

# 2024 COLLABORATIVE PROGRAMME OF WORK

NATO SCIENCE AND TECHNOLOGY ORGANIZATION



# Acknowledgements

## Preface

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## INTERESTED IN JOINING US?

Interested government representatives, military members, industry specialists, and academics interested in our research topics can join CPoW activities via two steps:



1. Contact your national coordinator, who facilitates your nation's participation in STO. Find the list of national coordinators on our website [here](#).
2. If you know the specific Scientific and Technical Committee you're interested in, reach out directly to the Committee Office. STC contact information can be found [here](#).



Visit our website to find out what the Scientific Technology Committees do:

<http://www.sto.nato.int/Pages/sto-panels.aspx>

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# Preface and Our Purpose



It is my pleasure to present the NATO Science and Technology Organization (STO) Collaborative Program of Work (CPoW) for 2024. The CPoW is the STO's core product, and our main contribution to developing modern interoperable military capabilities. Comprising nearly 400 research activities, it equips NATO Nations and partners with the science and technology (S&T) they need to ensure battlefield success. As such, it is key to fulfilling the STO's mission of "empowering NATO's technological edge."

The activities carried out under the CPoW focus on areas of critical importance to NATO militaries: cyber, space, sensors, weapons, command and control, human-machine interface, modelling and simulation, artificial intelligence, quantum technologies, and operational analysis. This work, currently carried out across seven Scientific and Technical Committees (STCs), leads to cutting-edge capabilities for our military and security organizations. The 2024 CPoW report details the publicly releasable portion of the 2024 CPoW, including a list of all ongoing projects.

The engine behind the CPoW is a voluntary and low-bureaucracy collaborative business model that brings together roughly 5,000 of the best and brightest scientists, engineers and analysts in government, industry, and academia across NATO and Partner Nations; collectively, they form the largest defence S&T research network in the world. At the Collaboration Support Office (CSO), our job is to manage, nurture and grow this network, and to support Nations in their S&T collaboration.

The 2024 CPoW report demonstrates the value that Nations gain through the CPoW. By participating with in-kind donations, Nations benefit from the shared knowledge and technology in a trusted environment, and multiply their own S&T investments. Participating in the CPoW also sets Nations on the path from scientific excellence to technological edge, military supremacy, and deterrence. As Director of the CSO, my vision is to ensure that the CPoW remains the "forum of choice for collaborative defence S&T" for decades to come. The NATO Science and Technology Board's recent approval of the CPoW Strategy 2024-2030, and corresponding actions for its implementation, has charted the way forward for the CPoW and the CSO in the face of an increasingly uncertain future.

S&T is now a key arena of global strategic competition. NATO's competitors and potential adversaries are investing heavily in S&T, which may potentially restrict access and freedom to operate in all domains, target civilian and military infrastructure, impair defence, and jeopardize security, and democracy itself. There is also an increased S&T intelligence threat and governments seek to reduce S&T interdependency risks and control international technology flows; enhance industrial performance through S&T investments; and strengthen international S&T alliances among like-minded nations. I am confident that our work will only become more critical in the coming years as Nations navigate an increasingly complex threat landscape. S&T provides the foundation upon which life-saving capabilities, weapons and equipment are developed—and as it evolves, the CPoW will continue to play a fundamental role in empowering NATO's technological edge, and in fulfilling our mission to protect the freedom and security of our citizens.

John-Mikal STØRDAL

*Director, STO Collaborative Support Office*

**Empowering NATO's Technological Edge**

# We Are the Science and Technology Organization

Science and Technology (S&T) research has a rich history within NATO and is sometimes referred to as NATO's Third Dimension. The predecessor to the STO, the Advisory Group for Aerospace Research and Development (AGARD), was established in 1952, serving as a platform for scientific cooperation among early NATO Nations. Over time, NATO's S&T research has expanded significantly, and the STO network has evolved into the world's largest international network of defense and security scientists, engineers, and analysts coming from government laboratories, armed forces, universities and industry.

Maintaining the technological edge is a key element to fulfilling NATO's responsibility today, and to meeting the complex challenges of tomorrow. Indeed, S&T is the foundation upon which the Alliance's deterrence and defence capabilities are built. There is a direct line from excellence in science, to leadership in technology, to technological edge, to military advantage, to credible deterrence and – if deterrence fails – to prevailing in conflict.

“*The CPoW represents the STO's main contribution to developing modern interoperable capabilities*”

## How is our organization structured?

The NATO Science & Technology Organization (STO) is a NATO subsidiary body to the North Atlantic Council (NAC) and reports to the NAC through the NATO Military Committee (MC) and the NATO Conference of National Armaments Directors (CNAD).

The STO's mission is to maintain NATO's scientific and technological advantage by generating, sharing and utilising advanced scientific knowledge, technological developments, and innovation to support the Alliance's core tasks: deterrence and collective defence, crisis prevention and management, and cooperative security.

## Composition of the STO

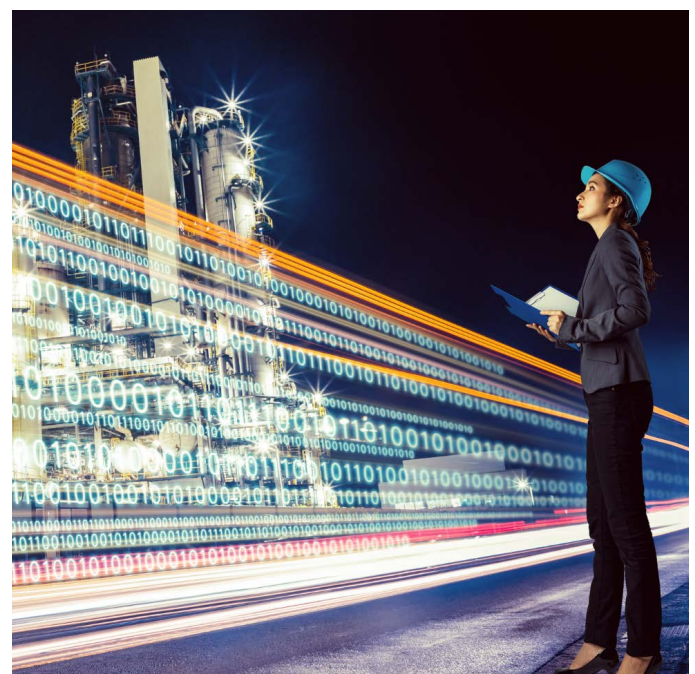
### The NATO Science and Technology Board (STB)

Comprising senior national defence S&T leaders, the STB is responsible for developing and maintaining strategic S&T guidance in NATO, fostering cooperation among stakeholders while respecting their individual roles and authorities.

### The Scientific and Technical Committees (STCs)

- Applied Vehicle Technology (AVT) Panel
- Human Factors and Medicine (HFM) Panel
- Information Systems Technology (IST) Panel
- System Analysis and Studies (SAS) Panel
- Systems Concepts and Integration (SCI) Panel
- Sensors and Electronics Technology (SET) Panel
- NATO Modelling and Simulation Group (NMSG)

“*The CPoW, built on an extensive network of scientists from the Nations and supported by the CSO, is the central pillar of the STO*”



## The Three Executive Bodies

### Office of the Chief Scientist (OCS)

The OCS, located at NATO HQ in Brussels, provides executive and administrative support to the Chief Scientist, who serves as the Chair of the Science and Technology Board and NATO's principle scientific advisor. The OCS also facilitates the dissemination of CPoW-generated results to various internal stakeholders and partners.

### The Collaboration Support Office (CSO)

The CSO, located in Paris, facilitates the world's largest and most vibrant scientific network for defence and security. More than 5,000 scientists, engineers, and analysts from NATO and Partner Nations and other NATO bodies are engaged in approximately 400 carefully selected S&T Activities in the CPoW. Together, they work to solve real-world problems that Nations face today, and to better prepare their Armed Forces to meet future challenges.

### The Centre for Maritime Research and Experimentation (CMRE)

The CMRE, located in La Spezia, Italy, conducts scientific research and technology development, and provides field-tested S&T solutions in the maritime domain to address Alliance defence and security needs.

The STO delivers its mission by:

- Building and promoting a strong, agile and responsive S&T network within NATO member Nations, some like-minded close Partner Nations, and NATO bodies.
- Accelerating NATO capability development with early technology identification and demonstration.
- Delivering timely and targeted S&T advice to relevant decision makers within NATO Nations and NATO bodies/agencies.

The STO Portfolio consists of three components, each operating under distinct business models:

1. **The Collaborative Programme of Work (CPoW)** is the collection of all S&T activities undertaken by the STCs within a unique collaborative business model. Research is resourced by Nations or supporting organizations. The CPoW is the cornerstone of the STO and comprises the majority of the STO Portfolio.
2. **The Centre for Maritime Research and Experimentation (CMRE) Programme of Work** operates under an in-house delivery business model, whereby research is funded directly by customers.
3. **The Office of the Chief Scientist (OCS) Advice Programme of Work** is funded by the Chief Scientist's budget and operates both an in-house and consultancy delivery business model. The programme supports S&T capacity building, nurtures the Alliance knowledge base and assesses S&T trends.

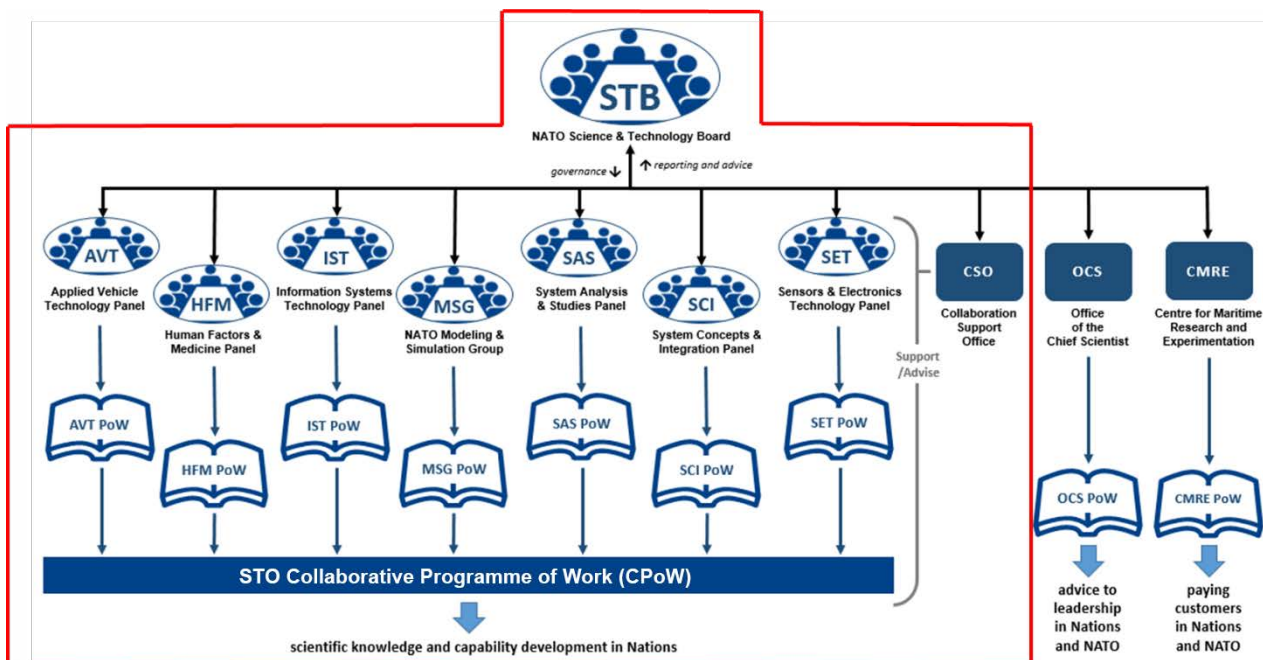


Figure 1: Overall STO and CPoW Structure

## Activity Lifecycle

The STCs initiate technical activities with guidance from Nations and their own scientific communities. The STCs typically hold two business meetings per year (spring and fall), with each meeting lasting between two and five days. During these meetings, new research activities are agreed upon at the STC Level.

“*The CPoW is funded directly by the Nations, who finance the extensive network of defence researchers*”

Technical activities are carried out by teams of national experts, with well-defined scopes and specific goals. The activity lifecycle is designed to be agile and low bureaucracy. It is illustrated below:

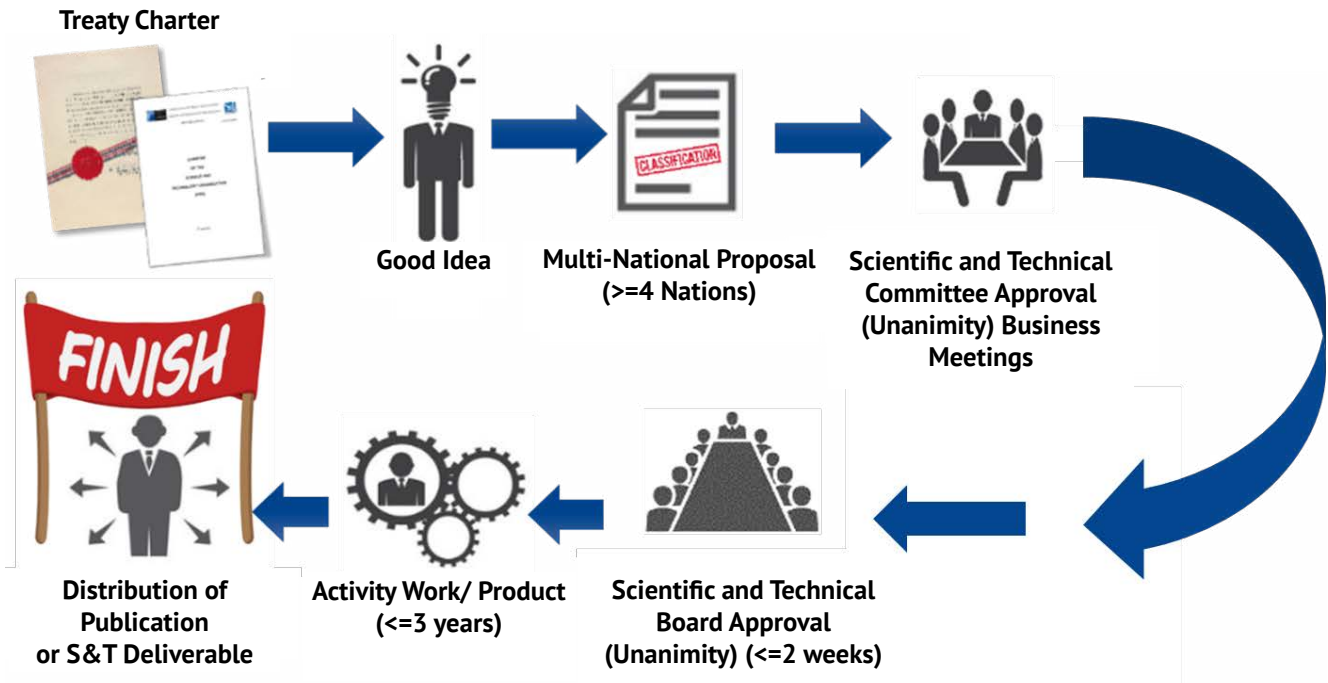


Figure 2: Activity Lifecycle

Ideas for new activities can come from Nations, network scientists, engineers, analysts, STC Members, or NATO bodies. However, each activity must have the support of at least four Nations before being initiated.

Once an activity draft is prepared, a Technical Activity Proposal (TAP) is presented for STC consensus prior to the upcoming business meeting. The TAP must receive unanimous endorsement from the STC. Some TAPs result in pilot studies or Exploratory Teams (ETs), approved at the STC-level. More mature ideas result in full-fledged research proposals, which must be approved by the STB. After the business meeting, newly endorsed activities are submitted to the STB for approval through a two-week silence procedure. If no objections are raised during this period, the activity is officially endorsed.

Final deliverables vary according to the activity type, and can include technical reports, cooperative technology demonstrations, or publications of meeting proceedings, among others.



All publically releasable STO scientific publications are available online at: [www.sto.nato.int](http://www.sto.nato.int)



# S&T Strategic Priorities and the Collaborative Programme of Work

The CPoW enables NATO Nations and some partner countries to address their S&T research needs in the fields of defence and security.

NATO Nations have elaborated several strategic documents to drive S&T cooperation.

As a first reference, the *NATO S&T Strategy* provides overarching guidance to steer the NATO S&T community's efforts in a coherent direction. It sets forth broad goals, investment areas, and five lines of effort (LoEs):

1. Stay at the forefront of S&T to outperform our competitors
2. Recognise partnerships as a strength
3. Encourage technical demonstrations to reduce the gap between research and actual delivery of capabilities
4. Improve the Alliance decision-making, in all compartments (operations, planning, etc.)
5. Concentrate efforts on the crucial requirements of Nations and NATO to achieve visible and valuable results

The *STO-CPoW Strategy 2024–2030* (“CPoW Strategy”) focusses specifically on the CPoW, and is designed to complement the *NATO S&T Strategy*. The CPoW Strategy sets forth four objectives aimed at:

1. Using the CPoW to turn S&T ideas and knowledge into support for military advantage in an agile and efficient way
2. Making the CPoW a strategic asset for Nations in maintaining NATO's technological edge
3. Ensuring that the CPoW is attractive to the best and brightest S&T talents
4. Ensuring that CPoW deliverables have impact and are exploited in a timely, effective and efficient manner, with targeted communication to key audiences

Under the umbrella of these two strategic documents, various guiding documents and practical initiatives allow Nations to prioritize S&T activities developed within the CPoW framework.

The NATO S&T Priorities guidance, adopted in 2017 and updated this year, steers medium- to long-term S&T planning across the NATO S&T community and informs smart investment decisions within Nations. The priorities are currently organised into 10 S&T areas, and broken down into 42 targets of emphasis (ToEs). These ToEs serve as key driving references, either to inspire new activities, or to verify that envisaged future projects are consistent with the NATO S&T Priorities.

In 2019, Allied defence ministers decided to focus Nations' attention on a more limited number of technologies, known as emerging and disruptive technologies (EDTs). As of 2024, NATO has identified nine EDTs.<sup>1</sup>

The STB has also acknowledged the need for more tailored tools and procedures to focus on specific strategic cross-domain areas, topics or problems. The *STO Strategic Initiatives* focus the NATO S&T community on such challenges and opportunities, with the aim of addressing them holistically and delivering results that go beyond the STO community. On a practical level, they help to create communities of interest in specific domains across the S&T community, and bring coherence to CPoW activities while addressing strategic S&T matters. In particular, the CPoW Challenges and the von Kármán Horizon Scanning (vKHS) studies deliver short-term analyses to trigger new CPoW activities, in the case of the CPoW Challenges, and to inform senior leadership on emerging and/or disruptive S&T issues, in the case of the vKHS studies.

Together, these strategic documents provide key guidance and tools to address vital S&T requirements within Nations. In 2024, they will be leveraged during the STO Plans & Programmes Workshop and the business meetings to frame and execute the CPoW.

<sup>1</sup> Artificial intelligence, autonomy, biotechnologies & human enhancement, energy & propulsion, hypersonics, next-generation communication networks, novel materials & manufacturing, quantum and space.

# The STO Technical Committees and Activities

The success of the CPOW relies on effective project management of technical activities. Management of the CPOW occurs at Level 2. The seven current STCs are responsible for a wide range of research, including a unique Group specializing in modelling and simulation. Together, they form the core of the STO. The STCs include national and NATO body representatives, as well as renowned scientists, engineers, and analysts. They propose new activities and oversee the CPOW, offering crucial technical oversight and acting as a vital bridge to military users and other NATO entities.

The current Level 2 committee structure comprises seven STCs:

- Applied Vehicle Technology (AVT) Panel
- Human Factors and Medicine (HFM) Panel
- Information Systems Technology (IST) Panel
- System Analysis and Studies (SAS) Panel
- Systems Concepts and Integration (SCI) Panel
- Sensors and Electronics Technology (SET) Panel
- NATO Modelling and Simulation Group (NMSG)

Each STC's respective work programme is executed by Technical Teams consisting of national experts. If specific expertise is necessary to assess the technical merit or feasibility of a proposal, an Exploratory Team (ET) is established prior to launching a Technical Team. ETs conduct feasibility and pilot studies to determine if a given research idea justifies a larger activity.

During the semi-annual business meetings, each NATO Nation represented in the STC is polled to gauge their willingness to allocate resources for, and participate in, a potential ET on a given topic. If the STC supports the initiative, the ET finalizes the TAP and submits it to the STC Office for review. If an idea is more mature, it can skip the ET step and may proceed directly to a Technical Activity. Nevertheless, the ET remains a crucial tool for scientists, engineers, and analysts to refine their proposals for a Technical Team.

The STCs assign Technical Teams to fulfil specific tasks, including:

**Research Task Group (RTG):** International collaboration, sponsored by STCs, to solve specific research and technological problems; RTGs operate for a maximum of three years, and may include cooperative demonstrations of technology (CDTs) or field trials (FTs).

**Research Lecture Series (RLS):** Two-day educational events disseminating advanced scientific knowledge among junior and mid-level scientists, accompanied by STO publications (Educational Notes).

**Research Technical Course (RTC):** Educational activities offering practical knowledge to military decision-makers, tailored for specific audiences; RTCs are held up to four times, with no mandatory STO publication.

**Research Workshop (RWS):** Facilitates intensive information exchange among experts on a specific topic, enhancing NATO S&T community capabilities; each RWS results in an STO publication (Meeting Proceedings).

**Research Specialists' Meeting (RSM):** Promotes knowledge exchange among specialists on important topics, enhancing NATO S&T capabilities; each RSM results in an STO publication (Meeting Proceedings).

**AGARDograph (AG):** Focuses on a single technical subject of lasting interest and value; AGs are chartered for a maximum of three years and authored by one or several experts.

**Long-Term Scientific Study (LTSS):** Provides recommendations based on the impact of science and technological developments on military operations; includes a brainstorming meeting called a Multinational Exercise (MNE); results in an STO publication (Technical Report).



**Military Application Study (MAS):** Rapid study assessing technological applications to solve operational deficiencies.

**Specialist Teams (ST):** Formed to address specialist research outside the Programme of Work.

**Research Symposia (RSY):** Promotes knowledge exchange on important scientific or applied topics through keynote addresses, oral presentations and poster presentations; results in an STO publication.

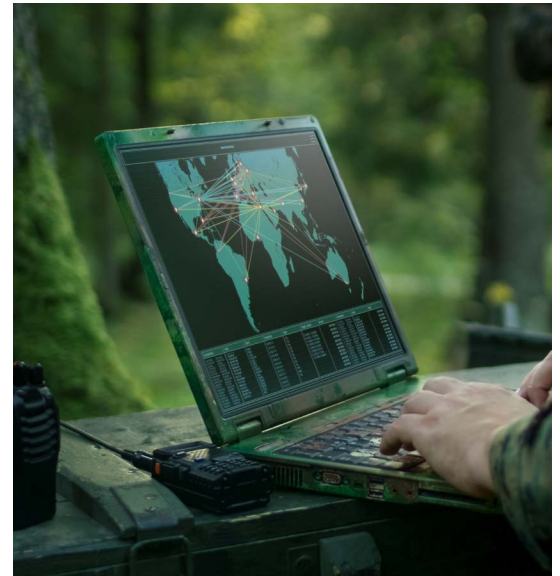
Other types of STC activities include the following:

**Support Project (SP):** Individual national projects with support from other Nations.

**Exploratory Teams (ET):** ETs may be established when an STC believes that a particular expertise is required to assist or advise the STC on the technical merit or feasibility of a specific proposal for a technical activity. ETs may also be used to help the STC develop recommendations on future content of the STC's Programme of Work.

SPs and ETs are not formally considered as STO CPoW Technical Teams, because their creation does not typically require full STB approval.

Finally, Cross-STC (commonly known as Cross-Panel) activities can occur across the plethora of STO activities. They are a joint venture between two or more STCs where different researchers collaborate by combining their unique set of specialist skills to tackle a multidisciplinary problem. Cross-STC activities bring together diverse perspectives, approaches to problem solving, and subject matter expertise to create unique synergies applied towards increasingly complex operating environment concerns. Within the CPoW, Cross-STC activities are not a goal in-and-of themselves, but are instead an additional tool to meet National S&T needs.



# Structure of the 2024 Collaborative Programme of Work

As of 1 January 2024, there are 343 ongoing activities in the STO CPoW. This figure includes activities that started before 2024 and will be still active in 2024, as well as new activities that will begin in 2024. Historically, this number is expected to increase as 2024 progresses, as new activities are added to the roster after the STC business meetings. It also includes activities awaiting final publication and support projects that are not listed in the individual STC areas of this document.

**Table 1: Total Breakdown of CPoW by Activity Type**

ACTIVITY TYPE		SCIENTIFIC TECHNICAL COMMITTEES							TOTAL
		AVT	HFM	IST	NMSG	SAS	SCI	SET	
Task Group	<b>RTG</b>	35	37	25	14	16	25	47	<b>199</b>
AGARDograph	<b>AG</b>	-	-	-	-	-	1	-	<b>1</b>
Long-Term Scientific Study	<b>LTSS</b>	5	-	-	-	-	-	-	<b>1</b>
Lectures Series	<b>RLS</b>	5	-	-	-	1	-	4	<b>10</b>
Specialists' Meeting	<b>RSM</b>	5	3	1	-	1	2	3	<b>15</b>
Symposium	<b>RSY</b>	2	2	4	2	2	1	2	<b>15</b>
Technical Course	<b>RTC</b>	-	1	-	1	3	-	-	<b>5</b>
Workshop	<b>RWS</b>	6	2	1	-	2	1	2	<b>14</b>
Specialist Team	<b>ST</b>	1	-	2	9	1	-	2	<b>15</b>
<b>Total Technical Teams</b>		<b>55</b>	<b>45</b>	<b>33</b>	<b>26</b>	<b>26</b>	<b>30</b>	<b>60</b>	<b>275</b>
<i>Exploratory Team</i>	<b>ET</b>	10	21	8	3	7	7	7	<b>63</b>
<i>Support Project</i>	<b>SP</b>	4	-	-	-	1	-	-	<b>5</b>
<b>Total including ETs and SPs</b>		<b>69</b>	<b>66</b>	<b>41</b>	<b>29</b>	<b>34</b>	<b>37</b>	<b>63</b>	<b>343</b>

In table 1 above and in tables 3 -16 on the following pages, Cross-STC activities are listed only once against the lead STC.

# Significant Meetings 2024

STCs endorse new activities after the spring and fall business meetings. These activities are then submitted to the STB for approval. The number of new activities may vary from year to year.

**Table 2: Overview of the 2024 Business Meetings**

STC or STB	2024 MEETINGS	MEETING DATES	MEETING LOCATION
STB	Plans & Programmes Workshop (PPW)	15-17 February	Paris (France)
AVT	Spring BM	20-24 May	Ottawa (Canada)
	Fall BM	14-18 October	Koblenz (Germany)
HFM	Spring BM	07-11 April	Tallinn (Estonia)
	Fall BM	20-25 October	Amsterdam (The Netherlands)
IST	Spring BM	22-26 April	Koblenz (Germany)
	Fall BM	14-18 October	Lillehammer (Norway)
NMSG	Spring BM	22-26 April	Bergen (Norway)
	Fall BM	21-25 October	La Spezia (Italy)
SAS	Spring BM	13-17 May	Stockholm (Sweden)
	Fall BM	6-8 November	Malaga (Spain)
SCI	Spring BM	13-15 May	Copenhagen (Denmark)
	Fall BM	14-18 October	Lisbon (Portugal)
SET	Spring BM	17-19 April	Amsterdam (The Netherlands)
	Fall BM	23-25 October	Dresden (Germany)
STB	Spring STB	19-21 March	Brussels (Belgium)
	Fall STB	17-19 September	Stockholm (Sweden)



Figure 3: NATO STO STB/PPW/BM Map

# Applied Vehicle Technology (AVT)

Chair: **Dr Tom THORVALDSEN (Norway)**

Executive: **Dr Kerstin HUBER (Germany)**

Vice-Chair: **Mr Christoph MUELLER (Germany)**

Executive Assistants: **Ms Isavela KONTOLAIMAKI (NATO)**  
and **Ms Edna FERRAZ (NATO)**

## Mission

The AVT Panel aims to enhance vehicle performance, reliability, affordability, and safety through technological advancements. This includes platform and power and propulsion technologies for vehicles across all domains: land, sea, air, and space, encompassing both existing and future systems.

To achieve this, the AVT community of more than 1,000 participants, leverages expertise in (1) mechanical systems, structures, and materials; (2) propulsion and power systems; and (3) performance, stability, control, and fluid physics. These efforts are supported by sub-committees that provide strategic guidance, scientific expertise, and bi-national collaboration.

Through bi-annual Business Meetings to discuss all sponsored activities, the Panel ensures the efficient use of NATO and national resources. Its approach fosters synergies through multidisciplinary and domain-agnostic methods; builds productive partnerships among academic scientists, governmental researchers, military operators, and industrial engineers; offers timely advice to NATO and Nations; and maintains a commitment to scientific excellence.

## Main Interests

The AVT Panel expertise encompasses a wide range of cross-cutting and technical focus areas that align with its mission:

- Assessment and multidisciplinary cooperation on hypersonic vehicles
- Further development and integration of autonomous vehicles in all domains
- Screening and evaluation of novel materials, structures, and manufacturing technologies for military applications
- International collaboration on a holistic virtual design approach for manned and unmanned future combat air platforms
- Determination and further compilation of innovative propulsion and power system technologies for military purposes
- Coordination and development of a future rotorcraft requirement trade-space, including key technology maturation
- Assessment and advancement of warship and fleet design capabilities
- Standardisation and implementation of sustainable use of munitions across their life-cycles
- Evaluation and integration of software-based applications for platform design, handling, and service
- Sustainment and life-cycle cost considerations for new and aging platforms, as well as fleet considerations.

Table 3: AVT Activities Continuing in 2023

ACTIVITY	ACTIVITY TYPE	TITLE
AVT-297	RTG	Development of a Framework for Validation of Computational Tools for Analysis of Air and Sea Vehicles
AVT-298	RTG	Reynolds Number Scaling Effects on Swept Wing Flows
AVT-332	RTG	In-Flight Demonstration (CDT) of Icephobic Coating and Ice Detection Sensor Technologies
AVT-341	RTG	Mobility Assessment Methods and Tools for Autonomous Military Ground Systems
AVT-342	RTG	Interoperability of Additive Manufacturing in NATO operations
AVT-345	RTG	Unified Tactical Missile Kinetic Performance Model
AVT-346	RTG	Predicting Hypersonic Boundary-Layer Transition on Complex Geometries
AVT-350	RTG	Innovative Control Effectors for Manoeuvring of Air Vehicles – Advanced Concepts
AVT-351	RTG	Enhanced Computational Performance and Stability & Control Prediction for NATO Military Vehicles
AVT-352	RTG	Measurement, Modelling and Prediction of Hypersonic Turbulence
AVT-358	RLS	Advanced Computational Fluid Dynamics Methods for Hypersonic Flows
AVT-359	LTSS	Impact of Hypersonic Operational Threats on Military Operations and Technical High Level Requirements
AVT-362	RTG	Water Sampling, Monitoring and Control/Remediation for Live-Fire Military Ranges
AVT-363	RTG	Improving the Understanding of Risks from Exposure to Munition Combustion Products
AVT-367	RTG	Sea-Ice Collision Risk Prediction and Mitigation for Naval Ships
AVT-368	RTG	Data Fusion and Assimilation for Scientific Sensing and Computing
AVT-370	RTG	Characterization of Structure-borne Noise in Military Vehicles
AVT-374	RSM	More Electric Gas Turbine Engines for Aircraft, Rotorcraft and UAVs
AVT-375	RLS	Munition Health Management Lecture Series: Implementation Challenges
AVT-376	RTG	Methodology for Tactical Missile IR Signature Predictions
AVT-377	RLS	Introduction to Quantum Computing in Fluid Dynamics
AVT-378	RTG	Progressive Rotorcraft Propulsion Alternatives
AVT-384	RSM	Novel Materials and Manufacturing in Military Vehicle Design
AVT-385	RLS	Multi-Fidelity Methods for Multidisciplinary Design Optimization

ACTIVITY	ACTIVITY TYPE	TITLE
AVT-391	RSM	Advanced Wind Tunnel Boundary Simulation III
AVT-393	RWS	Environmental and Thermal Barrier Coatings for Military Aircraft Engines
AVT-394	RSM	Water Sampling, Monitoring and Control/remediation for Live-fire Military Ranges
AVT-397	RTG	Sustainable Aviation Fuel (SAF) in military context
AVT-ET-231	ET	Criteria for Security Evaluation of Tamper Protection Technologies for Military Systems
AVT-ET-240	ET	Implementation Strategies for Environmentally Compliant Materials and Processes
AVT-ET-242	ET	Control Allocation for Complex Vehicle Control Systems
AVT-ET-243	ET	Critical Energetic Materials development of sustainability
AVT-ET-244	ET	Digital System Models for Integrated Propulsion, Power & Thermal Systems for Military
AVT-IST-398	RTG	Development of a STANREC for Augmented Reality in Land Platforms
AVT-SCI-ET-241	ET	Electro-optic Scatterometry – Application in Computational Platform Signature Modelling
AVT-SET-396	RSY	Technological And Operational Challenges Due To Hypersonic Flight And The Related Weapons Threat
AVT-ST-009	ST	Technical Support to NATO Next Generation Rotorcraft Capability (NGRC)

Table 4: AVT Activities (including ETs and Cross-STC Activities) Starting in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
AVT-380	RTG	Ground Vehicle Ride Quality Testing and Analysis with Complex Terrain
AVT-381	RTG	Maintenance Modeling in UxV Design for Improved Readiness & Endurance
AVT-382	RTG	Dynamic Reconfigurable Mission Planning for Improved Readiness of Autonomous Military Vehicles
AVT-383	RTG	Paint Removal Test Protocol and Application Guidelines
AVT-386	RTG	Assessment of Vortex-Vortex Interaction and Cavitation Inception
AVT-387	RTG	Common Research Wind Tunnels for CFD Verification and Validation
AVT-388	RTG	Operation of Unmanned Aerial Vehicles (UAVs) in Icing Environments
AVT-389	RTG	Understanding Risk Due to Reynolds Scaling Effects on the Stability and Control for Future Combat Aircraft Development
AVT-390	RTG	Vortex Flow Predictions for Stability and Control of Missile Airframes



ACTIVITY	ACTIVITY TYPE	TITLE
AVT-392	RTG	Assessment of Numerical Methods for Complex Flow over Marine Control Surfaces
AVT-395	RTG	Enhanced Weapons Performance through New Energetic Molecules/Formulations/Processing
AVT-400	RWS	Emerging Propulsion Technologies for NATO Land Vehicle Platform Systems
AVT-406	RTG	Innovative Solutions for Micro-Propulsion Systems for Small Spacecraft
AVT-407	RWS	System Qualification and Certification by Analysis
AVT-408	RTG	Autonomous Mobility Assessment for Military Ground Systems (CDT)
AVT-409	RWS	Life Cycle Analysis of Sustainable Technology for Military Platforms
AVT-410	RTG	End-2-End NG-NRMM Demonstration with Autonomous Assist Systems (CDT)
AVT-411	RWS	Machine Learning and Artificial Intelligence for Military Vehicle Design
AVT-412	RWS	Bonded Joint Design Validation and Inspection Methods to Achieve Certification
AVT-416	RLS	Lecture Series for Computational – Experimental Collaborations for Complex Analysis
AVT-ET-246	ET	Engine Integration Improvements due to advanced Engine Concepts
AVT-ET-247	ET	Three-dimensional Aspects of Unsteady Flow Interactions with Rigid Wings
AVT-ET-248	ET	Hydrogen as Fuel, Power Source & Infrastructure Challenges to NATO
AVT-HFM-403	RTG	PFAS In Soil and Water: Mitigation, Remediation and Risk Management for NATO Members
AVT-IST-ET-245	ET	Quantum-aided Design for Military Applications
AVT-SCI-405	RTG	Conceptual Aggregated Design of Hypersonic Glide Vehicle (HGV)



# Human Factors and Medicine (HFM)

Chair: **Dr Patrick MASON (United States)**

Executive: **LTC Siebren WOLF (The Netherlands)**

Vice-Chair: **Dr Larisa POGRAJC (Slovenia)**

Executive Assistant: **Ms Marie LINET (NATO)**  
and **Ms Vasiliki PLESSIA (NATO)**

## Mission

The mission of the HFM Panel is to establish the scientific and technological foundation for optimizing the health, protection, well-being and performance of individuals in operational settings. This entails ensuring physical, physiological, psychological, and cognitive compatibility among military personnel, technological systems, missions, and environments. Achieving this involves the exchange of information, collaborative experiments, and shared field trials.

## Main Interests

- 1. Combat casualty care:** The Panel focuses on evolving combat casualty care in line with advancements in weapon systems and battlespace tactics. Current guidelines rely on rapid evacuation to damage control surgery and critical care, but future operational environments may challenge these practices.
- 2. Chemical, biological, and radiological defence:** Changes in security policy, geopolitics, and weapon technologies influence the chemical, biological, radiological, and nuclear (CBRN) threat and defence. Closer collaboration between military and civilian sectors is essential. S&T areas supporting CBRN defence need to be identified, in light of expected threats between now and 2030.
- 3. Human-autonomy teaming:** Leveraging progress in Robotics, Artificial Intelligence, and Human Performance Modelling, the Panel develops and tests human-agent-robot teamwork (HART) systems. These systems involve dynamic cooperation between humans and autonomy to achieve joint objectives, often in shared spaces. They enhance performance and contingency management through coordinated responsibilities and commitments.
- 4. Cognitive warfare:** In response to an increasingly uncertain world with threats in both military and civilian domains, the Panel addresses the need for stronger collaboration between security and defence. It focuses on hybrid methods, such as propaganda, deception, sabotage, and non-military tactics, which have historically been used to undermine adversaries. The rise of technological/digital tools has amplified these methods, making them more accessible to various actors and emphasising the importance of information sharing and control.



Table 5: HFM Activities (including ETs and Cross-STC Activities) Continuing in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
HFM-285	RTG	Speech Understanding of English language in Native and non-Native Speakers/ Listeners in NATO with and without Hearing Deficits
HFM-306	RTG	Translating Medical Chemical Defence Research Into Operational Medical Capabilities Against Chemical Warfare Agent Threats
HFM-312	RTG	Unexplained Physiologic Events in High-Performance Aircraft
HFM-318	RTG	Personnel Retention in the Armed Forces
HFM-320	RTG	Fatigue Management in Aircrew
HFM-325	RTG	Performance Nutrition for Fresh Feeding during Military Training and Operations
HFM-326	RTG	Diet Supplementation for Military Personnel
HFM-327	RTG	Development of a NATO STANREC for Physiological Status Monitoring to Mitigate Exertional Heat Illness.
HFM-330	RTG	Human Systems Integration for Meaningful Human Control over AI-based systems
HFM-331	RTG	Biomedical Bases of Mental Fatigue and Military Fatigue Countermeasures
HFM-332	RTG	Development and Implementation of Autonomous Transport and Medical Systems for Casualty Evacuation
HFM-338	RTG	Guidelines to Mitigate Military Occupational Brain Health Risks from Repetitive Blast Exposure
HFM-341	RTG	Validation of Modeling and Simulation Methodologies for Human Lethality, Injury and Impairment from Blast-Related Threats
HFM-342	RTG	C2 Capability Lifecycle Governance
HFM-343	RTG	Digital Teaching Networks: Fostering digital collaboration among teachers, trainers, instructors, and coaches in the military
HFM-344	RTG	Human Impact Exposure onboard High Speed boats
HFM-345	RTG	Operations Security and Susceptibility to Influence in the Information Environment
HFM-347	RTG	Military Service Member and Veteran Domestic Radicalization
HFM-352	RTG	Moral Challenges in the Future Security Environment (FSE): Guidance for Leaders
HFM-358	RTG	Microbiome Applications in Human Health and Performance
HFM-359	RTG	Ionizing Radiation Bio Effects and Countermeasures
HFM-361	RSY	Mitigating and Responding to Cognitive Warfare
HFM-365	RTG	Human Capability & Survivability Enhancement: Augmenting people to deliver an enhanced and more resilient capability for defence
HFM-367	RTG	Pre-Symptomatic Detection of Biological Exposures
HFM-369	RWS	Leader Development for NATO Multinational Military Operations

ACTIVITY	ACTIVITY TYPE	TITLE
<b>HFM-374</b>	RTG	COGARMY: COGnitive training and teamwork assessment of ARMY personnel
<b>HFM-376</b>	RTC	Aerospace Medicine: Forward Together
<b>HFM-377</b>	RSY	Meaningful Human Control in Information Warfare
<b>HFM-ET-196</b>	ET	Enhanced Physical Protection and Hazard Management in CBRN Defence
<b>HFM-ET-202</b>	ET	COVID 19 in Aerospace and Diving: Riding the High and Low Waves
<b>HFM-ET-203</b>	ET	Optimized Menstrual Health in Servicewomen
<b>HFM-ET-206</b>	ET	Biomanufacturing of National Security Materials
<b>HFM-ET-209</b>	ET	Spiritual Dimension of Military Health
<b>HFM-ET-212</b>	ET	Evaluation Criteria and Use Cases for Information Operation/Social Media Simulators
<b>HFM-ET-215</b>	ET	The Ethical and Legal Challenges of Cognitive Warfare
<b>HFM-ET-216</b>	ET	Methods and Weapons of Adversary Cognitive Warfare
<b>HFM-ET-217</b>	ET	CBRN Medical Support Deep Dive and Future Optimization of CRBN Casualty Care
<b>HFM-IST-366</b>	RWS	Stakeholder involvement methods for Ethical Legal and Societal Aspects of Military AI
<b>HFM-IST-ET-200</b>	ET	Extended Reality (XR) Technology for Mediated Communication
<b>HFM-MSG-346</b>	RTG	Assessment of Factors Impacting Cybersickness
<b>HFM-MSG-354</b>	RTG	Study, Design, Building and Deployment of a CBRN XR Training Platform
<b>HFM-MSG-375</b>	RSM	Human Digital Twin in the Military: findings and perspectives
<b>HFM-SAS-357</b>	RTG	Standards for Military Personnel Data and Analytics Exchanges
<b>HFM-SET-353</b>	RTG	Operational CBR Threat Situational Awareness



Table 6: HFM Activities (including ETs and Cross-STC Activities) Beginning in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
HFM-368	RTG	Gender, Inclusive Leadership and Sustainable Security
HFM-371	RSM	Blast Exposure Monitoring in Military Training and Operations (BEMMTO)
HFM-372	RTG	Guidelines for Evaluation of Personal Protective Materiel and Systems Against Blast
HFM-373	RTG	Technology Enablers and Force Multipliers for CogWar: From Monitoring and Assessment to AI-based Assistance and Automation systems
HFM-378	RSM	Treatment Challenges with CBRN Combined Injuries
HFM-379	RTG	Occupant Injury Assessment Methods for Mine/IED Protection Levels of Vehicles
HFM-381	RTG	Military implications of Acute Noise-induced Changes in Hearing
HFM-382	RTG	Human Security and Military Operations
HFM-ET-210	ET	International Military Human Participation Research: Cross Cultural Applications
HFM-ET-211	ET	Endovascular Hemorrhage Control in Combat Casualties: Best Practices, Technology, and Training Harmonization
HFM-ET-214	ET	Cognitive Security: building and maintaining resistance to offensive cognitive strategies
HFM-ET-220	ET	Aircrew Human Performance Optimization
HFM-ET-221	ET	Biotechnology for Defense Innovation
HFM-ET-222	ET	Evidence Based Aerospace Medicine
HFM-MSG-ET-218	ET	Artificial Intelligence in Military Training and Education
HFM-SCI-ET-219	ET	Human Swarm Interaction



# Information Systems Technology (IST)

Chair: **Dr Nikolai STOIANOV (Bulgaria)**

Executive: **Lt Col Marek DOBEK (Poland)**

Vice-Chair: **Mr Antoine SMALLEGANGE (The Netherlands)**

Executive Assistant: **Ms Armelle DUTRUC (NATO)**

## Mission

The IST Panel fosters the advancement and exchange of techniques and technologies to enhance command & control, communications, computers, cyber, intelligence, surveillance, and reconnaissance (C5ISR) systems. C5ISR encompasses all facets of military capabilities, including personnel, resources, and methods, making it an indispensable component for any successful military endeavour.

## Main Interests

The work of the IST Panel centres on the technological dimensions of C5ISR, encompassing domains such as information warfare and assurance; information and knowledge management; communications and networks; and architecture and enabling technologies. With a special emphasis on artificial intelligence, big data, quantum technology, cognitive warfare, and cybersecurity, the IST STC strives to provide warfighters, planners, and strategists with timely, cost-effective, reliable, secure, and pertinent information.

The IST Programme of Work is structured around three focal areas – information and knowledge management, architecture and intelligence information systems (AI2S), and communications and networks (COM) – all of which are closely intertwined with the STC's activities.

**Table 7: IST Activities (including ETs and Cross-STC Activities) Continuing in 2024**

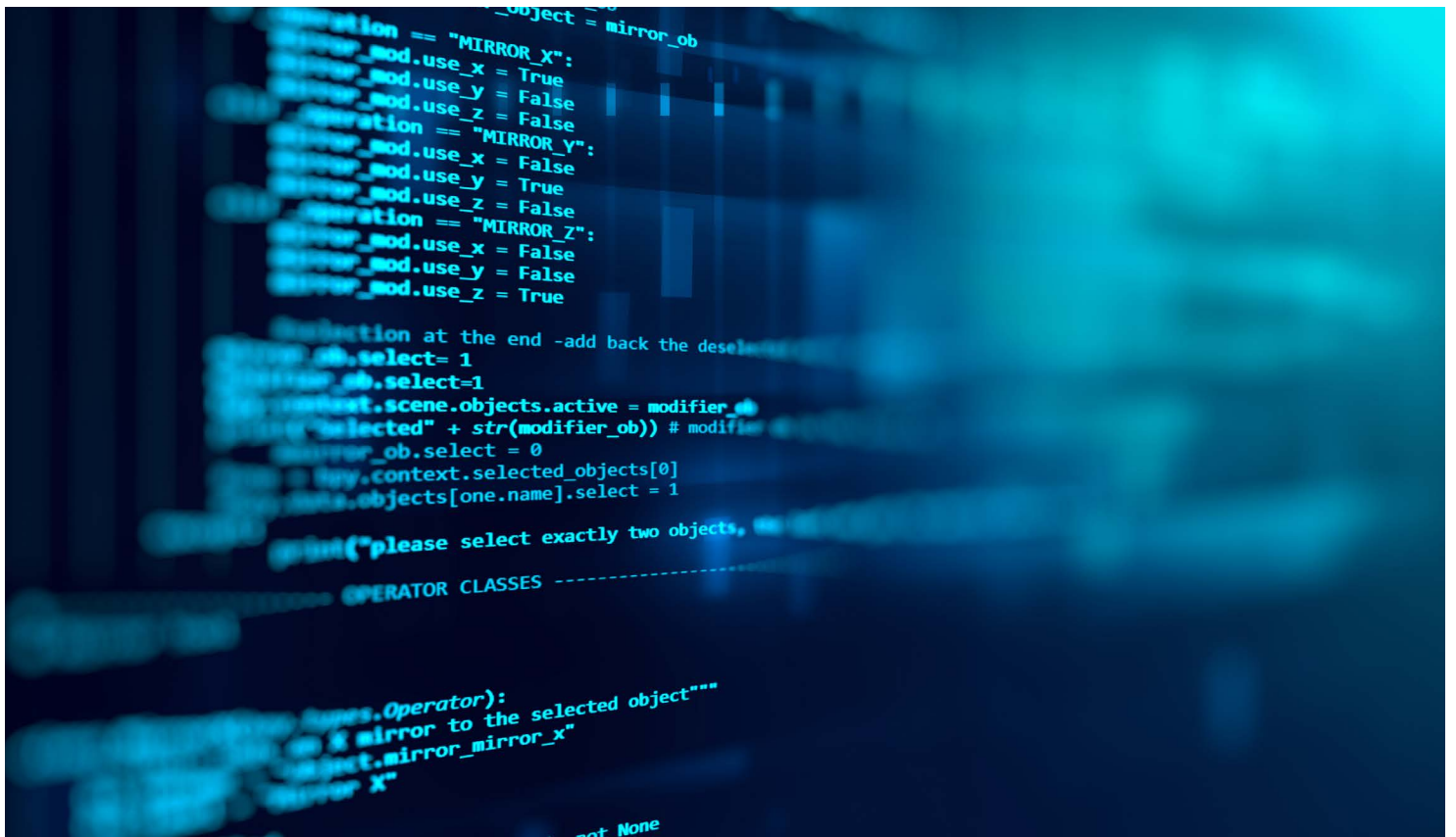
ACTIVITY	ACTIVITY TYPE	TITLE
IST-162	RTG	Cyber Monitoring and Detection Capability for Military Systems
IST-180	RTG	Network Management & Cyber Defense (NMCD) for Federated Mission Networking (FMN)
IST-184	RTG	Visual Analytics for Complex Systems
IST-187	RTG	5G Technologies Application to NATO Operations
IST-188	RTG	Applying and Validating the Cyber Security Risk Assessment Process for Military Systems
IST-189	RTG	Hybrid Military and Commercial SATCOM Networks
IST-191	RWS	Rescue Systems for Broken Trust
IST-192	RTG	ANTICIPE*@STJU-22
IST-193	RTG	Edge Computing at the Tactical Edge
IST-194	RTG	Adaptive Networks at the Tactical Edge
IST-196	RTG	Cyber Security in Virtualized Networks
IST-201	RTG	Federated Collaboration Services at the Tactical Edge

ACTIVITY	ACTIVITY TYPE	TITLE
IST-202	RTG	Federated Tactical Networking
IST-203	RSM	Wireless Communications Standardization in NATO
IST-205	RSY	IST Annual Symposium 2024 – International Conference on Military Communication and Information Systems (ICMCIS)
IST-206	RTG	Interoperability for Cooperating Unmanned Ground Vehicles
IST-208	RSY	Towards the convergence of Edge Computing, Adaptive Networking, and Information Management at the Tactical Edge
IST-211	RTG	Tools and Methods for Analyzing Cyber Security for Federated Autonomous Vehicles
IST-212	ST	Addressing New and Emerging C4I Challenges and creating impact in the Current Environment
IST-213	ST	Evaluating Strategy, Procedures, and Inner Structure of IST
IST-ET-117	ET	Data Hiding in Information Warfare Operations
IST-ET-123	ET	Exploring Countermeasures against Misinformation of a Nation’s Population
IST-ET-124	ET	Using an AI Maturity Model to Accelerate Successful AI adoption
IST-ET-125	ET	Evolving Threat Landscape for Coalition AI/ML Systems
IST-ET-126	ET	6G Telecommunications (Part of Response to EDT)
IST-SET-204	RTG	RF Based Detection and Classification of UAS



Table 8: IST Activities (including ETs and Cross-STC Activities) Starting in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
IST-199	RTG	Free-Space Optical Communications
IST-207	RTG	Military Applications for Large Language Models
IST-209	RSY	IST Annual Symposium 2025 – International Conference on Military Communication and Information Systems (ICMCIS)
IST-210	RSY	AI Security and Assurance for Military Systems
IST-214	RTG	Enabling AI Adoption for Enhanced Defense Interoperability
IST-215	RTG	AI Assurance & Security
IST-216	RTG	Channel Modelling and Application for Secure Underwater Acoustic Communications Waveform Assessment and Standardization
IST-217	RTG	Military Quantum Internet
IST-219	RTG	Quantum Technology Vulnerabilities
IST-220	RTG	NATO Wireless Communications Standards Project
IST-221	RTG	Defense Against Adversarial Attacks on Machine Learning Systems
IST-ET-127	ET	Explainable AI in Decision Support Systems
IST-ET-128	ET	Formal Modelling of Military Cryptographic Key-management (COMSEC) Processes





# NATO Modelling and Simulation Group (NMSG)

Chair: **Mr Bharat PATEL (United Kingdom)**  
 Vice-Chair: **Col John FERELL (United States)**  
 Executive: **Cdr Alvaro HERRAIZ-SOLLA (Spain)**

Technical Officer: **Mr Adrian VOICULET (NATO)**  
 Executive Assistant: **Ms Renata DANAUSKE (NATO)**

## Mission

The NMSG convenes stakeholders and subject matter experts to coordinate and oversee the execution of the NATO Modelling and Simulation Master Plan (NMSMP).

The NMSMP, an officially approved NATO policy document by the North Atlantic Council (NAC), offers a strategic vision and guidance for the effective coordination and utilization of modelling and simulation (M&S) within NATO. The overarching vision is to fully harness the potential of M&S across both NATO and member nations, thereby bolstering operational efficiency and cost effectiveness.

The NMSG's core mission is to promote collaboration among various Alliance entities, NATO itself, and partner nations, with the ultimate goal of optimizing the practical application of M&S. This mission encompasses various facets, including the standardization of M&S practices, educational initiatives, and the advancement of associated S&T. Furthermore, as designated by the Conference of National Armaments Directors (CNAD), the NMSG holds the delegated authority for overseeing standardization within the realm of NATO M&S.

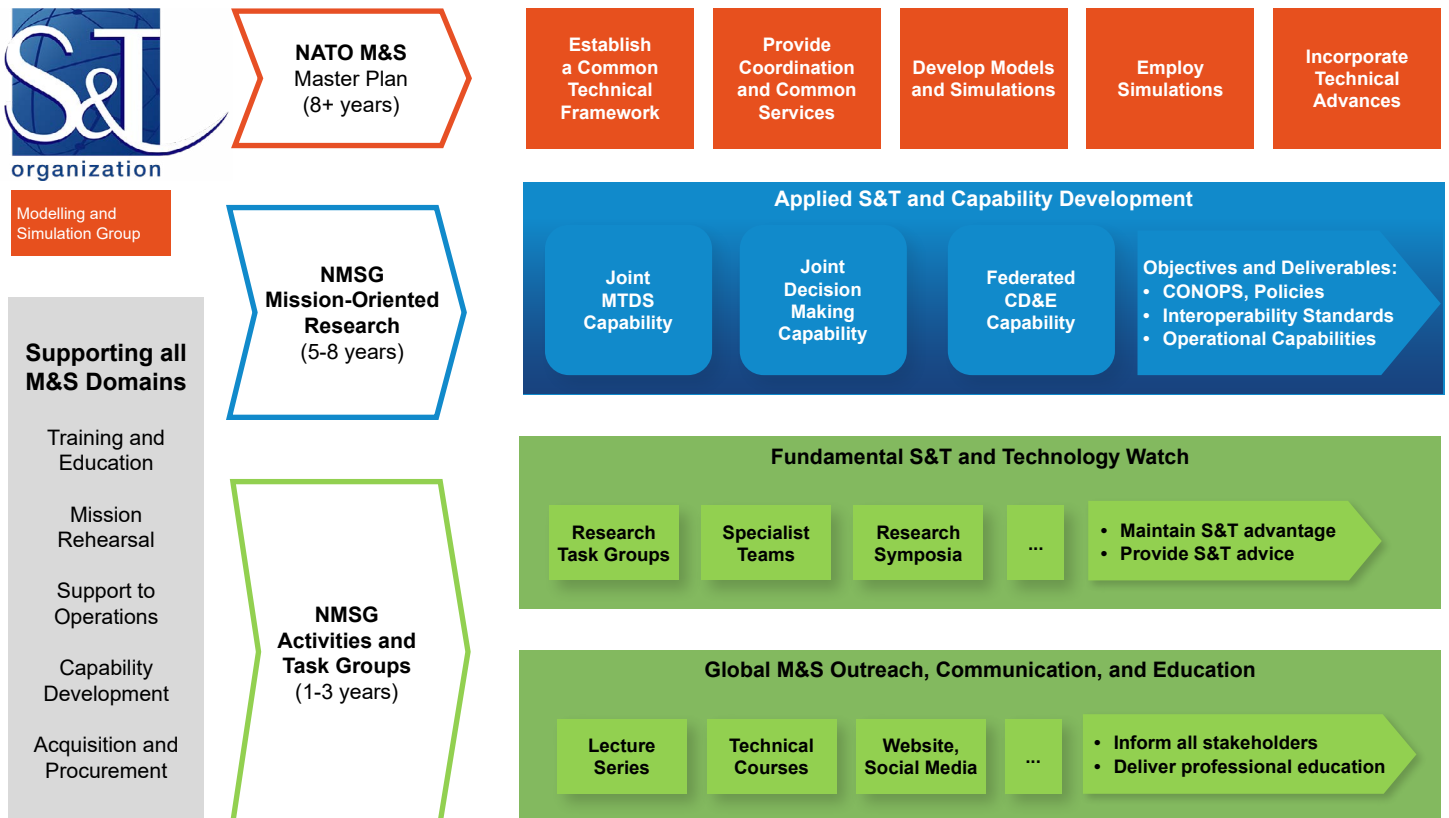


Figure 4: The NATO Modelling and Simulation Master Plan

## Main Interests

The NMSMP clearly defines NATO's vision and fundamental principles pertaining to the use of M&S in support of the NATO mission. It provides comprehensive insights into how realising this vision will impact various application areas within NATO M&S, while also outlining the governance structures, responsible bodies and key stakeholders in the NATO M&S landscape.

Aligned with the overarching objectives of establishing a unified technical framework, enhancing interoperability, and advancing models, simulations, and standards for M&S, the principal areas of focus for ongoing and future efforts include the following:

- 1. Distributed synthetic training:** This involves the development of training environments that span multiple locations, fostering realistic and collaborative training scenarios.
- 2. Federated battle labs for collaborative concept development:** This aims to create interconnected battle laboratories that facilitate collaborative concept development, experimentation, and support for operational missions.
- 3. Experimentation and operational mission support:** This area concentrates on conducting experiments and providing support for operational missions, ensuring that M&S capabilities align effectively with NATO's evolving needs.

In line with its mission to explore, strategize, update and propose future programmes of work, the NMSG operates through three permanent sub-groups:

- 1. Military Operational Requirements Subgroup:** This subgroup is responsible for identifying and addressing operational needs and requirements within the M&S domain, ensuring alignment with NATO's mission objectives.
- 2. M&S Standards Subgroup:** Focused on the standardization of M&S practices and technologies, this subgroup plays a pivotal role in establishing common protocols and standards for greater compatibility and efficiency.
- 3. Planning and Programmes Committee:** Tasked with the planning, development, and management of future programmes of work, this committee ensures that the NMSG's initiatives remain forward-looking and aligned with NATO's overarching goals and

**Table 9: NMSG Activities (including ETs and Cross-STC Activities) Continuing in 2024**

ACTIVITY	ACTIVITY TYPE	TITLE
MSG-173	RTG	Simulation for Training and Operation Group – Next Generation (STOG-NG)
MSG-181	RTG	Physics-Based Electro-Optic/Infrared Simulations – Best Practice Recommendations for Decision Support
MSG-186	RTG	Multi-Dimensional Data Farming
MSG-187	RTG	Space Weather Environmental Modelling (SWEM)
MSG-191	RTG	NATO Standards for Federated Simulation and Services for Integration, Verification and Certification
MSG-195	RTG	Modelling and Simulation as a Service – Phase 3
MSG-200	RTG	Modelling Cyber Domain Entities and Events within Distributed Simulations
MSG-201	RTG	Modelling and Simulation in Federated Mission Networking (FMN)
MSG-202	RTG	NATO Modelling and Simulation Resources/Standards Support Team - III

ACTIVITY	ACTIVITY TYPE	TITLE
MSG-204	ST	NMSG support to Distributed Synthetic Training (DST) A2CD2 efforts
MSG-205	RTG	Allied Interoperability and Standardization Initiatives for Digital Twins
MSG-206	RTG	Common Framework for the Assessment of XR Technologies for Use in Training and Education
MSG-211	RTC	Modelling and Simulation Standards in NATO Federated Mission Networking
MSG-212	ST	M&S in Federated Battle Labs for Collaborative Concept Development and Experimentation (CD&E)
MSG-214	ST	M&S for Operational Mission Support
MSG-215	ST	Cross-Domain Security in Distributed Simulation
MSG-216	ST	AMSP-05 "CAX Handbook" Revision
MSG-218	RSY	MSG/MSCO Support to International Training & Education Conferences IT2EC, I/ITSEC and CA2X2 Forum 2024
MSG-219	ST	Domain Specific Language (DSL) for Modeling & Simulation (M&S)
MSG-221	RTG	M&S in support of Building Resilience and Management of People Mass Movement
MSG-222	RTG	Representing Human Behavior and Decision-Making in Modelling and Simulation
MSG-ET-054	ET	Unified Network Architecture and Interface Declaration for Live Fire Exercise Systems on Shooting Ranges and Military Training Areas
MSG-ET-055	ET	Representing Electronic Warfare as part of Multi-Domain Operations in Modelling and Simulation Systems
MSG-HFM-220	ST	Effectiveness of Medical Training Based on eXtended Reality

Table 10: NMSG Activities (including ETs and Cross-STC Activities) Starting in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
MSG-217	RSY	Modelling and Simulation as Enabler for Digital Transformation in NATO and Nations
MSG-223	RTG	Evolving M&S Applications and Services for Compliance with NATO Standards for Federated Simulation
MSG-224	ST	Service Management and Control in Federated Simulation
MSG-ET-056	ET	Training Data Analytics and Standards

# System Analysis and Studies (SAS)

Chair: **Dr Donna WOOD (Canada)**

Executive: **LTC Spencer TIMMONS (United States)**

Vice-Chair: **Dr Richard DECKRO (United States)**

Executive Assistant: **Mr Jeroen GROENEVELT (NATO)**

## Mission

As the STO's foremost expert committee for analytical counsel, the SAS Panel conducts studies and analyses to enhance decision-making in matters of strategy, capability development, and operational activities within NATO, NATO Nations, and partner nations. The Panel's focus encompasses the effective use of emerging technologies, innovative organisational structures, and novel operational concepts.

## Main Interests

The Panel's primary focus centres on conducting operations analysis activities to address challenges related to the evolving strategic landscape, and to inform responses from NATO and NATO Nations. The SAS Panel's research initiatives can be categorised into four core areas:

- 1. Policy and strategy decision support:** This entails providing decision-making support by analysing and assessing the impacts of geopolitical forces, regional dynamics, future scenarios, and technological shifts.
- 2. Operations decision support:** The Panel engages in analysis to enhance operational tactics, training protocols and procedures. It actively contributes to the development of improved methods for operational planning.
- 3. Capability and investment decision support:** The Panel aids decision-making related to systems, force elements and enabler capabilities. This involves collecting and consolidating cost and performance data, and defining the necessary missions for these specific systems and capabilities.
- 4. Development and maintenance of analysis capabilities:** The Panel's foundational work revolves around developing and sustaining analytical capabilities that are innovative and academically robust. This is crucial to providing NATO with the necessary analytical tools for well-informed defence decision-making. Activities in this area include the creation of analytical methods to address emerging security challenges; sharing knowledge on operations analysis modelling concepts and best practices; researching new methodological approaches; and developing and exchanging analytical models.

The SAS Panel leverages its extensive range of analytical capabilities to provide decision support at various levels and across diverse domains. This includes not only identifying and assessing the influence of geopolitical factors, but also enhancing operational tactics, devising more effective training procedures, and supporting the development of advanced systems and capabilities. Additionally, it plays a pivotal role in collecting and consolidating essential cost and performance data.

The SAS Panel's research projects stem from proposals put forth by participating NATO Nations. It also responds to requests for analysis and studies from a variety of sources, including the STB and various other NATO entities such as the NATO Military Committee and the Conference of National Armament Directors (CNAD) with its Main Armaments Groups: the NATO Industrial Advisory Group (NIAG), Allied Command Operations (ACO), Allied Command Transformation (ACT), and the NATO Communications and Information Agency (NCIA).



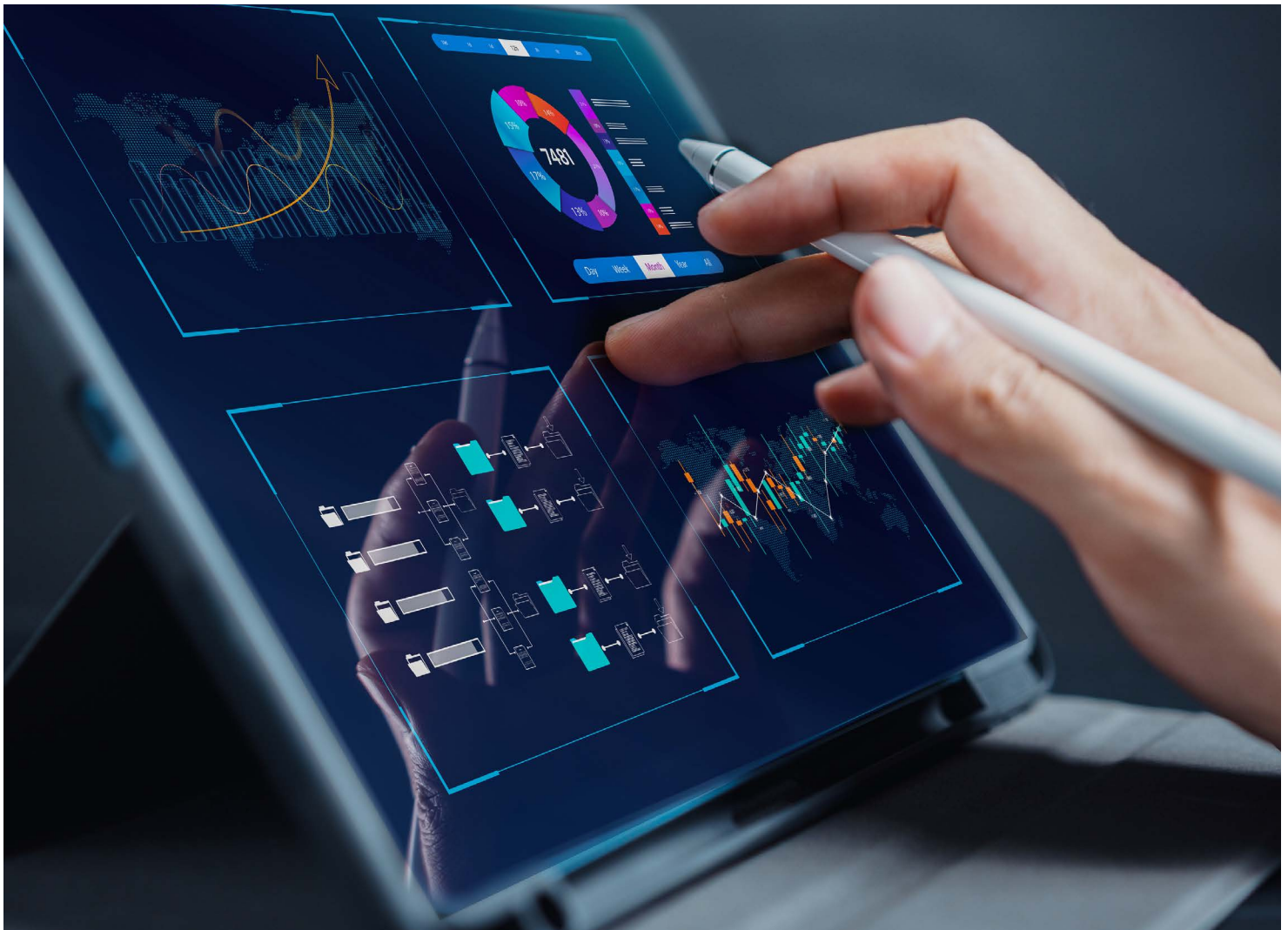
Table 11: SAS Activities (including ETs and Cross-STC Activities) Continuing in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
SAS-160	RTG	Ethical, Legal and Moral (ELM) Impacts of Novel Technologies on NATO's Operational Advantage – the "ELM Tree"
SAS-166	RTG	Wargaming Multi-Domain Operations in an A2/AD Environment
SAS-167	RTG	Assessing the Value of Cyber Operations in Military Operations
SAS-172	RTG	Multi-Domain Operations Wargame
SAS-175	RWS	Integration of Unmanned Systems (UxS) into operational units
SAS-177	RTG	Defending Democracy in the Information Environment – Foundations and Roles for Defence
SAS-181	RTG	Exploiting Reinforcement Learning to Achieve Decision Advantage
SAS-182	RTG	The Effects of Climate Change on Security
SAS-183	RTG	Energy Security Resilience, Capability and Interoperability
SAS-185	RTG	Indicators and Warnings for Cognitive Warfare in Cyberspace
SAS-186	RTC	Designing Effective Visualizations for Defence Investment Uncertainty and Risk
SAS-187	RWS	Understanding Strategic Culture
SAS-188	RTG	Analytic Support for Military Adaptation in War
SAS-189	RTG	Anticipatory Intelligence for Superior Decision-Making
SAS-ET-FF	ET	Planning for Uncertain Defence Budget Increases
SAS-ET-FL	ET	AI tools for Operational Planning
SAS-IST-171	RTG	C2 services in Multi Domain Operations for Federated Mission Networking (FMN)
SAS-IST-179	RTG	Semantic Representation to Enhance Exploitation of Military Lessons Learned
SAS-MSG-180	RTG	Modelling & Simulation-Wargaming Integration for Intermediate Force Capabilities (IFC)



Table 12: SAS Activities (including ETs and Cross-STC Activities) Starting in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
SAS-190	RSY	Enhancing Energy Security Resilience, Capabilities and Interoperability
SAS-191	RTC	Nordic Pine 2024: Hybrid Threats to Renewable Energy Systems
SAS-192	RSY	SAS Annual Symposium – 18th NATO Operations Research and Analysis (OR&A) Conference 2024
SAS-194	RTG	Validation and Enhancement of the Soldier System Weapon & Equipment Assessment Tool
SAS-195	RLS	NATO STO Summer School: Decision-Making for the Future
SAS-ET-FK	ET	Future Strategic Environment Assessment
SAS-ET-FO	ET	Comprehensive Assistance Package for Ukraine Tailored Support Measure - Operational Research and Analysis Support.
SAS-HFM-184	ST	Carbon Footprint Assessment of Military Organizations and Operations and related Logistics
SAS-HFM-ET-FM	ET	Natural Language Processing for Defence: Exploiting the Cutting Edge of Large Language Models for Military Contexts
SAS-SCI-ET-FN	ET	Directed Energy Weapons Integration into the NATO Force Mix



# Systems Concept and Integration (SCI)

Chair: **Mr Allan CHAN (United States)**

Executive: **Lt Col Tuan TRAN (United States)**

Vice-Chair: **Dr Nicholas LAW (United Kingdom)**

Executive Assistant: **Ms Carlotta ROSSI (NATO)**

## Mission

The SCI Panel is dedicated to advancing knowledge in advanced system concepts, integration, engineering techniques, and technologies, spanning a wide spectrum of platforms and operational environments. Its primary objective is to ensure the cost-effective attainment of mission area capabilities. The Panel's purview extends to integrated defence systems, encompassing air, land, sea, and space systems (both manned and unmanned), as well as the integration of associated weaponry and countermeasures. SCI activities are oriented towards addressing mid- to long-term system-level operational requirements for both NATO and NATO Nations.

## Main Interests

The STC's activities span a multidisciplinary spectrum, encompassing theoretical concepts, design, development and evaluation methods applied to integrated defence systems. It operates through three distinct working sessions, each with its own specific areas of focus:

- 1. Systems integration and interoperability:** This session is dedicated to fostering seamless integration and interoperability among various defence systems. It aims to facilitate the harmonious functioning of disparate components within a broader defence framework.
- 2. Integrated survivability:** This session places a significant emphasis on enhancing the survivability of integrated defence systems. This involves developing strategies and technologies that bolster the resilience of these systems in the face of threats and challenges.
- 3. Enablers and disruptive capabilities:** This session focuses on identifying and harnessing enabling technologies and disruptive capabilities that can significantly enhance the effectiveness and versatility of integrated defence systems.



Table 13: SCI Activities Continuing in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
SCI-304	RTG	Optimised and Reconfigurable Antennas for Future Vehicle Electronic Counter Measures
SCI-314	AG	AG-300 V.35 Ground and Flight Test Methods Used to Assure Aero elastic Stability of Fixed Wing Aircraft
SCI-316	RTG	High Energy Laser Weapons: Quantifying the Impact of Atmospheric and Reflections
SCI-321	RTG	UAV Applications for Military Search
SCI-322	RTG	Scientific Support to NATO Aerospace Capability Group 3 Sub-Group 2 (ACG3/SG2) on Suppression of Enemy Air Defence (SEAD)
SCI-325	RTG	Methods of Identifying and Evaluation the Camouflage and Deceptive Properties of the Military Equipment in Land Field Trials
SCI-327	RTG	Countermeasure Concepts against Anti-Aircraft Dual band EO/IR Imaging Seekers
SCI-332	RTG	Radio Frequency-based Electronic Attack to Modern Radar
SCI-333	RTG	Multi-sensor Fusion Architecture for the Detection of Person-borne-Improvised Explosive Devices (PB-IEDs)
SCI-334	RTG	Evaluation of Swarm System for Military Applications
SCI-342	RTG	Explosive Ordnance Disposal (EOD) Tele-manipulation Robot Technology Roadmap Development
SCI-343	RTG	Enabling Federated, Collaborative Autonomy
SCI-344	RTG	Future Multi-sensor Threat Defeat Concepts
SCI-346	RTG	Space Risk Assessment Matrix (S-RAM)
SCI-348	RTG	Real-time Coalition Electromagnetic Battle Management (EMBM)
SCI-349	RTG	Heterogeneous Data-Driven Space Domain Decision Intelligence
SCI-350	RTG	NATO Alliance SmallSat Constellation Effort (ALLSAT)
SCI-352	RTG	Flight Test Technical Team (FT3)
SCI-354	RTG	Air Platform Generic Self-Defence
SCI-356	RSY	Radio-Frequency Directed Energy Weapons – Status and Perspectives
SCI-357	RTG	Comparison of Allied Nations Space Strategies
SCI-359	RTG	CCDs Technologies to counter Artificial Intelligence Systems
SCI-360	RTG	Scientific Support to NATO Navy Armaments Group (NNAG) above Water Warfare Capability Group
SCI-361	RSM	Systems and Concept Challenges in enabling Multi-Domain Operations (MDO)
SCI-ET-063	ET	Laser Jamming Assessment and Techniques against IR Guidance Seeker



ACTIVITY	ACTIVITY TYPE	TITLE
SCI-ET-065	ET	Barriers, Challenges and Quantification of Trust in Complex Autonomous Systems and possible AI Acceleration
SCI-SAS-351	RTG	Alliance Space Deterrence Framework
SCI-SET-353	RTG	C-UAS Mission-Level Modelling & Simulation
SCI-SET-358	RSM	Electromagnetic Operations

Table 14: SCI Activities (including ETs and Cross-STC Activities) Starting in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
SCI-363	RWS	Standards for Maritime Situational Awareness (MSA)
SCI-ET-064	ET	Design and Test of Multispectral Decoys for Land Warfare
SCI-ET-066	ET	Countermine Technologies of the Future
SCI-MSG-ET-067	ET	Countering Autonomy/AI Threats
SCI-MSG-ET-068	ET	Virtual Reality for Distributed Planning, Analysis and Exploitation of 3D Geospatial Data
SCI-SET-355	RTG	Cross-Panel Collaborative Experimentation for Improved Space Situational Awareness (SSA)
SCI-SET-ET-069	ET	Overarching Quantum Technology Military Roadmap



# Sensors and Electronics Technology (SET)

Chair: **Prof Marco MARTORELLA (Italy)**

Executive: **Lt Col Isidoro MARCONE (Italy)**

Vice-Chair: **Dr Jason GUICHETEAU (United States)**

Executive Assistants: **Ms Alicia MAHARAJ (NATO)**  
and **Ms Alessia CHERUBINI (NATO)**

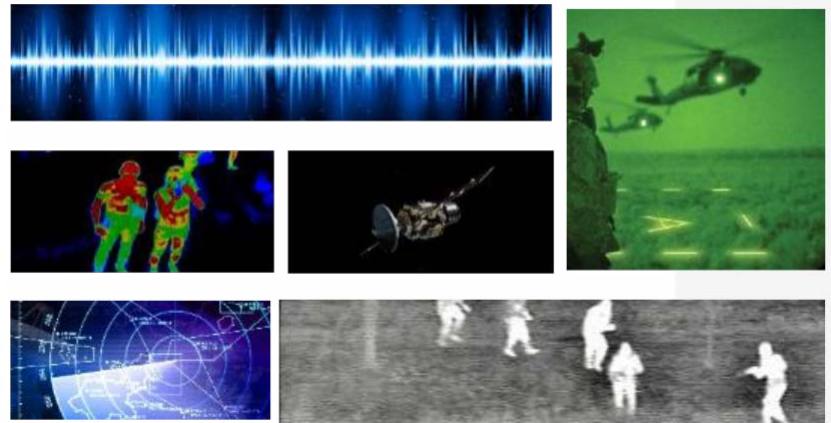
## Mission

The SET Panel facilitates collaborative research, information exchange and the advancement of S&T among NATO Nations in the field of sensors for defence and security purposes. The Panel focuses on the development and enhancement of both passive and active sensors in all warfare domains (space, air, land, and above and underwater), as well as associated technologies and capabilities, multi-sensor integration and fusion as they pertain to intelligence, surveillance, target acquisition and reconnaissance (ISTAR), remote sensing, electronic warfare (EW), communications, and navigation.

To execute this mission effectively, the SET STC is structured into three specialized focus groups: radio-frequency technology, optical technology, and multi-sensors and electronics.

## Main interests

The SET Panel's work primarily revolves around topics related to target signatures, signal propagation within battlespace environments, electro-optic (EO), radio-frequency (RF), acoustic and magnetic sensors. It also encompasses antennas, signal and image processing, sensor hardening, electromagnetic compatibility, and other phenomena associated with sensors and electronics that can provide valuable support to NATO warfighters in both future warfare scenarios and peacekeeping operations.



The focus groups address the following domains:

- 1. Radio-frequency technology:** Radar, including active, passive, synthetic aperture radar, noise, cognitive, multi- and bi-static, multi-function, and software-defined radar; automatic target recognition/non-cooperative target recognition (ATR/NCTR); radar imaging; (polarimetric) radar signatures; resource management and spectrum management; EW, encompassing electronic attack, electronic protection, and electronic support measures, including direction finding and passive electronic support measures tracker.
- 2. Optical technology:** Optical sensing, spanning from ultra violet to far infrared, as well as hyperspectral sensing; laser radar technology; light detection and ranging, laser sources, and systems; 3D imaging; system performance modelling, accounting for environmental effects; target signatures; optical electronic warfare countermeasures; computational imaging and compressive sensing; optical components and design.
- 3. Multi sensors and electronics:** Application areas, including counter-improvised explosive device, swarms, position navigation and timing (PNT), autonomous sensing, and counter-unmanned aerial systems, sensing for ISR; sensors, with a focus on multi-sensor fusion, sensors management, acoustics, chemical, biological, radiological and nuclear or explosive sensing, underwater maritime sensing, and quantum sensing.

Table 15: SET Activities (including ETs and Cross-STC Activities) Continuing in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
SET-260	RTG	Assessment of EO/IR Technologies for Detection of Small UAVs in an Urban Environment
SET-269	RTG	EO/IR Ship Signature Dynamics
SET-270	RTG	Overcoming the Technical Barriers that Inhibit use of Fuel Cells for Dismounted Soldier Applications
SET-272	RTG	Automated Scene Understanding for Battlefield Awareness
SET-278	RTG	Machine Learning for Wide Area Surveillance
SET-279	RTG	Space-based SAR and Big Data Technologies to Support NATO Operations
SET-280	RTG	Phenomenology and Exploitation of Counter-Measures (CMs)
SET-283	RTG	Advanced Machine Learning ATR Using SAR/ISAR data
SET-285	RTG	Multifunction RF Systems
SET-286	RTG	Acoustic and Seismic Sensing of Threats in Urban Environments
SET-287	RTG	Characterization of Noise Radar
SET-288	RTG	Integrating Compressive Sensing and Machine Learning Techniques for Radar Applications
SET-291	RTG	Sensitivity of EO TDAs to Environmental Factors
SET-292	RTG	Enhanced Raman Spectroscopy for Defense Applications
SET-294	RTG	Advanced Mid-Infrared Laser Technology
SET-295	RTG	Radar Signature Measurements of Maritime Platforms
SET-296	RTG	Radar against Hypersonic Threats
SET-300	RTG	3D Active and Passive EO/IR Sensing for Urban Operations
SET-301	RTG	SimPL Simulation of Low Photon Lidar
SET-302	RTG	Cognitive Radar
SET-304	RTG	Modeling, Measuring and Mitigating Optical Turbulence: M3T
SET-305	RTG	Improved Field of View for Night Vision Goggles – Technical Challenges, Concepts, Performance Assessment
SET-306	RTG	Improved Panoramic Situational Awareness for Vehicle Platforms – Technical Challenges, Concepts, Performance Assessment
SET-307	RTG	Advanced Radar Techniques for Robust Situation Awareness and Threat Assessment Considering Class I UAS in Complex Environments
SET-309	RTG	NATO PNT Open System Architecture & Standards to Ensure PNT in NAVWAR Environments

ACTIVITY	ACTIVITY TYPE	TITLE
SET-310	RTG	Assessment of EO/IR Compressive Sensing and Computational Imaging Systems
SET-313	RTG	Advanced Methods for Hyperspectral Data Exploitation
SET-316	RTG	Realistic Trace Explosives Test Standards for Evaluation of Optical Sensors in Relevant Scenarios
SET-317	RTG	Multi-dimensional/Multi-platform Radar Imaging
SET-318	RSM	AI/ML and Cognitive Radar
SET-320	RTG	New Frontiers in Modern Passive Radars
SET-321	RTG	Development of Standardized Targets for Military Search
SET-322	RTG	Evaluation Framework for Multi-sensor Tracking and Fusion Algorithms
SET-323	RTG	Advanced Methods for Laser Dazzle Evaluation
SET-325	RTG	Shortwave Infrared Technology: Irradiance Measurements to Evaluate Reflective Band Systems
SET-326	RLS	STO Summer School
SET-329	RTG	Radar Signature Measurement and Validation of a UCAV Model
SET-330	RTG	Algorithms as Observers: The Future of Imaging System Design, Modeling, and Testing
SET-331	RSM	Photonic Integrated Circuits
SET-ET-132	ET	Quantum Algorithms for Data Fusion and Resources Management
SET-ET-134	ET	Using Simulation to train AI for Automated Scene Understanding
SET-HFM-314	RWS	Multi-Omic Data Sciences Research Workshop
SET-HFM-324	RTG	Surface and Ground Chemical Contamination Detection and Avoidance
SET-HFM-328	RTG	Sequencing for Environmental Aerosol Background Monitoring

Table 16: SET Activities (including ETs and Cross-STC Activities) Starting in 2024

ACTIVITY	ACTIVITY TYPE	TITLE
SET-332	RTG	Assessment of Quantum-Based RF and EM Sensing Potential for Military Applications
SET-333	RTG	Bringing Quantum Sensing from the Laboratories to the Battlefield
SET-334	RTG	Military Applications of Extreme Laser Fields
SET-335	RTG	RFT-OT Data and Sharing Hub (DASH)
SET-336	RLS	Artificially Intelligent Military Situational Awareness
SET-337	RLS	Advances in Array Calibration for improved ESM Sensor Performance
SET-338	RTG	Assessment of Navigation with and without GNSS for Military Applications
SET-340	RTG	Multistatic RF Sensing for Enhanced Space Domain Awareness
SET-ET-135	ET	High Angle EO/IR Ship Signatures in an Arctic Environment
SET-IST-339	RTG	Investigations of Military Applications of Quantum Computing
SET-IST-ET-136	ET	Underwater Optical Wireless Communications
SET-SCI-341	RWS	EW Challenge Workshop
SET-SCI-342	RLS	Future EW Engineer (Summer School)
CPOW-001	ST	Coordination and Technical Committee on STO Quantum Activities



# STO Events in 2024 CPoW

Among the various activities administered by the Collaboration Support Office there are several types aimed at promoting exchange and dissemination of state of the art knowledge among targeted audiences on an important scientific or applied topic. These are: Lecture Series, Technical Courses, Symposia, Workshops and Specialist Meetings.



Visit our website at: <https://events.sto.nato.int/> to learn about the Educational Events we organise.



# CPoW in Numbers

## Yearly Overview of the STO CPoW with ETs and SPs

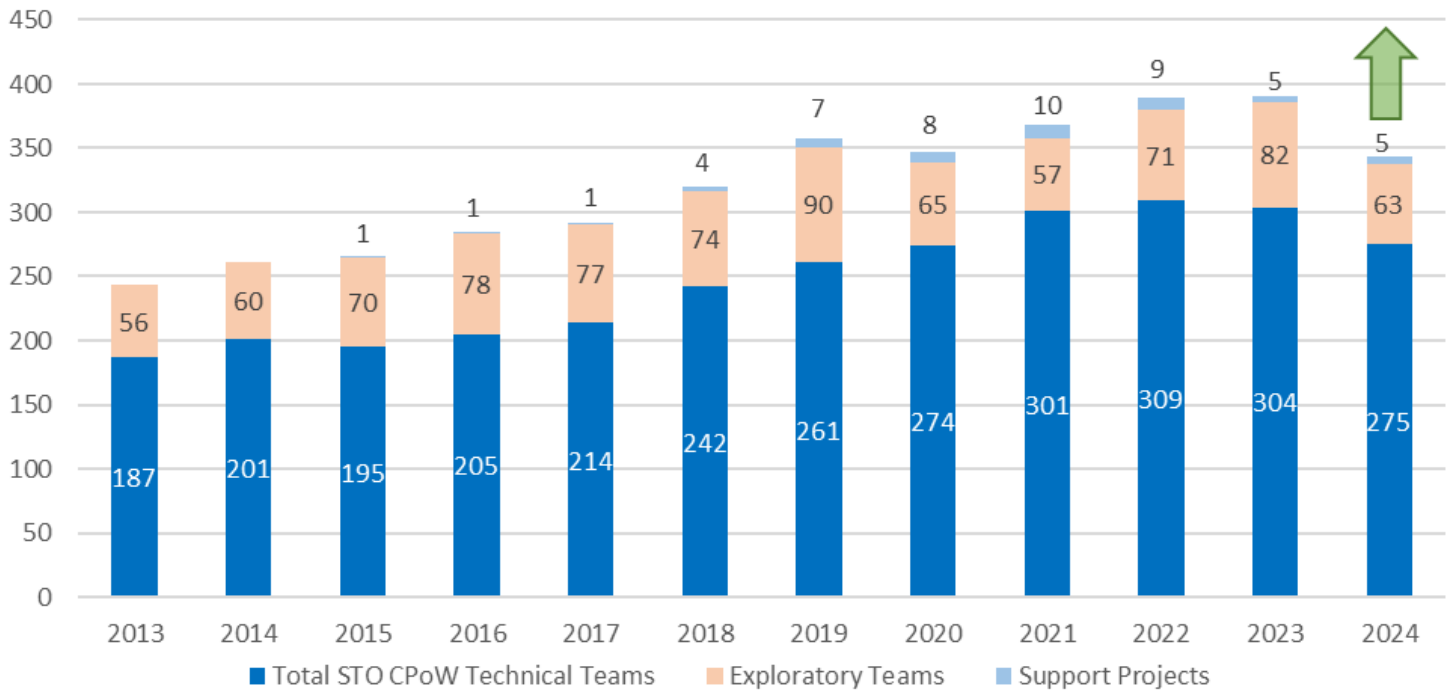


Figure 5: Yearly Overview of the STO CPoW TTs, ETs and SPs

\* 2024 is expected to exceed 2023 levels after the Spring and Fall 2024 Business Meetings

## Chart 2024 Overview of the CPoW per STC with ETs

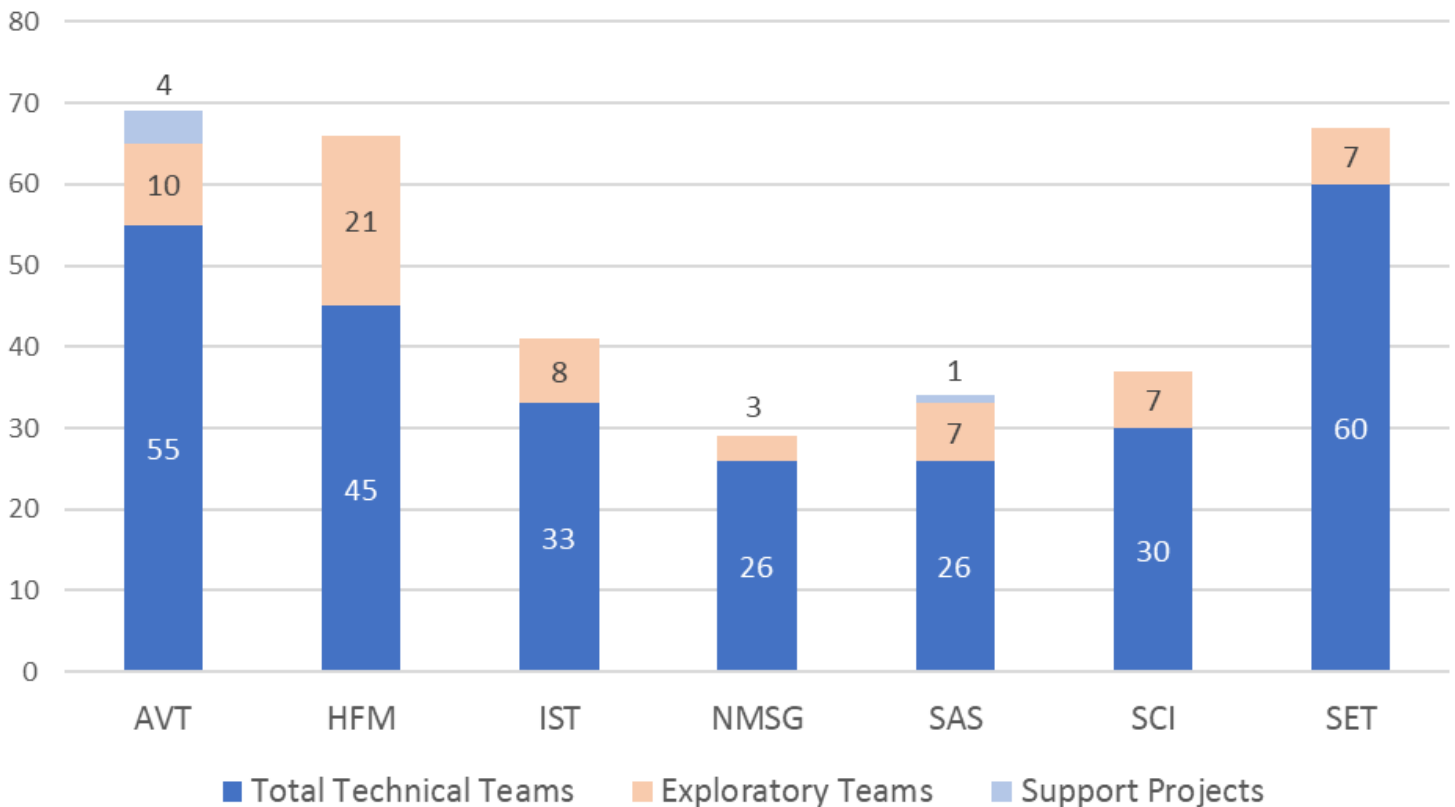


Figure 6: Overview of the 2024 STO CPoW TTs, ETs and SPs per STC

# Abbreviations

<b>A2/AD</b>	Anti-Access / Area Denial	<b>IT2EC</b>	International Training Technology Exhibition & Conference
<b>ACG3/SG2</b>	Aerospace Capability Group 3 Sub-Group 2	<b>IWA</b>	Information and Knowledge Management
<b>ACO</b>	Allied Command Operations	<b>LoEs</b>	Lines of Effort
<b>ACT</b>	Allied Command Transformation	<b>LTSS</b>	Long-Term Scientific Study
<b>AG</b>	AGARDograph – Advanced Guidance for Alliance Research and Development	<b>M&amp;S</b>	Modelling and Simulation
<b>AI</b>	Artificial Intelligence	<b>M3T</b>	Modelling, Measuring and Mitigating Optical Turbulence
<b>AI2S</b>	Architecture and Intelligence Information Systems	<b>MAS</b>	Military Application Study
<b>ATR</b>	Automatic/Assisted Target Recognition	<b>MDO</b>	Multi-Domain Operations
<b>AVT</b>	Applied Vehicle Technology Panel	<b>ML</b>	Machine Learning
<b>BEMMTO</b>	Blast Exposure Monitoring in Military Training and Operations	<b>MNE</b>	Multinational Exercise
<b>BM</b>	Business Meeting	<b>MSCO</b>	Modelling and Simulation Coordination Office (CSO)
<b>C2</b>	Command and Control	<b>MSE</b>	Multi-Sensors & Electronics
<b>CA2X2</b>	Computer Aided Analysis, Exercise – Experimentation Forum	<b>MSG</b>	Camouflage, Concealment, Deception and Obscuration
<b>CAX</b>	Computer Assisted Exercise Forum	<b>NAC</b>	North Atlantic Council
<b>CBRN</b>	Chemical, Biological, Radiological and Systems Nuclear	<b>NATO</b>	North Atlantic Treaty Organization
<b>CDT</b>	Cooperative Demonstration of Technology	<b>NAVWAR</b>	Navigation Warfare
<b>CMRE</b>	Centre for Maritime Research and Experimentation	<b>NCIA</b>	NATO Communications and Information Agency
<b>CMs</b>	Counter-Measures	<b>NCTR</b>	Non-Cooperative Target Recognition
<b>CNAD</b>	Conference of National Armament Directors	<b>NIAG</b>	NATO Industrial Advisory Group
<b>COM</b>	Communications & Networks	<b>NMCD</b>	Network Management & Cyber Defence
<b>CPoW</b>	Collaborative Program of Work	<b>NMSG</b>	NATO Modelling and Simulation Group
<b>CSO</b>	Collaboration Support Office	<b>NMSMP</b>	NATO M&S Master Plan
<b>EDTs</b>	Emerging and Disruptive Technologies	<b>NNAG</b>	NATO Naval Armaments Group
<b>ELM</b>	Ethical, Legal, and Moral	<b>NRMM</b>	NATO Reference Mobility Model
<b>EOD</b>	Explosive Ordnance Disposal	<b>OCS</b>	Office of the Chief Scientist
<b>EOP</b>	Enhanced Opportunity Partners	<b>OT</b>	Optical Technology
<b>ET</b>	Exploratory Team	<b>PB-IEDs</b>	Person-Borne-Improvised Explosive Devices
<b>EW</b>	Electronic Warfare	<b>PBM</b>	Panel (Group) Business Meeting
<b>FATE</b>	Futures Assessed Alongside Socio-Technical Evolutions	<b>PNT</b>	Positioning, Navigation and Timing
<b>FMN</b>	Federated Mission Networking	<b>PPW</b>	Plans and Programmes Workshop
<b>FT3</b>	Flight Test Technical Team	<b>RF</b>	Radio-Frequency
<b>HFM</b>	Human Factors and Medicine Panel	<b>RFT</b>	Radio-Frequency Technology
<b>HQ</b>	Headquarter	<b>RLS</b>	Research Lecture Series
<b>IED</b>	Improvised Explosive Device	<b>RSM</b>	Research Specialist's Meeting
<b>ISAR</b>	Inverse Synthetic Aperture Radar	<b>RSY</b>	Research Symposia
<b>ISR</b>	Intelligence, Surveillance and Reconnaissance	<b>RTC</b>	Research Technical Course
<b>IST</b>	Information Systems Technology Panel	<b>RTG</b>	Research Task Group
<b>ISTAR</b>	Target Acquisition and Reconnaissance	<b>RWS</b>	Research Workshop
		<b>SAR</b>	Synthetic Aperture Radar
		<b>SAS</b>	System Analysis and Studies Panel



<b>SATCOM</b>	Satellite Communication	<b>STOG-NG</b>	Simulation for Training and Operation Group - Next Generation
<b>SCI</b>	Systems Concepts and Integration Panels	<b>SWEM</b>	Space Weather Environmental Modelling
<b>SEAD</b>	Suppression of Enemy Air Defence	<b>TAP</b>	Technical Activity Proposal
<b>SET</b>	Sensors and Electronics Technology	<b>ToE</b>	Target of Emphasis
<b>SimPL</b>	Simulation of Low Photon Lidar	<b>TTs</b>	Technical Teams
<b>SPS</b>	Self-Protection System	<b>UAS</b>	Unmanned Aerial Systems
<b>S-RAM</b>	Space-Risk Assessment Matrix	<b>UAV</b>	Unmanned Aerial Vehicle
<b>ST</b>	Specialist Team	<b>UCAV</b>	Unmanned Combat Aerial Vehicle
<b>STANREC</b>	Standardization Recommendation	<b>VKHS</b>	Von Karman Horizon Scanning
<b>STB</b>	Science and Technology Board	<b>VKI</b>	Von Karman Institute
<b>STO</b>	Science & Technology Organization		





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