42nd International Symposium on Military Operational Research

National Oceanography Centre, 15-17 July 2025

Abstracts and Biographies

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Table of Contents

Symposium content subject to change without notice

KEYNOTE

The Implications of the Changing Character of Conflict for Future Force Design

After 35 years of Defence service, and in the wake of SDR25, Brig Pearce reflects on the nature of conflict and changes to its contemporary and future character, including how we will need to be able to innovate and adapt rapidly as we seek to develop a winning warfighting capability. In seeking to find the sweet spot between prediction and reaction, he considers both what is new and what we might re-learn from history, including going back to some fundamental ideas, not least from the ancient Greeks. The talk represents a call to arms about how the whole Defence enterprise needs to optimise how it works together, whether military, allies, partners, defence industry, academia, science, innovation and technology, or operational and intelligence analysts, to co-create, experiment with and provide evidence for the art of the possible, while making tough choices.

Brigadier (Ret'd) Austen Pearce, Dstl's Chief Force Development & Design

Brigadier (Ret'd) Austen 'Oz' Pearce commissioned into the British Army in 1990. He enjoyed a 34 year career in two main arenas. In intelligence roles, he commanded at all levels up to Brigade, largely specialising in intelligence assessment and human intelligence. In Strategy and Force Development roles, he was Head of British Army Concepts, Chief Instructor at the UK Staff College, the UK's National Military Representative in NATO ACT, and a Deputy Director for Strategy, Policy, Engagement and Force Development in UK Strategic Command. Operational deployments were centred on Bosnia and Afghanistan. In the latter he worked for Generals David Richards and Stanley McChrystal when they commanded ISAF, and he was awarded a Queen's Commendation for Valuable Service in that theatre. A historian, he holds Masters degrees from Cambridge and Cranfield Universities and is also an alumnus of the Royal College of Defence Studies. In 2024, upon retirement from the army, he joined Dstl as Chief Force Development & Design, and works as an adviser across programmes involved in Strategic Analysis, Force Development, Influence and Command.

PANELS

Force & Concept Development

Under the theme of Force and Concept Development, our presenters will have discussed the challenges and methodologies shaping future defence capability in a rapidly evolving strategic environment. These contributions emphasize the need for rigorous, adaptive, and multidisciplinary approaches to concept development and force optimization. Our panelists will discuss their perspectives on these challenges as we seek sound methodological foundations to ensure we have the right force, for the right job, ready at the right time.

Chair, **Matt Bunn**, Catalyze Consulting
Jan Frelin, FOI (Swedish Defence Research Agency)
Guy Griffiths, Sagentia Defence
Austen Pearce, Dstl

AI and Model Development

Under the theme of Artificial Intelligence (AI) and Model Development, four presentations illuminated the diverse and evolving applications of AI across defence contexts, with a focus on enhancing decision-making, autonomy, and resilience. The exploration of Generative AI (GenAI) highlights its strategic utility in domains such as intelligence analysis, logistics, cybersecurity, and information operations, while underscoring the imperative of responsible implementation with regard to reliability, sovereignty, and compliance. More narrowly focussed use cases demonstrate the breadth of application areas. Collectively, these efforts demonstrate AI's expanding role in operational foresight, autonomous system development, and adaptive learning for future military advantage. The panelists will discuss where these techniques are leading us, as military operations research continues to evolve as the 21st century progresses.

Chair, **Alex Sheen,** Catalyze Consulting
Iain Cruickshank, U.S. Special Operations Command
Scott Mongeau, Google Cloud
Gabriel Custodio Rangel, CASNAV - Brazilian Navy

Wargaming

Under the overarching theme of wargaming, four presentations of very different wargaming developments collectively underscored a growing emphasis on methodological innovation, analytical rigor, and the expanded utility of wargames as tools for both strategic insight and force development. Across these efforts, common threads emerge: a commitment to analytical integrity, a recognition of wargaming's value in exploring uncertainty and behaviour, and a drive to refine wargaming methodologies to better support defence decision-making. The panelists will discuss their perspectives as to the trajectory of this evergreen military operations research technique.

Chair, **Dr Ben Taylor**, Colcestrian Consulting
James Bennett, BAE Systems
Tom Halliday, Sirius Analysis
Sophia Lander, University of Texas
Dominic Rougier, Dstl

MORS' Eugene Visco Prize-Winning Presentations

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.

The Evolution of the AI/ML Operations Research Professional

Military analysis is undergoing significant transformation. Achieving decision advantage—the capability to make faster, better decisions than adversaries—is increasingly recognized as crucial for success on modern battlefields. This advantage necessitates handling large volumes of multimodal, noisy digital data and effectively leveraging technologies such as Artificial Intelligence (AI). The recent advancements in machine learning (ML) and AI are driving changes in military analysis. The robust open-source AI community, coupled with the generalist nature of foundational and generative AI models, is democratizing techniques from fields like data science and statistics. Consequently, domain experts outside of Operations Research (OR) can now perform analyses traditionally reserved for OR practitioners, challenging the role of military OR professionals. In this presentation, I will explore the emergence of the AI/ML OR professional. While military OR practitioners have been at the forefront of applying data science and AI to military challenges, these developments are prompting an evolution within the military OR field. I will discuss how AI/ML Operations Research/Systems Analysts (ORSAs) within the U.S. Army deliver value to operational commands. Additionally, I will cover recent efforts toward establishing an AI/ML ORSA career field within the Army, detailing work roles, career paths, and selection criteria for these professionals. Finally, I will conclude with best practices for delivering AI/ML solutions to military organizations and offer insights into the future of AI/ML OR professionals.

Iain Cruickshank, U.S. Special Operations Command, 2021 Winner

Deception as a Successful Deterrent of Aggressive Action: A Game Theoretical Approach to Wargaming

Current wargaming efforts tend to showcase interactions between adversaries and allies through seminar-type reenactments that control for uncertainty using a game plan. As a result, wargaming efforts tend to be limited by their labor intensity and non-replicability. This extends to models of deception, which commonly rely on dice rolls to determine the deception's outcome. Yet, this discounts the logical and complex organization any deception requires.

The works of Davis et al. and Sokri 2022 illustrate the benefits and natural appeal of using game theory to create replicable and logical models of deception. However, existing game theory models of deception struggle to operationalize their findings and fail to provide adequate applicability of their model to military operations. This paper attempts to relieve this shortcoming in two ways. First, by narrowing the scope of the deception to only serving as a deterrent of aggressive brute-force action by both adversary and ally, the model presented in this paper can prove an operational space in which a deception will be successful. Second, by allowing actors to play a continuum of moves (i.e., a specific deceptive strategy is left undefined) the model has an easier time translating qualitative assumptions regarding the costs and benefits of executing a deception. Ultimately, the model, in its findings, illustrates how qualitative qualms of current wargaming techniques can be mitigated by game theoretic approaches.

Sophia Lander, University of Texas, 2024 Winner

Session 1a: Concept Development | Chaired by Sam Andrews, Sirius Analysis

1a.1 **Concept Analysis: Delivering Affordable and Resilient Effect**

The landscape of warfare is changing. Advancements in technology and data are changing the way we Deter, Defend and Defeat. In order to react at a pace of relevance and to be able to adapt and sustain to outlast the duration of the conflict, innovative approaches are necessary to deliver combat mass and capability efficiently and affordably. Our customer sought to understand the products and technologies that would be most critical to them in the next 18 to 24 months. This presentation will outline the analytical techniques used (and the challenges faced) in identifying capabilities or product features that will provide operational advantage for future growth concepts, including:

- Evaluating concept maturity
- Developing vignettes and use cases
- Conducting driver analysis based on measures of performance (MoPs)
- Performing sensitivity analysis of MoPs to identify key factors that will maximise end-user advantage and product differentiation.

Clarice Chung, BAE Systems

1a.2 **What's wrong with CD&E? An Evaluation of the Justification for Concept Development & Experimentation**

The scientific validity of Concept Development & Experimentation (CD&E) methods have been questioned in a scholarly journal recently. As a response, I review CD&E manuals from NATO and the UK with the aim of evaluating their claims of scientific justification. The framework I use for assessing the scientific justification of CD&E is Ormerods framework for justifying operations research methods. My evaluation finds that the methods indicated in current CD&E manuals can find justification in this sense. However, there are important omissions in what scientific fields that CD&E draws from. There is hardly any mention of research from war studies, and the research into deep uncertainty has been passed over. This has led to an underestimation of the uncertainty that pertains to military concept development. Current methods fit the problem, but there is scope for investigating more options. However, uncertainty threatens the external validity of CD&E, and current manuals oversell what's possible to achieve.

Jan Frelin, Swedish Defence Research Agency (FOI)

1a.3 **Technology Investment Appraisal into JMSC**

The Joint Maritime Security Centre (JMSC) is the multi-agency organisation responsible for ensuring the UK maintains its understanding of the UK maritime domain. JMSC seeks to understand technologies that could provide long-range, persistent surveillance of the UK Marine Area. In late 2024, JMSC asked CORDA to perform an Investment Appraisal of High-Frequency Surface-Wave Radar (HFSWR) to understand the options for investing in it, how much it would cost, and how much benefit it would provide. CORDA, with help from Techmodal, applied tried-and-tested cost modelling, performance analysis, scenario analysis and multi-criteria decision analysis techniques to represent the cost and benefit of HFSWR. The evidence CORDA provided will be used to consider how the UK could improve its maritime

	domain awareness and understanding. In this presentation, we will present the methodology and findings used in this study by CORDA and Techmodal to deliver the Investment Appraisal into HFSWR. **Vinnie Young**, BAE Systems
Session 1b: Analytical Tool Development | Chaired by Ed Aubrey, BAE Systems	
1b.1	**ERICA: Empowering Experts in CBR Site Decontamination** The National Technical Advisory Group for chemical, biological or radiological (CBR) Recovery (NTAG-R) programme is a collaboration between DEFRA and Dstl to drive the development of tools, techniques, and capabilities to recover an incident site contaminated with CBR. As part of this, Sagentia Defence have been developing the Environmental Recovery Involving CBR Agents (ERICA) toolset over the last four years. What started as a quick Simul8 model to allow NTAG-R to assess stockpiling strategies and calculate recovery costs, has grown into a wide-ranging and complex toolset to support NTAG-R to rapidly represent contaminated sites, assist the expert in selecting a remediation strategy, highlight potential challenges, and provide estimates of time, consumable and resources required to render a site safe. The ERICA toolset is written entirely in Python, featuring: a user-interface that links to a custom SQL database, a discrete-event simulation of the actual recovery process, and an interactive results dashboard. **Mike Walker**, Sagentia Defence
1b.2	**Capability Audit Tool** The Army needs to make risk, threat and opportunity informed decisions around future capabilities. Part of this process is conducting a 'capability audit' for how its current and planned capability delivers against policy. Traditionally performed in Excel, the complexity, scale and value of this process necessitated a move to a modern software platform at the appropriate classification. This tool was developed to capture, manage, visualise and analyse capability data, supporting resource allocation and strategic planning across the command. It dynamically assesses risk forecast across multiple scenarios over a 20-year scope and presents historical data to help users scrutinise and moderate decisions from various perspectives. In this presentation, we'll discuss the design approach behind creating an intuitive user focused tool, the importance of audit trails in collaborative environments, and demonstrate key features including data visualisation, branching data sets, analytical capabilities, and upcoming enhancements that support more informed, data-driven decisions. **Will Sharrock**, Catalyze Consulting
1b.3	**Outplace: Interactive Games for Complex EME Optimisation** Optimising activities in the Electromagnetic Environment (EME) is a multi-agent, high-dimensional challenge influenced by spatial, temporal, and spectral factors such as power, frequency, polarisation, and environmental conditions. Outplace, an abstract adversarial game developed under Dstl's Integrated Electromagnetic Activities Options (IEMAO) project, explores optimisation algorithms and decision-making techniques to support operations in the EME. It encourages participants to tackle tactical

	challenges and adversarial scenarios, providing insights into the interaction between human decision-making and automated optimisation tools. This work aims to demonstrate the rapid development of prototype decision-support tools, exploiting a range of optimisation and data science techniques to address the complexities of the future EME. The presentation will include an interactive demonstration, offering attendees the opportunity to engage with the tool and explore its potential applications. **Ed Butcher**, Dstl
Session 2a: AI in Defence | Chaired by Geoffrey Chapman, Dstl	
2a.1	**GenAI for Defence: Use Cases and Requirements** This presentation will explore the transformative potential of Generative AI (GenAI) for military capabilities. Drawing upon recent research and operational insights, we will highlight practical GenAI applications in critical domains including intelligence analysis, logistics, cybersecurity, and simulations. In the context of the information environment, we will examine GenAI's contributions, particularly in enhancing information analysis, detecting mis/dis-information, and supporting strategic communication. This underscores GenAI's capacity to furnish mission-critical insights, enhance operational efficiency, and contribute substantially to achieving strategic and operational decision advantage. Finally, we will frame key considerations for responsible defence deployment, such as reliability, security, compliance, and sovereignty. **Scott Mongeau**, Google Cloud
2a.2	**Robust Machine Learning for Naval Image Classification in the Blue Amazon** Technological innovation plays a vital role in strengthening security and surveillance efforts, particularly in maritime domains where the extensive coastal landscape demands autonomous monitoring systems. Advanced tools like artificial intelligence, machine learning, and computer vision have enabled substantial progress in this field. However, their performance is closely tied to the quality of training data, which is often affected by human error, sensor malfunctions, or even intentional adversarial interference. To address these challenges, this study introduces a novel maritime image classification framework based on Rockafellian Risk Minimization (RRM). This method mitigates the impact of data corruption by dynamically adjusting neural network weights and modifying probability distributions, effectively isolating anomalies. As a result, the approach reduces the dependence on time-consuming data preprocessing and improves processing efficiency. Comparative evaluations have demonstrated that the RRM-based model offers enhanced resilience over conventional methods, making it a promising solution for more robust ship detection and improved maritime surveillance in support of the Brazilian Navy. **Gabriel Custódio Rangel**, CASNAV - Brazilian Navy
2a.3	**Simulation Testbed Capability** Modern advancements in automation and artificial intelligence (AI) have opened a new solution space in the underwater domain. There is an opportunity to reduce the Command and Control (C2) burden on the human operator, compared to current legacy C2 solutions. The aim for project Seetoo is to explore this new solution space by providing a simulation testbed, on

	which modern C2 solutions can be rapidly deployed and evaluated, without the overhead of real world platform test and integration. The simulation testbed will aim to model real world operational geometries and take advantage of computing power to run large-scale randomised simulations. Project Seetoo recently evaluated an AI navigation solution to automate collision avoidance and path planning for Ownship. This presentation will describe the Seetoo simulation testbed capability and evaluation of the AI navigation solution. **James Stevens & Shiva Waggott**, BAE Systems
Session 2b: Simulation | Chaired by Emma Hopkinson, MBDA	
2b.1	**From Fuzzy to CRISP: A Data-Driven Framework for Defence Simulation Studies with CRISP-DM** Modern military challenges demand more than just simulation – they require structured, data-driven approaches that deliver actionable insights. This presentation introduces a framework that integrates the CRoss-Industry Standard Process for Data Mining (CRISP-DM) into a mixed-method Defence simulation approach. Designed to help analysts navigate from unstructured problem narratives to actionable insights, the framework supports analysts from problem definition through to modelling, analysis, and visualisation of the simulation outputs. We showcase its impact through a real-world case study: an international war-gaming event exploring autonomous platforms. In this event, we used Human-in-the-Loop simulation and structured debriefs to constrain an ill-structured subspace of the experiment design matrix. A custom visual analytics application was deployed to support qualitative analysis and analysis of constructive simulation within a design of experiments approach. By embedding CRISP-DM into Defence simulation studies, this approach enables multi-dimensional analysis and provides a repeatable foundation for future Defence simulation studies. **April Tieu**, Dstl / DSTG
2b.2	**From Grid to Ground: Unlocking NRMM Terrain Intelligence in ArcGIS** Dstl identified a critical need to enhance the exploitation of NATO Reference Mobility Model (NRMM) data through improved geospatial visualisation and analysis. NRMM models terrain using a grid of cells, each containing parameters such as soil strength, slope, and vegetation—key inputs for assessing off-road vehicle mobility. However, limited GIS integration, manual processes, and constrained internal expertise limited effective analysis. To address this, BAE Systems CORDA developed a Python-based tool that automates the conversion of NRMM data into ArcGIS-compatible formats, with built-in validation to ensure data integrity. This enables the efficient production of terrain parameter maps, go/no-go overlays, and speed assessments. In parallel, a strategic roadmap was produced to guide the development of future GIS capabilities, addressing visualisation, and analysis. Together, these outputs enhance analytical efficiency, support more accurate mobility forecasting, and provide a scalable foundation for improved operational decision-making through geospatial intelligence. **Dr Annabel Whipp & Andrew McAra**, BAE Systems
2b.3	**Saving Lives with Simulation: Modeling Medical Support for Operations** Defence Medical Services contracted Techmodal to investigate deployed medical requirements for a warfighting operation.

	The team consulted Defence SMEs and experts in clinical medicine to understand the Operational Patient Care Pathway (OPCP), and developed the CHIRON discrete-event simulation model in Python. CHIRON simulates the flow of patients from the point of injury to evacuation, through various levels of deployed medical care. The model can quantify deployed hospital requirements for any planned operation, from the number of operating tables in use to the requirement for in-theatre transport and consumable equipment. As a result, DMS are now able to assess the efficacy of operational planning and the impacts of capability shortfalls or enhancement. Modelling & analysis using CHIRON enabled Defence Medical Services to support their investment decisions with clear evidence of how they would reduce queue times for treatment, improve operational effectiveness of fighting units and ultimately improve UK forces' survivability. **Oliver Grieve**, Techmodal
Session 3a: General OA (Stream 1) | Chaired by Sam Andrews, Sirius Analysis	
3a.1	**Analysis delivering diversity** The UK Defence community is currently dominated by a narrow demographic and ways of naturally increasing diversity are continually being explored. This presentation is a reflection on an impactful analysis study delivered by BAE Systems to MOD which, through appropriate coaching by an experienced technologist, saw more than half the hours spent on the project delivered by Early Careers talent. Given the greatest diversity in our workforce is in the Early Careers community, this model is a natural way of embracing the diverse talent amongst those starting their career and encouraging them to stay engaged in defence Science, Technology & Analysis. Making this model "normal" now will help bring diversity to the middle and senior research community of the future. **James Gerard**, BAE Systems
3a.2	**Predicting Russian Tank Army doctrine from historical patterns of doctrine development** In December 2024, the NATO SHAPE Red Team commissioned a study into the learning patterns of Russian tank army commanders in order to predict future Russian tank army doctrine. This study used the Red's Shoes AI application to analyse how 6 Russian tank army commanders of World War II learned from their experiences, and changed their doctrine through the war. In particular it highlighted the key metrics that drove learning and practical implementation of doctrine, how these differed by commander, and how this all translated into formal doctrine depending on the subsequent roles and responsibilities of the commanders. This pattern was then overlaid onto the experiences of the commanders of the Russian 1st Guards Tank Army to predict the emerging doctrine. This work highlighted the need to track the experiences and progression of particular army commanders in order to predict future doctrine. **Darrell Jaya-Ratnam**, DIEM Analytics
Session 3b: General OA (Stream 2) | Chaired by Ed Aubrey, BAE Systems	
3b.1	**Conducting Operational Research at the early stages of technology development – the Bright Corvus approach**

	Down-selecting technical concepts for further investment and research is a critical process at many stages of a project. However, it typically becomes more straightforward as concepts mature due to the availability of more data. This study explores the advantages of conducting operational research at the early stages of technology development, particularly at low Technology Readiness Levels (TRLs), and examines how operational research can enhance decision-making by providing valuable insights. Focusing on multiple different distributed Sense and Effect technologies under a project called Bright Corvus, this research employed a novel collaborative approach between Dstl and various industry suppliers to assess the potential utility of the emerging technologies in future operational scenarios. The study presents the analytical methods used and discusses both the benefits and challenges of this early-stage assessment, highlighting its impact on guiding investment decisions. **Becky Barlow,** Dstl
3b.2	**Power and Mobility Optimisation in Multi-Agent Electronic Warfare Games** We consider two adversarial fleets of autonomous UAVs making simultaneous decisions about intra-fleet communication, jamming the opponent, and movement within a shared environment. The focus is on optimising agent's strategies in adversarial multi-agent games using a Nash zero-sum framework, with the core of the model built around an objective measuring Signal-to-Interference-plus-Noise Ratio. Each fleet looks to maximise their aggregated communication links but minimise the opposition's. By formulating the model in such a way, we provide a representation of the effectiveness of the communication between two agents in the presence of noise and deliberate adversary interference based on the underlying properties of the electromagnetic spectrum. Agents face constraints on energy, mobility, and inter-agent separation, resulting in a tightly coupled optimisation problem. To handle the complexity of multiple objective functions, the problem is scalarised. We consider the non-convexity of the problem and provide a regularisation technique to circumvent such issues. Following that, we present a fixed-point formulation of the best-response dynamics, ensuring convergence to solutions which are both theoretically sound and computationally tractable. **Rachel Shaw,** Southampton University
Session 4a: Wargaming | Chaired by Ed Aubrey, BAE Systems	
4a.1	**What can nuclear wargames tell us about escalation and nuclear deterrence?** The Defence Science Technology Laboratory (Dstl) has created a simple, and accessible, wargame representing strategic nuclear deterrence. This game has been played a number of times, with players engaging in a fictional crisis with a range of possible outcomes exhibited from nuclear war to de-escalation. We are proposing a 20 minute presentation covering the design of the game, its objectives, observations on escalation pathways encountered so far, takeaways and future directions for research. It will also compare how existing theories of nuclear escalation compared to the observed narratives, and what insights might be drawn from this. This presentation would highlight how wargames provide unique insights into decision making processes in high escalation scenarios. In addition, it would showcase wargaming's utility in the study of nuclear deterrence, while increasing exposure to the use of wargaming as a research method. **Ethan Sykes,** Dstl

4a.2	**Rapid Parallel Wargaming – An Alternative Approach to Analytical Gaming** A complementary presentation to the workshop of the same name, in this session Sirius Analysis will explore the theory, methodology, benefits and pitfalls of running multiple rapid wargames in parallel. Sirius Analysis has hypothesised that it may be possible to multiply wargaming output by running multiple low-confidence wargames in parallel. By accepting a low-confidence output and using simple models, it may be possible to produce a greater quantity of qualitative insight than traditional analytical wargaming methods. Additionally, it may be possible to generate bulk data sets for quantitative analytical outputs. Opening with a discussion on the theory of this methodology and why Sirius is exploring it, the presentation will then move onto presenting the results of the parallel wargaming workshops to illustrate the theory of how rapid parallel wargames can be exploited at pace. Some of the pitfalls and difficulties with such a method will also be explored. **Tom Halliday & Jack Bolt**, Sirius Analysis
4a.3	**Wargaming Operational Art: The design of the Generic Low Operational Wargame system** The Generic Low Operational Wargame is a new analytical wargame designed by and for Dstl, designed to represent joint operations at the scale of multiple corps over a period of 2-4 weeks. The outputs are intended to be both qualitative and quantitative, with outputs to support force development and war development. Core aspects include the combat modelling, interactions between key enablers and representation of logistics. In particular, this wargaming method offers an approach for dealing with the termination problem in combat modelling, as well as a representation of logistics in a practical context. This presentation will discuss the theory, design, and implementation of the game from a technical perspective, with focus on the historical analysis, modelling and operational research that underpin the design. **Dominic Rougier**, Dstl
Session 4b: Framework Development | Chaired by Emma Hopkinson, MBDA	
4b.1	**How can we develop 'good' indicators for evaluating the effect(s) of our activities?** Monitoring and Evaluation (M&E) enables decision-makers to better understand the impact of planned activities, and informs future planning by considering what activities work, why they work, and what contexts they work in. Despite consistent acknowledgement across UK Government of the importance of M&E, doing M&E properly remains a fundamental challenge. A key problem within this is how to generate indicators of effect. An "indicator of effect" is a measurable variable that provides evidence of an impact or change caused by an intervention or action. As such, they are crucial for M&E. However, there is no agreed method for generating indicators of effect. Through consideration of current M&E best practice, Dstl has generated an 8-point list of universally applicable guidance for generating indicators of effect. This presentation will provide detail on this guidance, serving as a basis for improving M&E practice across UK Government, and the social sciences more broadly. **Ross Perry**, Dstl
4b.2	**The Key Attributes of an Ideal Complex Engineering Software Programme** The Global Combat Air Programme (GCAP) is a large, multi-national collaborative complex engineering procurement of a sixth-generation air system, being conducted by Japan, Italy and the UK. From a UK perspective, GCAP will be the core component of the UK's Future Combat Air System (FCAS). Software represents a significant risk to complex engineering projects like FCAS, hence there is a strong desire to understand and apply software lessons from previous similar endeavours. The UK Defence Science and Technology Laboratory (Dstl) had previously

	conducted an informal analysis of reports published by the US Government Accountability Office relevant to the F-35 procurement. Through a highly successful collaborative tasking Sirius Analysis and Arke Ltd worked to enhance and extend the previous findings through an in-depth, rigorous, open-source literature review. From the identified software lessons learned this task generated six "Key Attributes of an Ideal Complex Engineering Software Programme". **Jaspal Kang**, Sirius Analysis
4b.3	**The Analysis-Led Wargaming Framework** Originated and further developed by BAE Systems CORDA for UK Strategic Command's Defence Experimentation and Wargaming Hub (DEWH), the Analysis-Led Wargaming Framework (The Framework) builds on the foundations set out in the MOD's Defence Wargaming Handbook and integrates academic social science research methodology and methods into the wargaming life-cycle. DEWH is focused on wargaming for analysis, and the Framework is designed to make every phase of the wargaming life-cycle 'analysis-led' with concurrent assurance — analytical rigour is the central guiding principle. This presentation will outline the key components of the Framework, including: • a revised wargaming lifecycle for analytical wargames; • a commissioning protocol to ensure precise requirements capture (with application to all research projects), and; • real-time assurance processes for wargaming. **James Bennett,** BAE Systems
Session 5a: General OA (Stream 3) | Chaired by Geoffrey Chapman, Dstl	
5a.1	**Managing scenarios in a complex modelling enterprise** The SSNA Integrator acts as a central point of responsibility for ensuring that all the different parts of the submarine enterprise work together effectively. The Integrator works with various stakeholders, including: The Submarine Delivery Agency (SDA); BAE Systems; Babcock International; and Rolls-Royce Submarines. The team harnesses existing modelling capability across the Submarine Enterprise to forecast the programme outcomes. The Integrator required the development of a Scenario Configuration & Management Tool (SCMT), enabling the scenario modelling team to effectively create, configure and analyse modelling scenarios to track and manage key programme metrics and aid decision making. A centralised SCMT will manage the business processes in place to support scenario configuration for the Integrator and act as a centralised data store and single source of truth to provide scenario analysis and comparison. The main benefit of using a bespoke scenario configuration management tool is through the automation of the scenario modelling processes. **Luke Thorpe**, Techmodal

5a.2	**Detecting the Undetectable - Silent Transmitters and the Dogs that Didn't Bark** "Traffic Analysis... contributed greatly to assessments of U-boat numbers at sea". So wrote naval historian W J R (Jock) Gardner in "Decoding History: The Battle of Atlantic and Ultra". If a certain number of U boats have been detected from their characteristic radio emissions, the question arises "Ah, but how many might be lurking out there that you have NOT detected!" Proceeding from the known to the unknown is a gap that can be bridged in a number of ways, including by the use of simple statistical models and estimation techniques. These can provide not only an estimate of the unknowns, but, possibly more importantly, confidence levels that can reasonably be associated with such estimates. This talk illustrates the process with a readily-accessible example. **John Magill**, Independent
Session 5b: Logistics | Chaired by Sam Andrews, Sirius Analysis	
5b.1	**SUSTAINing Fighting Power – A Method to Explore Tactical Logistics** In line with the British Army Chief of General Staff's direction that the British Army is to "increase [its] fighting power with an immediate target of doubling it by 2027," Dstl's Land Warfare Centre Science and Technology Project ran a study to provide the Field Army with an understanding of the logistical requirements and frictions encountered in sustaining the uplift in lethality provided by the enhanced 2027 land force in a warfighting-at-scale scenario. The methodology centred on SUSTAIN – an asymmetric, semi-rigid and scalable method for wargaming logistics in a high tactical to low operational context. A range of quantitative data was captured against key supply types and key supply platforms, while qualitative data was captured through the discussions and decisions facilitated by the wargame. SUSTAIN enabled the team to quantify and understand the impact of materiel consumed, as well as both materiel and CSS vehicles lost to enemy action. **Aidan Lindsay**, Dstl
5b.2	**Hybrid method for munition consumption estimation** In the current security environment, munitions are of high priority within NATO and estimates of their expenditure are required by operational and defence planners to scale logistics plans and stockpiles. Traditional methods are based on Targets or 'Level of Effort (LOE)' approaches, both have pros and cons. In addition, validated data is often scarce and subject to national sensitivities about its release. This paper outlines a 'hybrid' method to support decision makers in determining munition requirements combining features of both Target and LOE methods. The method is constrained by a scarcity of validated data, limited time and availability of subject matter expertise. The method uses a threat informed approach including a simple assessment of targets allied with a LOE method informed by red and blue orders of battle. An example is presented showing how requirements for a 'standard day' are determined as well as intensity factors representing different missions. **Glenn Richards & Chris Gray**, OA Centre, NATO Communication and Information Agency

WORKSHOPS

Workshops will run in parallel and over three separate sessions, offering delegates the opportunity to participate in up to three 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	**Data Visualisation: Presenting your data in a way your customer will love** Data is at the heart of Operational Analysis and the need to convey a large amount of information in an easy, digestible way is essential as we deal with increasingly complex problems. This workshop will explore what makes a good visualisation, how to create engaging visualisations and how to tailor insights to different customers. During this workshop we will present our top tips and will encourage attendees to provide constructive comments on a range of data visualisation, before you get to give it a go yourselves. This interactive workshop tackles an extremely broad subject area with limited time, so we will be led by your interactions and hopefully a rich conversation. It is open to all, and participants are invited to join in and ask questions as we work through example data and visualisations. **Gretta Bun & Rebecca Fry,** Sirius Analysis
A2 / B2	**Rapid Parallel Wargaming – An Alternative Approach to Analytical Gaming** In this highly interactive workshop, participants will explore the ways in which simple, rapid wargames – executed in parallel and in bulk – could be used in support of wargaming. Participants will play in one of four simultaneous simple land wargames, grouped by self-assessed 'experience levels'. On conclusion of the games, group performance will be assessed to see the role of experience in outcome, followed (time permitting) by a repeat play to explore the 'learning effect'. This will lead into a group discussion on wargaming methodology, covering areas such as: • What role does player experience play in the outcome of wargames? • How significant is the 'learning effect' and what can we take from it? • How can bulk wargames be most efficiently and effectively analysed? • How fast is fast enough to be useful? How simple is too simple to be useful? **Jack Bolt & Fred Hood,** Sirius Analysis
A3 / B3	**Beyond Generation after Next military concept development** The aim of this interactive workshop is to generate future military concepts based on a selection of low-TRL Science and Technology (S&T) ideas. Drawing on the knowledge and experience of attendees, the session will identify potential applications for each idea and develop relevant concepts and use cases. Each will then be assessed for timeliness, relevance, unfamiliarity and exploitability via a simple assessment exercise. The workshop will mirror the process used by Alchemy, a consortium of companies led by Sagentia Defence that is delivering game-changing future S&T concepts to Dstl. Alchemy manages a pipeline that harvests ideas from across the international research landscape, develops concepts from them via a creative workshop

	approach, matures each by evaluating the scientific basis and potential benefits to Defence, and identifies a plan of how to develop these further with the aim of maintaining operational advantage for future UK Defence. **Guy Griffiths,** Sagentia Defence
A4	**Decision Superiority with Consilium™: Hands-On with AI-Driven Command & Control Systems** This workshop will immerse participants in Espanaro's Consilium™ platform, an AI-enabled command-and-control system designed for real-time operational decision-making in defence and security environments. Participants will explore: • Algorithmic Backbone – We will present and dissect the core algorithms driving data aggregation and prioritisation across sensors (e.g., facial recognition, UAVs, UGVs, radar). This includes real-time fusion models, prioritised alerting logic, and autonomous recommendation engines. • Human-Centric Visualisation – Attendees will evaluate the interface's design for decision-makers under stress, highlighting how we visualise complex threat environments, dynamic alerts, and AI-suggested responses without information overload. • Live Interactive Demo – Attendees will be grouped into teams acting as crisis response cells. Each group will run a simulated scenario (e.g., drone swarm detection, perimeter breach) using a demo version of Consilium. Participants will assess and react to real-time data feeds, with debriefs comparing outcomes and system-supported decisions. Attendees will gain hands-on experience in managing multi-modal security data using an AI-enabled decision-support tool, providing insight into how algorithmic design and interface choices shape operational effectiveness. **Dan Edmunds,** Espanaro
B1	**Unpacking complex security agendas with systems mapping** As security agendas become more complex new techniques for understanding connections will be important. Partnerships across different sectors are needed along with joint issue identification and strategic planning. This workshop and draws on existing work as part of EU research on Circular Economy & Security and will use participatory mapping techniques to gain an overview. The workshop will be based on a recent NATO report looking at security issues, strategic autonomy and civilian risk. The issues around Critical Raw Materials has taken on added significance in the present geopolitical situation and is highly topical. The aims of this workshop are: • To involve participants in systems dynamics mapping, showing connections between different kinds of security agendas – national, human and ecological. • Introduce the example of critical raw materials. • Give participants confidence to start using free online software. **Dr Jenneth Parker**, Schumacher Institute for Sustainable Systems

B4	**Agent Based Modelling – What is it and how can you use it Military OR?** Agent based modelling has long been a powerful capability for operational researchers, but until recently access was limited to those with knowledge and experience in computer programming. Recent improvements to the tools available have increased the accessibility and made it possible for anyone with basic analytical programming experience to build agent based models opening the capability up to a wider audience. In this workshop we will discuss agent based modelling in general including modern tools, the concept of agency and getting complex high level insights from simple low level agent rules. We will then do some worked examples of building Military OR specific simple models in Dstl's open-source Rapid Exploratory Modelling toolset including covering how modern development tools can support documenting model building, running, analysis, assumptions and validation. **Mark Gould**, Roke