# 41st International Symposium on Military Operational Research

National Oceanography Centre, 16 – 18 July 2024

# Abstracts and Biographies

Updated 5 July 2024

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## KEYNOTE

**Are we punching below our weight? Leveraging the skill set of our OR&A community to bring more rigor and creativity to strategic decision making in defense and security**

A clarion call to our epistemic community to start tackling strategic-level threats and opportunities with the same amount of intensity, rigor and creativity as we currently apply to tactical-operational ones.

**Stephan De Spiegeleire**, Principal Scientist, Hague Centre for Strategic Studies (HCSS)

Stephan De Spiegeleire is Principal Scientist at HCSS. He has Master's degrees from the Graduate Institute in Geneva and Columbia University in New York, as well as a C.Phil. degree in Political Science from UCLA. He worked for the RAND Corporation for nearly ten years, interrupted by stints at the Stiftung Wissenschaft und Politik and the WEU's Institute for Security Studies. Mr. De Spiegeleire started out as a Soviet specialist, but has since branched out into several fields of international security and defense policy. His current work at HCSS focuses on strategic defense management, security resilience, network-centrism, capabilities-based planning, and the transformation of defense planning. He is particularly active in HCSS's security foresight efforts to inform national and European security policy planning in the broader sense. He also teaches at Webster University in Leiden. Stephan keeps a personal blog, where he records his reflections on his fields of expertise. Please visit: gettingdefenseright.blogspot.com

## PANELS

**International research collaboration in OR**

The United Kingdom is engaged in bilateral and multilateral collaboration programmes in defence Operations Research. Chief amongst them are the collaborative programme run by NATO's Science and Technology Organisation and The Technical Cooperation Program (TTCP) between the five-eyes nations (Australia, Canada, New Zealand, United Kingdom and United States). Panellists will explain how these programmes work, why the UK is engaged in them, and the benefits that accrue to both the nation and the individuals taking part. The aim of the panel is to provide delegates with a clearer understanding of these programmes and opportunities that might exist to participate in them.

Chair, **Dr Ben Taylor**, Defence Research & Development Canada

**Jim Squire**, DSTL

**Andrew Beard**, DSTL

**Engaging academic and industry expertise in wargaming**

Demand for wargaming in the UK continues to grow, with more stakeholders from across Government asking increasingly wide and challenging questions. As research questions move wargaming into areas that are less traditionally the focus of gaming, the need for subject matter expert support from a wide range of disciplines gets ever stronger. As the reach of wargaming gets wider, the range of perspectives that are relevant is similarly expanding. In particular, with wargames focusing at the strategic and grand strategic levels, almost all aspects of state and non-state decision-making, as well as wider societal and technological factors could all be relevant.

The challenge we face as wargame designers is how to identify, engage, and harness this expertise. In particular, we need to find better ways of bringing in expertise from outside the usual wargaming community. The topic of this panel will be on how we decide what expertise we need to engage, and how we find the right people? And, related to that, how do we convince those experts that wargaming is a discipline they should be involved in? We would like discussions to focus on the need for expertise, the types of input we require, and the challenges we face in engaging that expertise at present. We would then wish to delve into potential solutions to these issues.

Chair, **Dr Pip Pepper,** Lockheed Martin

**Mike Bagwell**, DSTL

**Rory Kinane**, SONAC

**Lt Col Tom Ellen**, Defence Wargaming & Experimentation Hub

**Dr Maeve Ryan**, Kings College London

**OR&A in NATO**

The North Atlantic Treaty Organisation (NATO) has Operations Research and Analysis (OR&A) capabilities in a number of its headquarters and agencies, most of the staff of which started their careers in member nations (including the UK). Panellists from NATO Allied Command Transformation (ACT) and the NATO Communications and Information Agency (NCIA) will describe the OR&A conducted in their organisations, and elsewhere in NATO. The aim of the panel is to provide delegates with an understanding of the analysis conducted within NATO, how these organisations work with national analysis organisations, and life as a NATO analyst.

Chair, **Dr Ben Taylor**, Defence Research & Development Canada

**Glenn Richards**, NCIA

**Sue Collins**, ACT

**Understanding JSP 939**

Abstract TBC

Chair, **Dr Pip Pepper**, Lockheed Martin

**Grant Bailey**, DMSO

**Andrew Beard**, DSTL

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.

**Infrastructure Systems as Institutional Relics**

This presentation discusses challenges with infrastructure management at the nexus of sociology and engineering, highlighting multiple research efforts that depict infrastructure as fundamentally endogenous to society. We quantitatively demonstrate the construct of infrastructure as "institutional relics", in that physical attributes of objects reflect accepted standards of the time of construction and persist even as standards and social systems change around them. This manifests in several ways. Regulative-based relics occur when powerful institutions change policies and normative-based relics occur when local norms conflict with the vision of powerful institutions. Attachment to these relics inspire collective action around preserving them, thereby restricting engineering options. Using machine learning, we identify the key factors that influence bridge sufficiency in order to provide tractable insights to managers. Finally, we highlight the continued importance of physical connectivity in the world of entrepreneurship, even in today's high-tech landscape. By leveraging the "institutional relics" construct, these findings imply that long-lasting infrastructure requires management of both its technical and social elements. Thus, we reinforce the fruitfulness in collaborative dialogue between engineering and sociology, which is an emerging yet still nascent trend.

**Dr. Jaison D. Desai,** Major, U.S. Army Reserve, 2023 Winner

Dr. Jaison Desai is an Expert Solutions Architect at SMX Technologies, where he provides full-time support as Senior Technical Advisor to the U.S. Army Intelligence & Security Command (INSCOM) Data Capabilities Division (DCD). In that role, he advises military leaders in providing operational management, governance, program development, and data science efforts in support of global all-source intelligence analysis. He is also an Operations Research & Systems Analysis (ORSA, FA49) officer in the United States Army Reserve, holding the rank of Major with 18 years of service. He currently serves part-time as Chief Data Scientist for the U.S. Army Military Intelligence Readiness Command (MIRC). He is Vice President of Professional Development for the Military Operations Research Society (MORS) and co-chair for its Infrastructure Analysis working group.

## PRESENTATION SESSIONS

### Session 1a: Accounting for uncertainty | Chaired by Adam Price, Roke

1a.1

**Softer Methods for a Hard-to-Understand World: A Case Study in Competition**

The Information Age and higher levels of international dependency have caused the world to accelerate into becoming a vastly more complex and interconnected place, with high levels of Volatility, Uncertainty, Complexity and Ambiguity (VUCA). Against this backdrop, the Royal Air Force (RAF) has had to deliver activities to support the UK's role in Global Competition. This transition has presented challenges for conceptualising and planning for such an environment, where the RAF's extant planning tools were designed for well-bounded warfighting operations.

This paper will discuss the context for a greater need for softer methods to understand strategic human-centric problems, providing a case study using the Zero-Sum Safety (ZSS) concept. The ZSS concept was developed to frame and improve the ability to predict high-level drivers in Strategic Competition and conflict escalation, while directly accounting for the realistic impact of emotions on decision-making.

**Mike Sinha**, Air & Space Warfare Centre, Royal Air Force

1a.2

**Managing Uncertainty in the Analysis Process**

Today's decision makers face conditions of uncertainty and change, and traditional decision analysis commonly relies on point and probabilistic predictions to manage this uncertainty in the analysis process. We, and others, however, contend that many systems we make decisions upon are often much more uncertain than typically acknowledged. Adopting traditional approaches under these conditions could lead to modelling and analysis outputs that may not be fit for purpose.

In this presentation we will present a problem-structuring approach that describes and categorises the level of uncertainty inherent in a problem or system, and proposes modelling and analysis techniques to deal with progressively more uncertain systems. We will transition from traditional approaches for lower levels of uncertainty – such as sensitivity analysis, monte carlo analysis and what-if scenario analysis – and into more contemporary approaches for higher uncertainty covering ensemble modelling, Exploratory Modelling and robustness-based decision making.

**Paul Barratt**, CORDA

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| 1a.3 | **Modelling Military Adaptation**<br><br>The assumptions armed forces bring into war are almost always wrong, forcing commanders to adapt to unforeseen circumstances. The war in Ukraine has also demonstrated the necessity of rapid adaptation on the battlefield. In a previous investigation, we conducted a meta-study of military adaptation in war. Based on that work, we explore simple models of military adaptation, focusing on the qualitative dynamical properties of such models.<br><br>Noting similarities between military adaptation and biological evolution, we seek inspiration from co-evolutionary processes. One example is Red Queen dynamics, where interacting species must evolve at a high rate to survive, suggestive of tac-tical adaptation duels in war.<br><br>Modifying Lotka-Volterra's equations, we study how combat outcomes are affected by various adaptations. Closing the feedback loop, where combat outcomes<br><br>creates pressure to generate new adaptations, which again affects outcomes, re-quires more complex techniques. We conclude with some ideas for building such models.<br><br>**Christian Carling**, Swedish Defence Research Agency |

## Session 1b: Multi-domain operations | Chaired by Dan Page, Morshead Consulting

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| 1b.1 | **Integrated Air and Missile Defence – why it's not just about integration**<br><br>Multi-Domain Operations has become something of a buzz phrase. It's easy to assume that the hardest part of Integrated Air and Missile Defence is the integration, but is it? It's also fairly easy to assume that improving an Integrated Air and Missile Defence capability requires investment in equipment such as things that go whoosh and bang. This presentation considers the broad spectrum of Integrated Air and Missile Defence and whether there are softer aspects that could improve Integrated Air and Missile Defence capabilities.<br><br>**Shameer Omar & Dr Pip Pepper**, Lockheed Martin |
| 1b.2 | **Multi-Domain Integrated Systems (MDIS) Operational Analysis (OA) modelling**<br><br>The MDIS Programme is a capability investigation into how an integrated network of Robotic Autonomous Systems (RAS) might support UK forces in the 2030 epoch. The OA workstream has developed four key use cases: Theatre Entry: Opening a New Flank, Suppression of Enemy Air Defence, an Anti-Submarine Warfare barrier around a Carrier Strike Group, and a Non-combatant Evacuation Operation from an air/seaport. To study measures of merit of using RAS within these, workshops, tabletop exercises and simulations were developed.<br><br>Python and Simul8 were used to create discrete event simulation models and geospatial models, capable of demonstrating RAS concepts, comparing different force-mixes, and highlighting the benefits of a unified architecture and robust connectivity. Insights from the modelling (gained from selected Measures of Merit averaged across multiple repetitions of each variation and tested for statistical significance) have demonstrated the benefits of multi-domain integrated RAS, of varying quantities and capabilities, across each of the use cases.<br><br>**Chloe Ainger & Alex Deith**, TP Group |

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| 1b.3 | **Assessing the utility of Non-Lethal Weapons**<br><br>The purpose of Non-lethal Weapons (NLWs) is to temporarily disable, delay, disorientate, deter, or disarm targets across all domains and phases of conflict. In 2022, the US Department of Defense commissioned a piece of work focussing on how NLWs contribute to defensive goals, and have potential tactical, operational and strategic impacts. This prompted the UK to want to better understand how we could assess such systems, taking into account the impact across these three levels of warfare.<br><br>BAE Systems CORDA were tasked with defining a framework(s) or repeatable methodology for assessing the impact of NLWs (current or under development) in situations at tactical, operational, and strategic levels of command. A data capture plan (DCMP) that considered perception, PESTLE, DLoDs and more was set up for better 'live' analysis, requiring less analytical burden after the event.<br><br>This will enable the customer to compare the effectiveness of different NLWs in defined tactical vignettes, to determine where future development or funding should be placed.<br><br>**Rebecca Asquith & Clarice Chung**, CORDA |

## Session 2a: Tools techniques & processes 1 | Chaired by Callum Woodhall, QinetiQ

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| 2a.1 | **Adaptability Assessment Framework (AAF)**<br><br>The Adaptability Assessment Framework (AAF) is a set of methods and tools to enable collaborative project team mapping of responses to future change - including opportunities as well as threats - throughout the lifespan of a system. It can be applied throughout the CADMID cycle. Originally developed for use with Communication and Information Systems (CIS), validation has shown that it can add value for any system that has a digital or data component deployed into a complex and changing human and operating environment. It seeks to help test - and develop understanding against - the questions "what do we want to be our system adaptable to, and to what extent?" with all of the cost, complexity and capability implications exploring this question raises. This presentation summarises how, where and why the AAF can be applied and provides a deep dive example showing key strengths of this soft systems-based approach.<br><br>**Louisa Stewart**, Arke Ltd |
| 2a.2 | **SCIFI**<br><br>SCIFI (The Supply Chain & Inventory Forecasting Intelligence) Toolset is a model and dashboard suite built by CORDA (Digital Intelligence, BAE Systems) in conjunction with SMSCMC (Saudi Maintenance & Supply Chain Management Company). It is a cross functional tool that is designed to help manage end to end supply chain and IF&P (Inventory Forecasting & Planning) issues, report on the availability contract financials and provide better spares and repairs forecasts to ensure the aircraft fleets are supported and available.<br><br>We will be presenting the journey of how CORDA developed the toolset with SMSCMC, what it is capable of, how has it been used so far and the operational and management impact the business has seen with the user of SCIFI across multiple platforms.<br><br>**Carl Tillett**, CORDA |

## Session 2b: Space-based capabilities | Chaired by Mark Gould, Roke

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| 2b.1 | **Operational research in space**<br><br>The Space domain has always presented challenges for the design and operation of systems intended to function there. From issues of optimisation, of designs and manoeuvres, through estimation (e.g. to determine orbital parameters), budget allocation (mass and power as well as financial), robustness, resilience and cost effectiveness, these are all areas to which Operational Research, and the neighbouring fields of Systems Engineering and Systems Analysis, can lay claims of relevance.<br><br>Recent developments have included the recognition of Space as a "Operational Domain" from a military point of view, the lowering of barriers to entry into the field as a result of a trend towards smaller satellites, and an increased number of commercial operators and launch providers.<br><br>This talk will briefly review the developments in the field and indicate where Operational Research might address the associated challenges, both natural and man-made.<br><br>**John Magill**, Independent |
| 2b.2 | **Hypersonic weapons – what is the hype?**<br><br>Hypersonic weapons are expensive to develop and expensive to procure but many see hypersonic weapons as a panacea. Defence budgets are limited and investment decisions should be informed by evidenced analysis. This presentation considers whether the operational objective can be achieved without hypersonic weapons and highlights where hypersonic weapons can distinguish themselves. Are hypersonic weapons worth the hype?<br><br>**Shameer Omar & Dr Pip Pepper**, Lockheed Martin |

Session 3a: International concepts & planning | Chaired by Joe Croucher, MBDA

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| 3a.1 | **Feasible, Applicable, Valid? Analysis in support of NATO Concept Development and Experimentation**<br><br>NATO Concept Development & Experimentation (CD&E) is a combination of methods and tools that drives NATO's transformation by enabling the structured development of creative and innovative ideas into viable solutions, the primary purpose of which is to provide credible solutions to capability shortfalls and gaps.<br><br>Analysis plays a central role in the NATO CD&E methodology by bringing structure and analytical rigor to the process. It supports concept developers through the provision of precise, impartial, evidence-based advice to:<br><br>Explore problems;<br>Define requirements for concepts;<br>Identify and assess potential solutions;<br>Evaluate concepts' benefits and risks.<br><br>The evidence provided through analysis improves concept effectiveness, which in turn increase the likelihood of successful concept endorsement and implementation.<br><br>However, what happens when the analysis does not support a concept?<br><br>This presentation will outline analytical techniques used in concept development in recent projects, and talk about some of the pitfalls that can befall analysts supporting these efforts.<br><br>**Ric Sherburne and LtCol Mantas Juozaitis**, ACT NATO |
| 3a.2 | **National and Alliance force planning - parallels and contrasts**<br><br>All nations have some process by which they determine how their armed forces should evolve into the future. This is often termed Force Development. During 2022 and 2023 the Research Task Group SAS-164, comprising representatives of eight nations and NATO Communication and Information Agency staff derived a generalised analytical process model for Force Development. NATO uses the NATO Defence Planning Process (NDPP) to determine a pool of force needed to meet the level of ambition in the medium term. SAS 164 proposes a framework for use by the nations taking into account the challenges faced by planners in the 21st century. NDPP has been in its latest form has been in place since 2009 and has recently begun its latest cycle in 2023. This cycle has seen a number of significant changes in terms of the scope of the process and enhanced linkages to operational planning. This brief introduces both the SAS-164 process and the NDPP and highlights where there are differences between the two processes (such as balance of investment etc) and similarities (such as scenarios, concurrency etc). The brief also highlights the role and the challenges faced by the Operational Analyst as new processes and demands are placed upon them.<br><br>**Glenn Richards & Ben Taylor**, NATO NCIA & DRDC |

Session 3b: Advanced computer analytics | Chaired by Rebecca Fry, Morshead Consulting

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| 3b.1 | **Using LLMs and RAG to examine (stated) differences between different 'ways of war'**<br>Stephan will present some findings from an ongoing HCSS/TNO research effort that uses LLMs and a RAG setup to tease some findings out of a unique multilingual corpus of ~ 26k scholarly publications dealing with different 'ways of war'. The workshop he will also be giving at this symposium will be more on the 'tooling' (and how all of you can use it for your own purposes); this presentation will focus more on the 'findings'.<br>**Stephan de Spiegeleire,** Hague Centre for Strategic Studies (HCSS) |
| 3b.2 | **Effective Human-AI teaming**<br>We present work developing a demonstrator toolset to show how AIs can be deployed in a way that successfully supports effective decision making, by adopting a psychology driven design for human machine teaming throughout the toolset development.<br>This demonstrator was built around a challenging problem-set relevant to a wide range of real-world problems.<br>A trial was conducted, collecting clear evidence that:<br>The interaction design makes significant difference in decision making, both in speed of planning, and in the quality and detail of the plans the user is able to produce.<br>The interaction design led to less biased decisions, the plans offering by the AI challenging the user's naïve assumptions.<br>The interaction design also led to high user confidence and "happiness with the solution," with the user having a real sense of control over, and responsibility for, the plans generated supported by the AI.<br>**Stephen Lucek,** Roke |

## Session 4: Policy | Chaired by Adam Price, Roke

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| 4.1 | **Assessing Women, Peace and Security in military operations**<br>In an unstable world, the gender perspective is relevant to both security policy and military defense. The use of gender bias and sexual based gender violence is a feature of current armed conflicts. In addition, the international community has learned that a gender perspective is vital to force protection, protection of civilians and recruitment of personnel.<br>The international community has adopted a comprehensive agenda on Women, Peace and Security (WPS) that recognizes the need to integrate a gender perspective in military activity. This has trigged the need for tools to assess progress of the agenda and closing the gap between the policy intentions and concrete actions. The Swedish Defense Research Agency (FOI) has developed an assessment tool, which we will present at the ISMOR conference. The tool encompasses the main intentions of the WPS agenda and the elements necessary when assessing implementation.<br>**Helené Lackenbauer,** The Swedish Defense Research Agency (FOI) |

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| 4.2 | **Hierarchical Structure of Brazilian Sovereignty: A Multi-Criteria Analysis of Defense Policy Variables Through the SAPEVO-H² Method**<br><br>Effective decision-making is critical to ensuring security and sovereignty concerning the complex and dynamic environment of global defence. This research investigates the integration of the SAPEVO-H² method to structure and analyze the Brazilian Defence Policy. Employing a multi-criteria approach evaluates the interdependencies among variables from foundational principles to strategic actions. The methodology implementation into the problematic situation demonstrates its capacity to identify strategic priorities and elucidate how variables at different hierarchical levels influence or impact high-level decision-making processes. Considering the intricate nature of defence decisions involving numerous variables and the imperative for strategic coherence, the method is a favourable tool that analyses variables and their interrelations. The results underscore the robustness of the method handling complex environments, reinforcing the need for systematic and structured evaluation tools in defence contexts. The research concludes with suggestions for extending this methodology to broader public policy applications, supporting higher-level decision-making processes for defence orientation.<br><br>**Luiz Frederico**, LCDR - Brazilian Navy |
| 4.3 | **Filling the Operational Vacuum: A Crie de Coeur**<br><br>If nature abhors a vacuum, British military doctrine risks upsetting her greatly. The Operational Level of Engagement has been formally recognised by all three services for thirty years, yet its by-ways have still not been fully explored by a population drawn more intuitively towards the aristocratic Strategic and the gritty Tactical levels. Whilst there have been a few intrepid explorers, and some attempts at cultivation, the terrain remains open to occupation, agnostic of the nature of future conflict.<br><br>Systems thinking is gaining traction and momentum. It offers a creative and iterative perspective on how strategic objectives can be translated into tactical activity and it is ripe to harvest the benefits of AI. The OR community is well placed to lead the charge in bringing true meaning and utility to the Operational Level. This presentation is a plea to take up arms and provides a framework for how to do so.<br><br>**Capt (Retd) JL Poole OBE & LtCol (Retd) AD Firth**, Aperture Strategy Ltd |

## Session 5a: Tools techniques and processes 2 | Chaired by Dan Page, Morshead Consulting

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| 5a.1 | **Bridging the gap between soft and hard OR for rapid military applications**<br><br>Since WW2, OR techniques and practitioners have switched their focus from rapid analysis of simple high consequence problems - e.g. developing tactics for existing systems - to slower analysis of more complicated problems - e.g. optimising force structure for future operations. Taking months or years to build models and data has become the norm, increasing stakeholders' confidence, but slowing analysis and reducing OR's ability to drive innovation into decisions. Rapid OR is still undertaken, but either in predictable situations where old models and data can be re-used, or using soft OR methods based on subjective judgements and limited robustness. This presentation shows through examples from recent studies how Cosimmetry's Sketch tool uniquely fills this gap using soft OR to rapidly capture expert knowledge into conceptual models, and AI-assistance helping users to translate these into calculable hard OR models for rapid, but broad and shallow analysis suitable for urgent, high consequence problems.<br><br>**Rob Solly**, Cosimmetry |

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| 5a.2 | **Land Tactical Deep Find (LTDF) OR**<br><br>In 2023 DSTL and Roke Manor conducted analysis to explore options for the Land Tactical Deep Find (LTDF) project. LTDF is intended to provide elements of Divisional and Corps-level wide area intelligence, surveillance, target acquisition and reconnaissance (ISTAR) in the Land Deep.<br><br>Agent-Based Modelling (ABM) (using Rapid Exploratory modelling Toolkit) was conducted by Roke Manor to compare the effectiveness of several platform options, explore Tactics, Techniques and Procedures (TTPs) to better understand how these platforms should be used, and understand the benefits and risks associated with the options. The Evidence Framework Approach (EFA) was used to communicate the confidence in these initial insights to all stakeholders and shape the remaining analysis to deliver the most benefit.<br><br>This presentation will outline the analytical questions and context for LTDF before considering the RET model, the analytical challenges encountered, and the impact of using this method for Dstl, industry and the various stakeholders.<br><br><br><br>**Adam Murgatroyd & Mark Gould**, DSTL & Roke |
| 5a.3 | **STORMing the Beaches: Surface Manoeuvre Survivability**<br><br>The UK and NL governments have both recently announced their plans to develop the next generation of amphibious shipping and associated surface connector craft. Discussions between the UK and NL MOD identified a gap in analysis tools between naval manoeuvre wargames that do not get down to the granularity of landing craft operations and land-based analysis that starts with the assumption that the littoral insertion phase was successful. Simulation of Tactical Offload of Royal Marines (STORM) is a python simulation with a web interface that has been created to fill this gap. Entities (surface manoeuvre craft, UXVs, fast attack craft, helicopters etc) can detect, interact and engage each other allowing TTPs and countermeasures to be tested. The presentation will include a live demonstration of the STORM model and a discussion on the “survivability onion” and its representation in the analysis.<br><br>**Carlin McCormack and Mike Rowlands,** Catalyze |

Session 5b: Wargaming | Chaired by Callum Woodhall, QinetiQ

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| 5b.1 | **A mix methods approach combining vulnerability- and lethality analysis (VLA) with war-gaming, in support of Swedish capability development concerning long-range weapons**<br><br>FOI was tasked to do a series of studies in direct support of the Swedish Joint Chief of Staff to analyse pro:s and con:s when implementing a long range weapons capability. Most of the DOTMPLFI aspects were covered. This presentation will focus on how we used detailed VLA results to support adjudication of table-top wargaming in order to develop scenario vignettes that was used in later studies analysing e.g. the targeting process, command and control structures and implementation aspects. A handful of example weapons were described and simulated in FOI:s inhouse program Aval, to investigate potential effects for a series of targets including, field based staff, infrastructure, staging areas, military bases etc. These results were subsequently used for adjudication in a series of war-games to establish desired combat effectiveness measures to inform the concept development that followed.<br><br>**Camilla Andersson & Matilda Ågren**, FOI |
| 5b.2 | **Operationalising recreational computer wargames: MOD's growing Capability**<br><br>Six years ago DSTL went to the recreational computer games market for new capability. We adopted and evolved three tools (Command, Flashpoint Campaigns and Combat Mission) from the UK supplier Slitherine. These are now fundamental components of our wargaming and simulation capability, being used for analysis relating to all of the Front Line Commands and Head Office, and for a range of analytical use cases including concept assessment, force structuring, contingency planning and support to operations reachback. They provide an important relatively rapid, moderate confidence quantitative analysis option, complementing existing wargaming and simulation methods. We have developed a range of best practice and analytical tooling that we are now increasingly looking to share, particularly as these tools are now being adopted more widely across UK Defence. This presentation provides an update on progress and signposts some of the tooling developed.<br><br><br><br>**Nick Bell**, DSTL |

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| 5b.3 | **AI for Grey Zone Wargaming**<br><br>To unlock the potential of an understanding of indicators, warnings, intent, and attribution that might be achieved by generation-after-next intelligence analysis, the decision maker needs an appreciation of the 'so-what' of the emerging information. This understanding would allow the allocation of intelligence assets and effort to support the plan of action, closing the "observe-orient-decide-act" loop.<br><br>Therefore, a wargame of a sub-threshold information scenario (in this case a surveillance game) has been developed, and a hierarchical AI successfully applied to play it.<br><br>Importantly, using a hierarchical AI, with two different techniques, each playing to their strengths, allows the system to be applied not only to problems with significant uncertainty (involving hidden threats, with unknown intent), but also be deployed in novel scenarios, for which the AI has not been trained.<br><br>This small-scale development proves this can be done at pace, important for a domain that is rapidly evolving<br><br>**Stephen Lucek**, Roke |

## Session 6a: Learning from the past | Chaired by Mark Gould, Roke

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| 6a.1 | **From U-Boats to AI: The Unseen Force Behind 80 Years of United States Defense Strategy**<br><br>Operations Research (OR) has been a driving force in the evolution of the United States Department of Defense (DoD) for over eight decades. This presentation traces the pivotal role of OR from its origins in anti-submarine warfare during World War II to its modern applications in autonomous vehicles and multi-domain operations. We will explore how OR has consistently shaped military tactics, operational strategies, and investment decisions, acting as a critical force multiplier in an ever-evolving threat landscape. By examining key historical milestones and current applications, this presentation highlights the enduring impact of OR on the DoD and its continued importance in ensuring national security.<br><br>**Walt DeGrange**, CANA LLC |

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| 6a.2 | **Capability Planning: Exploring the shifts of scientific paradigms among Operations Analysts**<br><br>When supporting Capability Planning projects of the Swedish Armed Forces, the Operations Analysts (OA) at the Swedish Defence Research Agency (FOI) become integral members of the project management team, which is predominantly composed of officers.<br><br>OAs role is to solve problems by collecting and analysing data and applying it to an existing body of knowledge.<br><br>However, the problems OA addresses are often complex. Solving such problems typically requires multiple perspectives or scientific paradigms, each with its own methods of data collection and knowledge domain.<br><br>FOI have initiated an interview study aimed at gaining deeper insights into how our senior analysts support Capability Planning projects. Initial findings suggest that problem-solving methods are frequently selected based on the stage of the problem-solving process rather than adhering to scientific paradigms.<br><br>Can increased awareness of these paradigms lead to more efficient problem-solving processes?<br><br>**Git Roxström**, FOI |
| 6a.3 | **Medium Heavy helicopter Mix Study**<br><br>Using a study designed to inform the balance of future investment between Medium and Heavy lift capability (ASTRID Task 238), at an acceptable cost, without overly constraining the UK's ability to react to a broad range of threats and crisis.<br><br>We will extract lessons learned with regards to finding an optimal solution to a problem where what is optimal is not defined. In order to provide suggestions on how to explore, identify and refine potential requirements for an optimal solution whilst keeping the customer engaged and involved in decision making.<br><br>**Huw Snowden**, CORDA |
| Session 6b: Concept & capability development \| Chaired by Joe Croucher, MBDA | |
| 6b.1 | **Warship Land Strike Capability Exploration**<br><br>Overview of an early capability exploration study conducted by MBDA Missile Systems with a Navy customer.<br><br>To present the study approach used, the customer interaction methods and experimentation techniques used.<br><br>This presentation will cover aspects such as;<br><br>Use of scenarios/ vignettes<br>Design of Map Exercise and Wargame<br>Force Mix considerations<br>Ensuring objectivity of analysis<br>Capturing conclusions<br>Challenges and lessons learnt<br><br>**Andrew Charlton**, MBDA |

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| 6b.2 | **How the Land Warfare Centre Operational Research Branch supports UK Field Army**<br><br>The Field Army Operational Research Branch uses analytics, modelling, problem structuring, simulation, and data science to enable decision makers to make better decisions. It provides evidence for the optimisation of the Field Army operating in a contemporary battlespace. The Field Army Operational Research Branch are continuing to augment their offering with several tools and models forming the Operational Research Tool Set (OATS).<br><br>This presentation will explain the Operational Research Branch's mission statement, structure, and ways of working. It will cover two case studies of recent activities.<br><br>Case Study 1: The Operational Research Branch has been working alongside Field Army to develop a CSS Planning Calculator. This will discuss how we have built the tool and how it is supporting Field Army.<br><br>Case Study 2: The Operational Research Branch is the Owner and Operator of CIRSIUM. A tool for running Kriegspiel wargames. This will discuss how it has been developed and how it is currently being exploited in Field Army.<br><br>**Callum Woodhall**, Land Warfare Centre |
| 6b.3 | **Quick on the Draw: Tank Battlesight Shooting**<br><br>British and American analysis of WW2 experience showed that winning a tank fight depended largely on firing first.<br><br>In 1957, Lulworth Gunnery School started teaching the battle range technique. Three rapid shots are fired at different ranges, relying on the flat trajectory of high-velocity shot to hit without accurate range information. Fall of shot cannot be observed because of obscuration.<br><br>To investigate the value of this technique, a simple model has been created to compare it with slower shooting using accurate rangefinding. The model has been implemented both in Python and a spreadsheet. An attempt has been made to gather relevant ballistic data for tank main armament since 1945. A parametric excursion was run to cover all reasonable values of muzzle velocity, drag, and ballistic dispersion.<br><br>The results show the technique confers a substantial advantage, greatest for the highest velocity shots, which is approximately halved if the target is hull-down.<br><br>**Dr John Salt**, Cranfield Defence & Security |

## 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

**From RAGs to Defense Analytical Richness: Large Language Models, Retrieval-Augmented Generation and Defense and Security Analysis**

Join us at ISMOR for a pioneering workshop that revolutionizes operational research by elevating text to a critical data source. With the advent of artificial intelligence, specifically through Large Language Models and Retrieval-Augmented Generation, 'text' is no longer just 'qualitative'. 'Text' has become 'data'. This breakthrough enables OR analysts to harness an increasingly sophisticated suite of AI tools, integrating quantitative methodologies with the textual data that are so abundantly present in the defense and security world. Be part of this transformative experience where we can start leveraging text as a dynamic asset in multi-echelon analytics.

This workshop will not only explore the current capabilities and future potential of LLMs in defense analysis but will also showcase a series of cutting-edge applications directly from the defense and security analysis sector. Participants will gain insights into how these technologies are not just supporting but revolutionizing the way we understand and leverage vast amounts of textual information.

Interactive Session Highlights:

**Understanding LLM**s: Delve into the state of LLMs today, their challenges, but also their surprising versatility in operational and strategic contexts.
**Taxonomy Building**: Learn how to construct robust taxonomies that help organize and analyze complex datasets, with a specific example of armed forces profiles.
**Hands-On Exploration**: Participants will use pre-designed prompts to experiment with LLMs on topics of their choice, gaining firsthand experience in generating useful analytical frameworks.
**Advanced Retrieval Techniques**: Discover methods to effectively compile and utilize large, multilingual corpora, with a case study on 'The Russian Way of War'.
**Real-World Applications**: Examine how RAGs are being implemented in recent projects, including a detailed analysis of Ukrainian defense strategies against cyber and disinformation attacks.

Examples will be demonstrated, methodologies explained, and code shared to encourage participants to apply these insights to their own projects interactively during the workshop.

**Requirements**:

Participants should bring their own internet-capable devices to engage with the digital content and hands-on activities.
Basic familiarity with data analysis and interest in the application of LLMs in operations research will be advantageous.

This workshop is ideal for those eager to bridge the gap between quantitative prowess and qualitative data richness in military operations research. Whether you're looking to enhance

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| | your existing skills or explore new analytical techniques, this session promises a deep dive into the capabilities of modern AI tools that are set to transform defense and security analysis.<br>**Stephan de Spiegeleire,** Hague Centre for Strategic Studies (HCSS) |
| A2 / C5 | **How can analysts help Defence decision makers when the only seemingly sensible answer is "it depends"? A demonstration using exploratory modelling**<br>Exploratory Models map a wide range of assumptions onto their consequences without privileging one set of assumptions over another. They are ideal for providing decision support when the subject is deeply uncertain. This is when decision makers and analysts are faced with multiple, potentially conflicting, objectives, and where they do not know or cannot agree on how to define the system that represents their problem and represent uncertainty within that system.<br>This workshop will introduce exploratory modelling and deep uncertainty before providing a demonstration of how exploratory modelling can be used to provide decision support. It will use the example of a hypothetical epidemic. DSTL will also briefly introduce our attempts at applying exploratory modelling to Defence problems. Delegates will then have the opportunity to ask questions, provide constructive feedback on the approach and its application, and consider its utility for their own work.<br><br>**Darren Rockett & Mark Williams,** DSTL |
| A3 | **Capability Planning: Exploring the shifts of scientific paradigms among Operations Analysts**<br>Is there a recommended sequence to follow when transitioning between paradigms? Join us for an in-depth exploration of Operational Analysts´ work processes. Consider a scenario where a working group is tasked with estimating how the military effectiveness of a unit varies depending on available weapon systems. When addressing real-world problems similar to this, the methodology employed can vary significantly depending on the perspective and scientific paradigm. A single scientific paradigm seldom offers all requisite data and as such it may be advantageous to utilise multiple paradigms.<br>In this workshop, we gather to exchange insights on how to solve the problem in the scenario and what methods can be used. Together, we identify which paradigms are most prevalently employed and discuss the reasons underpinning their usage. Thereafter, we discuss which paradigms the proposed solutions align with, and whether there is a need for an established sequence when shifting between paradigms.<br>**Lisa Hörnsten,** FOI |
| A4 | **Pop-up CBRN - how to deliver specialist add-ons to mainstream wargames**<br>CBRN, EW, Medical and C-UAS are all examples of capabilities that can play a key role in peer-to-peer warfare but can be difficult to represent at a meaningful level within traditional force-on-force wargames. Equally, games designed to explore each of these capabilities in detail may struggle to integrate their effects into operational level engagements. |

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| | SIDEARM is a new capability from Morshead Consulting that allows Wargamers to add appropriate fidelity rules, tools and counters to existing wargames, enabling players to understand how specialist capabilities may affect their decisions and outcomes.<br>In this workshop, Richard Wood, CRBN specialist and Head of Experimentation at Morshead Consulting, will demonstrate how SIDEARM has been integrated into the commercial wargame Littoral Commander (as used by the USMC and other warfighters as a learning aid) to allow the effects of CBRN to be explored in a peer-on-peer warfighting scenario.<br>Come along and join either the Red or Blue Team, play a few moves with and without the SIDEARM CBRN inject, provide your feedback and offer up your wish list for how you'd like to SIDEARM be developed.<br>No wargaming or CBRN knowledge necessary!<br>**Richard Wood,** Morshead Consulting |
| B1 / C1 | **Critical thinking: Understanding the relative criticality of infrastructure in Defence**<br>UK Ministry of Defence has committed to improving it's understanding of which infrastructure assets are most critical and why in order to support prioritisation of investment and resource allocation. Furthermore, the works aims to better understand how infrastructure contributes to Defence outcomes, support understanding of risk and resilience, and underpin the establishment of an evidence-based asset management approach. Over the course of 7 months, we developed, prototyped, and piloted an approach that provides a robust, repeatable, and transparent method to defining the relative criticality of infrastructure assets. In this workshop, we present the background, method and the developed conceptual approach alongside lessons from the study. We then seek your input in refining and improving the model prior to implementation.<br>**Matt Bunn,** Catalyze |
| B2 / C2 | **Strategic analytics**<br>This tutorial orients on the future of our Military Operations Research profession: "Where do we need to be going?"; "What should we be doing?"; How can we address, in imaginative and creative ways, the many persisting problems and seemingly intractible national and global security challenges that confront us? Strategic Analytics, the alignment of optimization methods, predictive models, and descriptive techniques with the "ends-ways-means" strategy paradigm, is presented. To fully capitalize on advances in information technologies and rapidly growing Big Data opportunities, the complementary power of Operations Research, data sciences, and management innovation will be essential. Functional components and enabling disciplines are described: decision support capabilities, engineering systems, dynamic strategic planning, and "engines for innovation" to encourage and guide transformational endeavors. Three recent applications of Strategic Analytics to enterprise system challenges are described and explored: defense resource planning, global logistics supply chains for<br>materiel readiness, and recruiting for the All-Volunteer Force. We must integrate our intellectual capacities, considerable strategic planning acumen, diverse analytical capabilities, and bring them all to bear on formidable national and international security challenges of our time. Our Nations, alliances, and partners across the globe will surely benefit from such a commitment on our part.<br>**Greg Parlier,** Independent |

B3 / C3

**The problem of bad information**

While Sherlock Holmes may have said "I cannot theorise without data", the veracity of that data is important – and not always assured. Using historical examples, there are several areas, where distortions or outright errors have become the generally accepted fact and remain stubbornly persistent. Examples include:-

When HMS Sheffield was hit by an Exocet missile, the warhead didn't detonate but her aluminium superstructure caught fire

German nightfighters used upward-firing guns to wreak havoc on RAF bombers in WW2, and Bomber Command were oblivious to this.

US tactical aircraft in Vietnam lacked guns and couldn't cope with NVAF fighters, and only when they got cannon armament could they prevail.

This workshop aims to ask – and better still, propose answers to - two questions.

What causes these myths to take hold?

How can analysts avoid being misled by them?

**Paul Adam**, Roke

B4 / C4

**Wargame design methods – making the intangible tangible**

DSTL conducts a large amount of wargaming at the strategic and grand strategic levels, where the focus of research is often how Defence interacts with other levers of national power as well as allies and partners to help achieve national goals. To do this effectively, games must be designed to ensure the key drivers of governmental decision-making are reasonably represented, and the motivations, implications and consequences of decision-making are accurately felt by players. Wargames have a long history of representing warfare, and a mature understanding exists of how military actions can be abstracted and visualised. There is less understanding of how other levers of power should be represented. These are often long-term in nature, not geographically bound, and not always executed by tangible entities in the physical domain. In wargames that mix the military with other levers, the comparative ease of representing military actions can mean it is too prominent in the minds of players, while arguably more important but less visceral elements are given less attention.

This workshop seeks to elicit ideas on how we can better represent factors that are intangible, and ensure that players properly appreciate the wider implications of their actions and the pressures on cross-government decision-making.



**Mike Bagwell**, DSTL