normandy campaign 1944, we consider the hypothesis that morale affects the outcome of combat and develops an understanding of the factors that contribute to morale.

Initial analysis of censorship reporting from 21st Army Group and reports from German archives has identified over 50 factors that are potentially correlated by morale. These metrics are compared with combat modelling of specific engagements, to calculate the probability of combat success based on the physical components of combat power (e.g. personnel and equipment).

This work was a collaboration between Army Operational Research Branch (UK Ministry of Defence (MOD)), Changing Character of War Centre (University of Oxford), School of Politics and International Studies (University of Nottingham) and Defence and War Studies Departments (Jonathan Fennell & Jake Gasson, King's College London).

Stephen Coulson, Angus Main & Kevin Fahey, University of Oxford, MOD & University of Nottingham

4a.2

Developing a Corps Level Attrition Model

The Corps Level Attrition Model (CLAM) is an Operational Analysis tool developed to support British Army studies. Drawing on historical data, it seeks to investigate the losses of personnel and equipment that may be incurred from a peer level, divisional scale operation.

Complexity wise, CLAM sits between a simple Excel spreadsheet, and an entity level simulation. Constructed using Python code, running under a Jupyter Notebooks framework, it modifies an ORBAT (Order of Battle) on a day-by-day basis using a set of plug-in modules representing the different causes of attrition including DNBI, Indirect fire and Close Combat. This allows the user to view the underlying algorithms, and if required, modify them to match the requirements of a specific study.

This presentation looks at the underlying problem, how we designed and constructed the model, and anticipated future developments.

David Robson, QinetiQ Training and Simulation Ltd (QTSL)

Session 4b: Adversarial Reasoning under Uncertainty | Chaired by Pip Pepper, Lockheed Martin

4b.1

Opponent State Inference Under Partial Observability in Competitive Strategic Systems

Strategic decision making in adversarial environments requires inferring hidden opponent intentions from limited observations. This work proposes a framework combining Hidden Markov Models and Partially Observable Markov Decision Processes (POMDPs) to estimate latent opponent strategy states and anticipate behavioural changes. A demonstration is presented using competitive motorsport strategy, where hidden energy deployment decisions must be inferred from incomplete telemetry. Although motorsport provides the case study, the method generalises to defence and security applications involving adversarial decision making under uncertainty.

Kalliopi Kleisarchaki, Open University

4b.2

Camouflage, Concealment & Deception in an Age of Artificial Intelligence

While principles of Camouflage, Concealment & Deception (CCD) are long established (at least since Birnam Wood came to Dunsinane) their application has depended on the state of the art of military technology at the time. Witness for example the change from gaudy to drab battledress by the time of WW1, largely in response to improvements in firearms.

We set the scene by breezing through this innovative and sometimes colourful world, ranging from the "dazzle" camouflage of WW1, through pink-painted Spitfires and the "ship disguised as an island" of WW2, to the "nothing to see here" design and operation of Cold War satellites. Coming up to the present, we note how the recent coming-of-age of Artificial Intelligence after decades of being the "next-big-thing" has coincided with the outbreak of major land warfare in Europe. We consider how the development and fielding of drone technologies at scale impact on how CCD is implemented and its effectiveness in the contemporary battlespace.

John Magill, Independent Researcher

Session 5a: Wargaming | Chaired by Mari Troskie, QinetiQ

5a.1

Communications & Electronic Warfare (EW) Warfare Development (WARDEV)

Wargaming in the electromagnetic spectrum domain to test and develop ways of working for comms and electromagnetic warfare has historically been challenging due to the intangible nature of the electromagnetic spectrum. At the same time, wargaming is very effective at representing and developing ways of working in the very physical land domain. As a pilot for UK Land Warfare Centre Operations Research Branch, Roke has demonstrated how a communications and electromagnetic surveillance and attack analysis tool can be used to bring the electromagnetic spectrum to life in a wargame environment and allow a true multi-domain battle to take place. The success of this has launched several follow-on tabletop exercises that are scheduled in 2026 to help UK MOD units understand and develop their multi-domain tactics.

Zoran Dobrosavljevic & Ossian Holford, Roke Manor Research Ltd

5a.2

Blended Wargaming: Integrating Manual and Digital Wargames

Manual and digital wargames are often treated separately, yet this arbitrary division can lead to valuable insights and corollaries being lost. This presentation examines the benefits, challenges, and effort involved in both approaches, and how combining them enables the effective integration of qualitative and quantitative methods. It will explore the trade-offs between fidelity and accessibility, highlighting how different approaches balance realism, cost, speed, and scale. The presentation will also address data validation, showing how manual wargames can challenge assumptions while digital wargames test outcomes at scale. Examples will include Sirius' ongoing analytical wargaming work with the Land Forces Command Operational Research Branch through Project ORION, focused on armoured warfighting for the British Army 20th Armoured Brigade, part of the 3rd (UK) Division, and demonstrating the value of a blended approach.

Jack Bolt, Sirius Analysis

Session 5b: OA using Mathematical and Statistical Methods | Chaired by Alex Ward, Arke Ltd

5b.1 **Multilayered combat modelling using dynamical systems equations inspired by Mathematical Ecology**

We extend Lanchester attrition models to multiple sequential layers of combat using dynamical systems inspired by the mathematical ecology of food chains, where species compete, predators cooperate, and dangerous prey fight back.

The resulting system exhibits complex behaviour including phase portraits with hidden stationary points, unstable saddle points, and critical ridges where tactical decisions or disruptive technologies can produce rapidly changing outcomes or descend into stalemate — behaviours absent from classical Lanchester formulations.

This framework is applied to the air battles over the Bay of Biscay in 1943, incorporating new primary source data from the UK National Archives and RAF Official Histories. The results reveal surprising findings regarding combat outcomes and the factors that determined them, with implications for how historical campaign analysis and counterfactual reasoning can be placed on a rigorous quantitative foundation. Authors Peter Lloyd and Niall MacKay of the University York Mathematics Dept.

Peter G. Lloyd, University of York

5b.2 **Enhancing Online Statistical Decision-Making in Maritime Command and Control Systems: A Resilience Analysis of the LORD Procedure Under Adversarial Data Perturbations**

Real-time statistical inference is critical in maritime Command and Control (C2) systems, particularly for satellite object detection and underwater signal analysis. These applications require online multiple hypothesis testing with strict False Discovery Rate (FDR) control. In operational settings, missing or corrupted data may degrade statistical guarantees. This study evaluates the robustness of the LORD procedure under adversarial perturbations, including missing and corrupted p-values from simulated Gaussian processes. We propose mitigation strategies that adjust significance thresholds and integrate an online Benjamini–Hochberg correction. Monte Carlo simulations show that even isolated missing values can reduce power, while the proposed modifications enhance resilience while preserving FDR control.

Victor Benicio Ardilha da Silva Alves, Center for Naval Systems Analysis, Brazillian Navy

Session 6a: General OA (C) | Chaired by Kieran Rowley, Sagentia Defence

6a.1

Modeling Interdependencies and Cascading Effects on Critical Infrastructures with Risk-Posture-Driven Aviation Security Portfolio Optimization

Critical infrastructures are interdependent, so disruptions can cascade across sectors with major national security, economic, and public safety impacts. We propose a unified modeling-optimization framework that links cascade dynamics to risk-aware airport security investment. We first construct a weighted multi-layer linear-threshold influence network (WMILTIN) to represent cross-sector dependencies and propagation. We then couple WMILTIN to a risk-stratified, multi-objective security portfolio allocation that quantifies airport Risk Posture from enterprise risk factors and security controls. Risk Posture is embedded as node weights (W_4) in the influence objective, while chosen portfolios raise resilience thresholds that increase activation thresholds and suppress cascades. A scalable two-stage engine combines clustering with Simpath/ MC-Greedy for influence evaluation and a Dantzig-Wolfe/ column-generation master for national device allocation. Using U.S. data (216 airports; national flow arcs), we generate Pareto frontiers optimizing Risk Posture, expected detection, and cascade suppression, prioritizing W_4 -critical airports for greatest marginal risk reduction.

This paper is co-authored with Dr. Eva K. Lee.

Dr. Taylor J. Leonard, U.S. Air Force Academy Department of Mathematical Sciences

6a.2

Mission Engineering - a potential solution to systematic capability audits

Capability Audits have historically been disjointed and lacking completeness, resulting in capability gaps being prioritised based on how loudly an argument is made rather than a genuine link to operational effectiveness.

Mission engineering has been proposed as an option to introducing fairness to the capability audit process. This process defines standard end-to-end missions that MOD should be able to perform and describes how these missions can be conducted in different scenarios using current capabilities, allowing failure points to be identified. Iterative use of this technique could allow MOD to understand the impact of these failure points both at a mission level, and across multiple missions or scenarios.

In this presentation, you will get an overview of the mission approach, some of its benefits and potential pitfalls to help you identify where it could be useful in your work.

Jeremy Schwarting, Sirius Analysis

6a.3

Evidencing the Hybrid Navy: Operational Analysis for System-of-Systems Maritime Force Design

The Royal Navy is developing the Hybrid Navy to generate greater operational mass, adaptability and resilience in a rapidly changing maritime environment. The concept applies a system-of-systems approach, combining crewed platforms with distributed uncrewed and autonomous systems, sensors, effectors and digital architectures to deliver maritime effect more affordably and at scale.

This presentation explains how Operational Analysis is shaping, testing and maturing the concept. Wargaming, Modelling and Simulation, Force Generation analysis, cost modelling and structured evidence management are being combined within an iterative evidence cycle. Findings are captured through a Claim–Argument–Evidence framework, linking assumptions to evidence, uncertainty, risk, cost and delivery dependencies.

Using Hybrid Navy as a case study, the presentation explores how Operational Research can actively shape force design, expose critical assumptions, prioritise evidence gaps and support transparent, defensible decisions about the future maritime force.

Daniel Bray, Office of the Chief Scientific Adviser, UK Ministry of Defence

Session 6b: Artificial Intelligence Enabled OA | Chaired by Ed Aubrey, BAE Systems

6b.1

A Framework for Assessing Sovereign Decision Support

Digital sovereignty can be understood as enabling organisations to consciously shape their own digital futures (Mike Braken, '[Our view on digital sovereignty](#)', Public Digital, 2025). For organisations where AI is increasingly integrated into analysts' and decision makers' workflows that provide decision support, such as Dstl, how should digital sovereignty be assessed? How should risks be considered and where should interventions be prioritised? This presentation proposes using a systems thinking-based approach to chart how analysts support senior decision-makers, mapping the inputs and outputs of this process, the dependencies, risks and opportunities across the decision support 'tech stack.' Such an approach would assist organisations in planning where to prioritise interventions, and to manage or mitigate risk.

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Geoffrey Chapman & Amy Salmons, Dstl

6b.2

Edge Artificial Intelligence and automation supporting decision-making efficiency in defence

Defence verification, assessment, and compliance workflows are typically data-intensive, document-heavy, and time-constrained, yet they must remain auditable, consistent, and defensible. This presentation draws on operational research conducted for a customer within the MOD to examine how Artificial Intelligence (AI) and automation can be combined to enhance decision-making efficiency in such environments.

The research synthesises evidence across major AI techniques alongside automation approaches. A recurring finding is that operational impact requires combinations of techniques embedded within controlled workflow architectures. Therefore, a modular edge AI architecture is proposed, incorporating a purpose-built orchestration layer to route data between functional modules and a bespoke human-facing interface designed to support non-technical decision-makers. Governance constraints and data sovereignty requirements are examined as critical considerations for responsible deployment within the defence context.

Jon Carter, RT Consulting

6b.3

What can Artificial Intelligence really do for defence OA?

Operational Analysis (OA) has long provided decision-makers with rigorous, evidence-based insight under uncertainty. This presentation provides a high-level overview of how advances in Artificial Intelligence (AI), specifically prompt engineering and the use of AI agents, offer new opportunities to enhance this analytical discipline, while also raising important questions around trust, validation, and appropriate use in defence contexts.

It explores how AI can be effectively integrated into the OA toolset to augment, rather than replace, established analytical methods. Drawing on the OA lifecycle, it demonstrates where AI techniques can improve speed, scale, and insight generation. The presentation also addresses the limits of AI, including data dependency, explainability, and governance challenges, and discusses how traditional OA practices provide a strong foundation for responsible adoption. The aim is to move beyond “AI hype” and provide a pragmatic perspective on how AI can strengthen the quality and impact of defence OA.

Joe Clayton, Sirius Analysis

WORKSHOPS

Workshops will run in parallel and over two separate sessions, offering delegates the opportunity to participate in up to two different workshops. Schedule and timings will be available in the programme and delegates will be able to sign up for workshops in the morning break sessions.

A1	<p>Impactful Presenting: Top tips to prepare and deliver briefings with ease</p> <p>Presenting work can be daunting and anxiety-inducing but being prepared can help. This workshop aims to give an introductory overview to presenting work and information and is aimed at early career analysts. We will cover top tips on the whole presenting process, from planning through to the actual presentation and will include interactive group sessions on answering impromptu questions. This workshop is a supportive environment, but please feel free to talk to Gretta Bunn or Lucy Thompson if you feel especially nervous or anxious.</p> <p>Gretta Bunn, Lucy Thompson & Marilyn Evans, Sirius Analysis</p>
B1	<p>Networking – How to build and grow your connections</p> <p>This workshop will be a hands-on networking session, providing both tools and techniques, as well as time to meet new faces at ISMOR. Participants will be introduced to a set of networking techniques, which they will then have the opportunity to try and practice with other participants.</p> <p>These sessions will include advice on how to make initial introductions with a new contact, as well as how to leverage your current network to find and meet relevant new people. They are designed to be beginner friendly, to help participants build their confidence, and establish initial contacts to use for the rest of the conference.</p> <p>The workshop will also have a keynote speaker, who will talk about their experience networking. This will include discussing how they have used their network to forward their career, as well as a question-and-answer session at the end for those looking for specific advice.</p> <p>Alexander Ward & Rob Solly, Arke Ltd & Cosimmetry</p>
A2 / B2	<p>Visualising Complexity: A Practical Workshop on Ecosystem Mapping</p> <p>This workshop introduces Ecosystem Mapping as a systems-thinking tool for visualising how activities interact across complex organisations. A short presentation will be delivered on the purpose and structure of Ecosystem Maps, that will equip participants with a toolbox of techniques for constructing ecosystem maps. Participants will then work through an unfamiliar scenario in hands-on group exercises to build an interconnected map. Each task develops a different layer, exploring interdependencies, risks, bottlenecks, and value flows. Groups will then back-brief insights to deepen their understanding of how Ecosystem Mapping supports analysis and decision-making. Participants will leave with practical experience constructing layered maps, recognising critical relationships, and applying collaborative modelling techniques to communicate insights and challenge assumptions</p> <p>Philip Holness, Sirius Analysis</p>

<p>A3 / B3</p>	<p>Exploring Modelling in Defence: Methods, Limitations and Uncertainty</p> <p>This workshop opens with a discussion of different modelling approaches, leading into an interactive exercise to explore how these can be applied to Defence problems. The workshop will then discuss modelling enablers, such as sensitivity analysis, Verification & Validation (V&V) and crafting representations of the real-world.</p> <p>Mike Walker, Arke Ltd</p>
<p>A4 / B4</p>	<p>Edge of Tomorrow: Outlining a Pathway Methodology for Scenario Development</p> <p>A Pathway Methodology for Scenario Development was utilised as part of Operational Analysis undertaken to support the British Army during Army Wargame 2025. Seeking to cohere and structure Adjudication decisions and provide a coherent, probable and considered narrative to Wargame Participants, the Pathway Methodology for Scenario Development acts as a bridge between often abstract, ill-defined Scenario Development techniques, and the Analytical requirements which underpin a Wargame (e.g. Research Questions). The techniques facilitates dynamic play, allowing for the consideration and play of factors previously unconsidered or beyond or outside the expertise collated within an Adjudication cell.</p> <p>This presentation explains the methodology and its application, considers critiques and asks how it can or should be developed.</p> <p>Mari Troskie, Louis Jeffries and Nick Riggs, QinetiQ Training and Simulation Ltd (QTSL)</p>

POSTERS

Posters will be available to view during the poster session, which will be held during lunch of Day 2 of the conference. The posters' authors will be available during this session to answer any questions regarding their poster. Following the poster session, the posters will remain available for viewing until the conference close.

A	<p>Multi-target path planning for pseudo-collaborative scalable Artificial Intelligence Unmanned Aerial Vehicle swarms using Quality-Diversity neuro-evolution</p> <p>This work demonstrates multi-target path planning for Artificial Intelligence (AI) Unmanned Aerial Vehicle (UAV) swarm simulation by utilising a novel approach of assembling AI agents from a diverse repertoire of high-performing AI UAV controllers, which achieve different goals, trained through Quality-Diversity (QD) optimisation applied to neuro-evolution. QD approaches have been shown to develop a collection of high-performance AI agents which each belong to a behavioural niche for a given task, we extend this by defining different goals as behavioural descriptors in order to assemble these individual agents in pseudo-collaborative swarms without explicit communication. This work uses MAP-Elites to generate a repertoire of UAV neural controllers guided toward a number of different targets. The trained agents are then sampled to assemble and simulate massively scalable UAV swarms.</p> <p>Dan Scarrett, MBDA UK</p>
B	<p>Carbon Fighting - An Arke carbon model</p> <p>Singapore aims for net zero by 2050 and to cut emissions to 60 MtCO₂e by 2030. The Singapore Civil Defence Force (SCDF) are part of this commitment and have implemented various initiatives in support of a sustainable Singapore. The Arke 'Carbon Fighting' model provides SCDF with evidence to benchmark carbon emissions avoided through an early firefighting response. By simulating the suppression of the fire, the model calculates how much carbon is saved through extinguishing a fire, but also how many greenhouse gasses are released by the SCDF fleet in their firefighting efforts. This evidence-based understanding of SCDF's firefighting carbon footprint is key to understanding the impacts of SCDF sustainable initiatives such as vehicle electrification. This model was developed by Arke Ltd for SCDF through the Hatch Dimension X programme and is a POC in response to the challenge statement: "Measure and benchmark carbon emissions avoided through early firefighting response".</p> <p>Thomas Hurst, Arke Ltd</p>

C	<p>From Observations to Interventions: A Method for Analysing Complex Training Processes</p> <p>This analysis reviews collective training and exercise processes to identify opportunities for improved effectiveness, efficiency, and adaptability. Analysis and stakeholder engagement highlighted challenges including prolonged planning timelines, unclear roles, limited automation, and weak integration of lessons learned. The findings show that staff capacity constraints, poor requirement traceability, and inconsistent process discipline reduce training quality and responsiveness. The analysis proposes targeted interventions such as streamlining planning products and milestones, strengthening governance and terminology, improving knowledge retention, and adopting automation and artificial intelligence. Together, these measures aim to enhance agility, reduce resource demands, and deliver more relevant, timely, and realistic training outcomes.</p> <p>Esmeralda Gomes, Sirius Analysis</p>
D	<p>Speaking the same language: Using the Strategic Planning Framework to align Strategy, Risk and Resources</p> <p>Cyber and Specialist Operations Command (CSOC) comprises a diverse set of organisations spanning multiple domains and capabilities. While this diversity is a strength, it presents a systematic challenge: achieving coherence, alignment and unity of effort across activities that may otherwise appear disjoint. This talk presents the Strategic Planning Framework (SPF), a command-level logic model that enables CSOC to operate as a single, coherent enterprise. The SPF translates strategic intent into a hierarchical model linking Command Objectives, Decisive Conditions and Effects. By abstracting organisational detail into higher-order constructs, it enables shared analysis of complex systems and provides a clear link between strategy and planning. The talk demonstrates how applying the SPF to resource allocation, performance measurement and risk management produces consistent prioritisation outcomes, enabling evidence-based decision-making and improved strategic coherence across the Command.</p> <p>Will Sharrock, Catalyze</p>
E	<p>From Wargame to Dataset: A Platform for Real-Time Wargame Data Collection and Analysis</p> <p><i>Abstract awaiting approval for release</i></p> <p>Karsten Pedersen, Sirius Digital</p>

F	<p>Turning Science Fiction into Science Fact</p> <p>Defence needs to keep ahead of emerging Science and Technology (S&T) to remain relevant into the future and maintain an operational advantage over its adversaries. Operational Research (OR), especially soft OR approaches, offers one way to help Defence understand which potential future technologies might be of interest, and which ones are actual fiction. As some of this emerging S&T may only be viable in 50 years' time, these can border on science fiction but could offer a real opportunity, if understood effectively.</p> <p>Our poster will illustrate how we use OR techniques to navigate through the process of identifying signals, assessing scientific validity, and developing concepts for potential Defence application. We will highlight our approaches to horizon scanning, concept development, and ultimately road mapping for what else needs to happen to ensure these concepts become science fact, offering insight to Defence on ways it could retain its technological edge.</p> <p>Lewis Downward, Sagentia Defence</p>
G	<p>Climate Change Impacts on Defence and Security</p> <p>With climate change having more of drastic and prolonged an impact on weather events across the world it's time to develop our understanding of what effects this could potentially have on defence and security. This poster begins to question what these effects could be from what changes could be expected across the expected operating environment to understanding how civil resilience will change and how it weaknesses caused by climate change could be exploited; it will also begin to raise questions regarding climate change technology and how it could be exploited to bring operational advantage. The Poster will also propose a hypothetical scenario, focused on the UK, that demonstrates how scenarios and wargaming techniques can be applied to aid planning through decision support.</p> <p>Jonathan Walker, QinetiQ</p>