NATO SCIENCE AND TECHNOLOGY ORGANIZATION

COLLABORATIVE PROGRAMME OF WORK AND BUDGET FOR YEAR 2020

PREFACE

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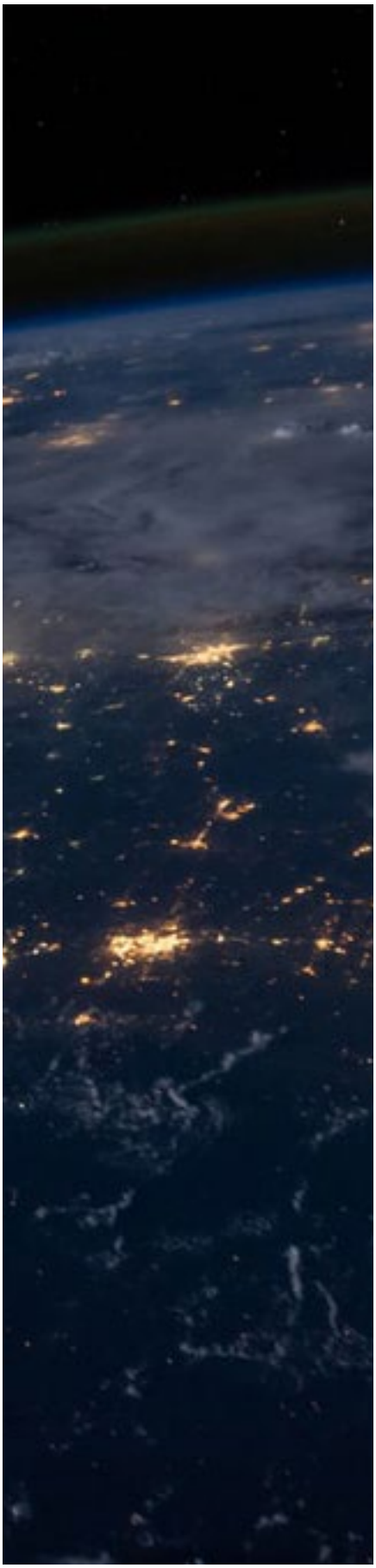


PREFACE

It is my distinct pleasure to present the NATO Science & Technology Organization's (STO) Collaborative Program of Work (CPoW) for 2020. The CPoW represents the STO's business model, which provides a forum whereby NATO Nations and partner nations elect to use their national resources to define, conduct, and promote cooperative research and information exchange. My organization – the Collaboration Support Office (CSO) – is one of the STO executive bodies and provides executive and administrative support to the network of experts that, within the CPoW, conduct defence and security relevant research and technology development leading to operational military capability. With such a mandate, we are grateful to have the opportunity to work with the many esteemed scientists and engineers from national laboratories, academia, and industry who make the CPoW useful to Nations and NATO. With the joint effort of military professionals, the CPoW provides relevant scientific solutions to current and future needs of NATO and nations.

In 2020, our goal is to pursue our long-term efforts in strengthening the CPoW. This collaborative programme is highly appealing to experts as the network is steadily growing, today comprising approximately 6,500 scientists, engineers, and analysts originating from 29 NATO and 48 partner nations. We expect to have more than 300 active teams during the course of the year with 13 Collaborative Demonstrations of Technologies organized and more than 100 technical reports and proceedings published. In order to sustain this high tempo, we have to secure effective and qualitative executive and administrative support. In particular, we want our network to continue responding to the call for high military relevance and technical quality from NATO and nations. For our publications, we recently started to implement a peer reeview process to increase their scientific quality and recognition by the international scientific community.

We all understand that technology trends are changing and the speed of technology applications is increasing. New scientific discoveries and applied solutions have a huge impact on existing and future military capabilities. We do understand that we have to keep or restore our technology edge over our peer competitors. NATO recently stressed the need for more work on Emerging Disruptive Technologies (EDTs) and innovation to accelerate and achieve capability development and delivery. NATO Nations political and military leaders see Artificial Intelligence, Data Science, Autonomy, Quantum, Hypersonics, Bio-Technology, and Space as areas of major potential impact on military capabilities in the future. The CPoW has already addressed these focus areas to some extent in recent years, but we now have to be more focused on how to bring the results of our collaborative research more quickly into application, capability development, and delivery. Collaborative demonstrations of technologies and operational experiments are probably the best means in that regard, and this calls for greater cooperation with industry because, in most cases, industry ultimately delivers the capabilities to the forces.

Collaboration and coherence with other NATO S&T stakeholders is also critical. We closely cooperate with and support the capability efforts of all NATO political and military structures and agencies, such as ACT, the CNAD, NIAG, NCIA, COMEDS, and the Centres of Excellence. This cooperation and coordination will be growing and deepening and we are currently adapting the CSO work force to cope with such an evolution. Also of note, the participation of Partner nations in CPoW activities is enlarging and this will have a positive effect on our network's worldwide recognition.

Finally, I want to recognize that the core of the CPoW business is managed by the Scientific and Technical Committees of the STO (i.e., the Applied Vehicle Technology, Human Factors and Medicine, Information Systems Technology, Systems Analysis and Studies, Systems Concepts and Integration, and Sensors and Electronics Technology panels and the NATO Modelling and Simulation Group). These seven so-called Level II Committees are led, on a part-time basis, by voluntary national contributors who do a great job. The entire CPoW network benefits and appreciates such leadership that adds to their normal jobs, duties, and responsibilities. We all have to warmly thank these volunteers and their Nations for the very fine work done in those demanding positions.

Pavel Zuna

Director, STO Collaboration Support Office

#WE ARE STO

STO: WHO ARE WE?

The Science &Technology Organization (STO) is a NATO subsidiary body created to meet the collective science and technology needs of the NATO Alliance and its partner nations. The STO does this by generating, sharing, and disseminating advanced scientific knowledge, technological developments, and innovation resulting from its many activities completed within the Collaborative Programme of Work (CPoW).

HOW ARE WE ORGANISED?

The STO is led by the Science and Technology Board (STB) which exercises governance through the following executive bodies:

- The **Office of the Chief Scientist (OCS)** provides executive and administrative support to the Chief Scientist to exercise their role as a Chair of the Science and Technology Board and as the primary Scientific Advisor for NATO. The OCS promotes the exploitation of the results generated within the CPoW to numerous internal stakeholders and partners.
- The **Collaboration Support Office (CSO)** provides executive and administrative support to collaborative activities, maintains an active network of scientists, and runs 6 Technical Panels and one Group that organize technical activities.
- The **Centre for Maritime Research and Experimentation (CMRE)** organizes and conducts scientific research and technology development, and delivers innovative and field tested S&T solutions in the maritime domain to address the defence and security needs of the Alliance.

HOW DOES CSO FUNCTION /HOW DO WE STRUCTURE OUR WORK IN CSO?

The CSO provides NATO Nations and Partner Nations with a technical forum where researchers and analysts can define, conduct, and promote cooperative research and information exchange. The CSO runs its many activities through a collaborative business model. The international collaborative programme of work is carried out in 7 different technical areas. These technical areas are represented by 6 Panels and 1 Group running their scientific efforts within several types of scientific activities (see section 4).

ACTIVITY LIFECYCLE

The Panels/Group take the initiative to create technical activities based on top-down guidance from NATO and the Nations, and bottom-up initiatives from the NATO scientific community. The Panels/Group usually meet twice a year (in Spring and Fall) during Panel (Group) Business Meetings (PBMs), which are medium-scale, two-to-three day events. Technical activities are organized in teams of national experts with clearly defined scopes and products as goals at the end of the activity.

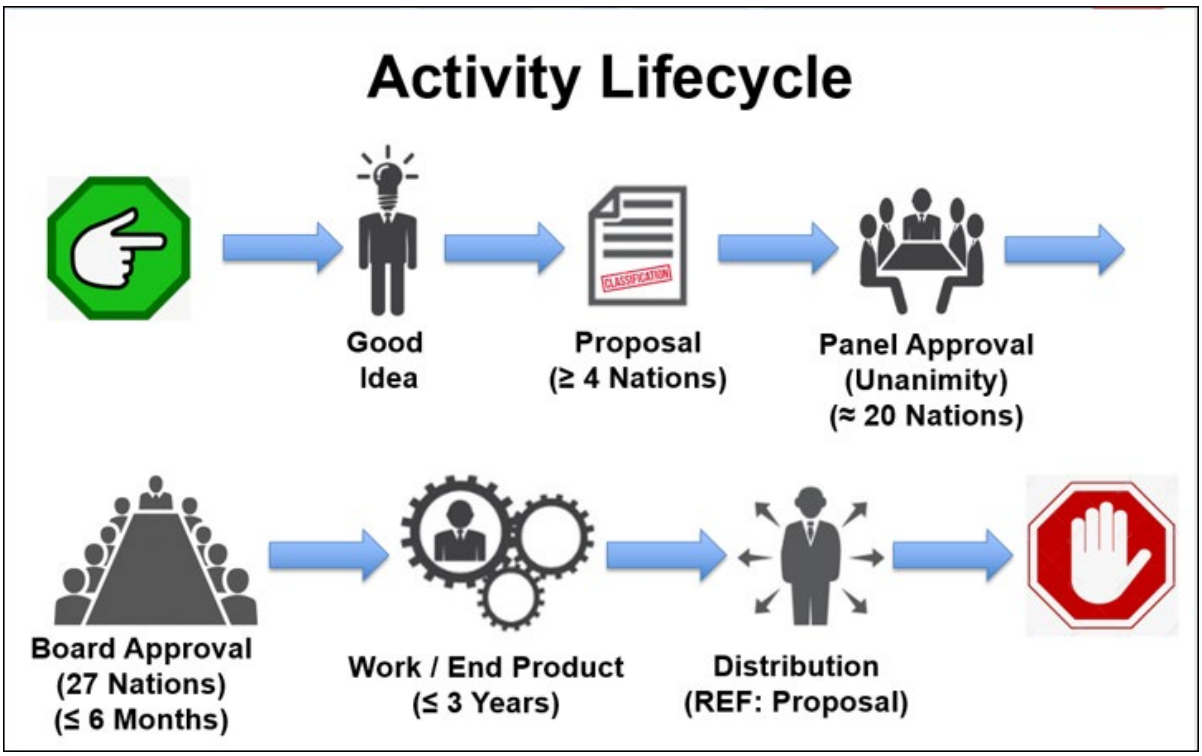


Figure 1: Activity lifecycle

Ideas for new activities may originate from NATO bodies, Panel Members, or scientists and engineers within any of the participating nations. However, it is mandatory that the activity be supported by a minimum of 4 nations before being initiated.

After an activity draft has been put together, a technical activity proposal (TAP) is presented to the Panels/Group for decision prior to the upcoming PBMs. After the submission, a TAP has to be approved unanimously by the Panel. After the PBM, the new activities that have been endorsed by the Panel are submitted to the STB for approval through a two-week silence procedure. Following the silence procedure, the activity is officially approved provided that no objection is raised during the two week period.

Depending on the type of activity, a technical report or a meeting proceedings publication can be provided as the final result of its completion.

HOW TO JOIN US?

Whether you are a government representative, a military member, a specialist from industry, or an academic interested in any of our research topics, you can join our activities. There are two required steps to be a part of the CSO's activities:

1) Contact your national coordinator.

The national coordinator is an individual designated by the nation to facilitate their nation's participation in the STO. The list of institutions responsible for national coordination can be found on our website:

https://www.sto.nato.int/Pages/national-coordinators.aspx

The national coordinator can provide you with more details on how your country is involved in activities and put you in contact with national representatives within a panel.

2) Contact a panel executive/assistant

If you know which panel you're interested in, you can directly contact the Panel Office that would give you directions on how to join their activities. Contact information for each panel can be found at:

https://www.sto.nato.int/Pages/contactus.aspx

Are you an academic or just interested in the use of science and technology in the military sector?

Reach out to your national coordinator who can guide you on further actions. Coordinator institutions can be found here:

http://www.sto.nato.int/Pages/national-coodinators.aspx

Write to a Panel Office. The list is found here:

http://www.sto.nato.int/Pages/contactus.aspx

Visit our website to find out what the Panels/Group do:

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

STO PANELS, GROUPS AND ACTIVITIES

The scientific and technical committees consist of six Panels that manage a wide range of scientific research activities, and one Group specializing in modelling and simulation. The Panels and Group are the powerhouse of the collaborative business model. They organize the overall workflow of recognized world-class scientists, engineers, analysts, and information specialists that come from different NATO nations and partner nations. Apart from delivering a critical technical oversight, the Panels and Group provide a communication link to the military users and other NATO bodies.

The current Level 2 committee structure consists of the following six Panels and one Group:

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

Each panel's or group's programme of work is carried out by Technical Teams made up of national experts. Prior to launching a Technical Team, an **Exploratory Team (ET)** is established. When a Panel/Group believes that a particular expertise is required to assist or advise it on the technical merit or feasibility of a specific proposal. An ET is the CSO's instrument to carry out a feasibility study to establish whether it is worth starting a larger activity. During the PBM, each NATO nation in the Panel/Group is polled to determine if it is willing to allocate resources and participate in a future ET on the topic. If this is the case, the ET finalizes the TAP and submits it to the Panel Office for revision. The step of involving an ET is sometimes omitted if the idea has strong support, and it will move directly to an Activity. It is, however, an essential supporting instrument for scientists who wish to scope their proposal for a Technical Team.

Technical Teams are assigned by the Panels/Group to perform specific tasks, such as:

- Task Group **(RTG – Research Task Group)**
  (study group, 3 years max.)
- Specialist Team **(ST)**
  (quick reaction)
- Workshop **(RSW – Research Workshop)**
  (selected participation, 2-3 days)
- Symposium **(RSY – Research Symposium)**
  (>100 people, 3-4 days)
- Specialist's Meeting
  (RSM - Research Specialist's Meeting Multinational Exercise (MNE))
  (<100 people, 2-3 days)
- Lecture Series **(RLS – Research Lectures Series)**
  (junior and mid-level scientists)
- Technical Course **(RTC – Research Technical Course)**
- Support Project **(SP)**
- Long-Term Scientific Study **(LTSS)**
- Multinational Exercise **(MNE)**
- Military Application Study **(MAS)**
- Advanced Guidance for Alliance Research and Development **(AG – AGARDographs)**

2020 BUSINESS MEETINGS (PPW/PBM/STB)

All major Science and Technology Organization business meeting are listed in Table 1.

Table 1: 2020 Business Meetings

2020 PBM/STB/PPW		MEETING DATES	MEETING LOCATION
PPW	PLANS & PROGRAMMES WORKSHOP (PPW)	24-27 FEBRUARY 2020	PARIS (FRA)
AVT	Spring PBM	27 April - 1 May 2020	Quebec City (CAN)
	Fall PBM	5 - 9 October 2020	Båstad (SWE)
HFM	Spring PBM	19-23 April 2020	Copenhagen (DNK)
	Fall PBM	4-9 October 2020	Madrid (ESP)
IST	Spring PBM	12-13 May	Amsterdam (NDL)
	Fall PBM	12-16 October 2020	Bled (SVN)
NMSG	Spring BM	20-24 April 2020	Bled (SVN)
	Fall BM	19-21 October 2020	Bath (GBR)
SAS	Spring PBM	20-24 April 2020	Bled (SVN)
	Fall PBM	7-9 October 2020	Riga (LVA)
SCI	Spring PBM	25-29 May 2020	Nuuk (GRL)
	Fall PBM	5-9 October 2020	La Spezia (ITA)
SET	Spring PBM	20-24 April 2020	Warsaw (POL)
	Fall PBM	12-16 October 2020	Interlaken (CHE)
STB	Spring STB	24-26 March 2020	Brussels (BEL)
	Fall STB	15-18 September 2020	Oslo (NOR)

STRUCTURE OF 2020 COLLABORATIVE PROGRAMME OF WORK

As of 1 January 2020 the total number of activities in the CPoW is 269. This represents the sum of the number of activities that started before 2020 and that will be still active in 2020, as well as the number of activities that will start in 2020.

Table 2: CPoW Composition (as of 1 January 2020)

ACTIVITY		PANEL/GROUP							TOTAL
		AVT	HFM	IST	NMSG	SAS	SCI	SET	
Task Group	RTG	31	40	22	17	27	22	35	**194**
Symposia	RSY	1	1	3	3	1	0	2	**11**
Specialists Meeting	RSM	4	0	0	1	0	3	2	**10**
Specialist Team	ST	2	1	1	0	4	2	1	**11**
Workshop	RWS	7	1	2	1	0	2	2	**15**
Lectures Series	RLS	1	2	1	1	0	2	2	**9**
Technical Course	RTC	0	1	0	0	1	0	0	**2**
Agardograph	AG	1	0	0	0	0	5	0	**6**
Long-Term Scientific Study	LTSS	1	2	0	0	0	0	0	**3**
Support Project	SP	8	0	0	0	0	0	0	**8**
TOTAL		**56**	**48**	**29**	**23**	**33**	**37**	**44**	**269**

All data presented in Table 2, as well as in overall document, are referred to 1 January 2020. These numbers are changing every day. For example, some activities might end, while new activities will be approved and launched after the Spring PBMs cycle. The number of new activities can reach 30 (which is the average number of new Projects that are usually approved during the Spring Silence Procedure). Therefore, the numbers presented in Table 2 refer to all activities that are going to be active at least one day in 2020 (with respect to the 1 Janurary 2020 as the reference date).

2020 BUDGET

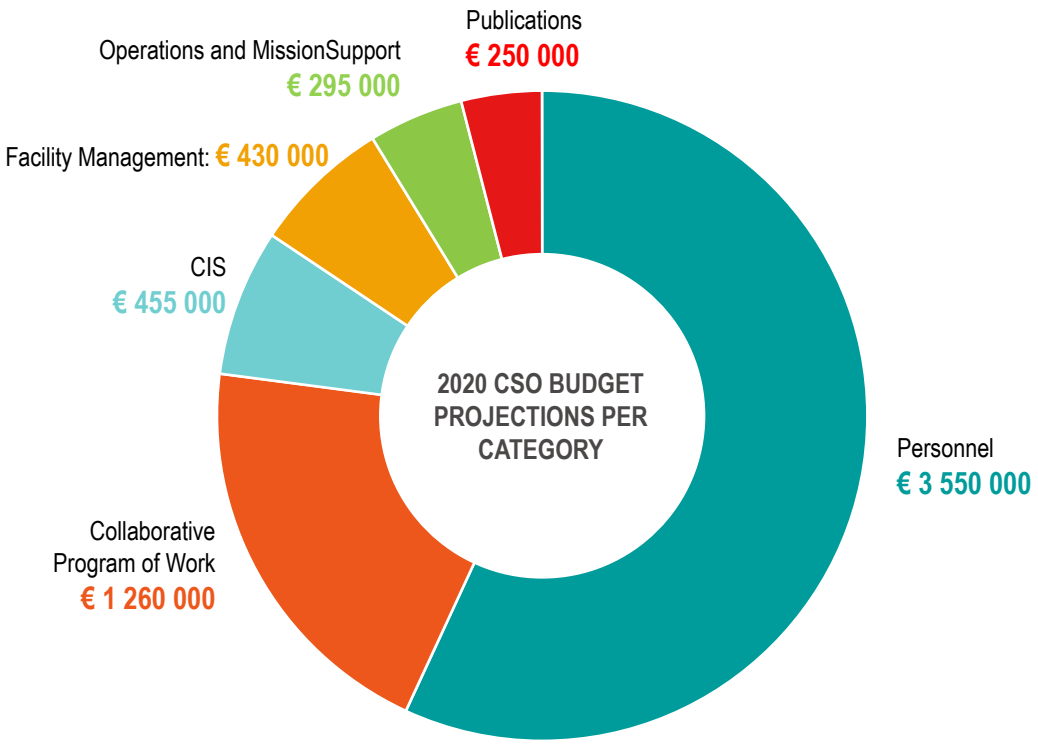
In accordance with the 2020 Medium-Term-Resource Plan, the S&T Collaboration Support Office (CSO) has projected a funding requirement of EUR 6,240,000 for 2020. This represents an increase of EUR 180,000 over the 2019 budget (EUR 6,060,000) and is necessary to meet increased demand in support of collaborative activities. The North Atlantic Council approved the requested budget in December 2019.

Table 3: 2020 CSO Budget Projections per Category*

BUDGET CATEGORIES	PROJECTED 2019
Personnel	€ 3 550 000
Facility Management	€ 430 000
Operations and Mission Support	€ 295 000
Publications	€ 250 000
CIS	€ 455 000
Collaborative Program of Work	€ 1 260 000
Total NATO Funded Effort	€ 6 240 000

* Note: Allocations to categories may vary pending operational requirements.

The majority of the STO CPoW activities are open for NATO partners under the PfP and MD programs. Funding for Partner-related activities within the STO CPoW is provided through the Outreach Budget of the International Military Staff (IMS). The CSO acts as an agent between the Nations and the IMS for Outreach activities.



S&T STRATEGY, PRIORITIES, STRATEGIC INITIATIVES AND EMERGING & DISRUPTIVE TECHNOLOGIES: "WHAT, WHY AND HOW"

The Collaborative Program of Work (CPoW) is a tool designed to answer needs of Nations, as well as the NATO requirements within the field of Defense and Security Science and Technology research. Therefore, its construct is based on the strategic orientation provided by the higher NATO centralized organization, and on inputs delivered directly by the Nations during the Panels and Group business meetings. Ultimately, the Nations, through the S&T Board (STB), remain the collective authority deciding on how the CPoW should develop.

As a first reference, the NATO S&T Strategy provides the overarching guidance to steer the NATO S&T community's efforts in a coherent direction, establishing broad goals, and defining Lines of Effort (LoEs) and Investment Areas. In this three-tier vision, the five LoEs can be considered to be the engine of the strategy. The LoEs set the level of ambition to include the following:

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

This strategy appeals to pragmatism, efficiency, the will to share and cooperate, and excellence.

As a visionary document, the NATO S&T Strategy needs to be complemented by a more practical document linking the strategic thoughts to actionable S&T priorities. Anticipating foreseeable military requirements, the NATO S&T Priorities guidance serves to guide medium-to-long-term S&T planning across the NATO S&T community and to inform smart investment decisions by Nations and within the Alliance. The priorities are organized in 10 S&T Areas,[1] with corresponding Targets of Emphasis (ToEs). These ToEs must be seen as key driving references, either to inspire new activities, or to verify that the envisaged new projects are consistent with the NATO S&T Priorities. The current NATO S&T Priorities were adopted in 2017 and they will be updated in 2020.

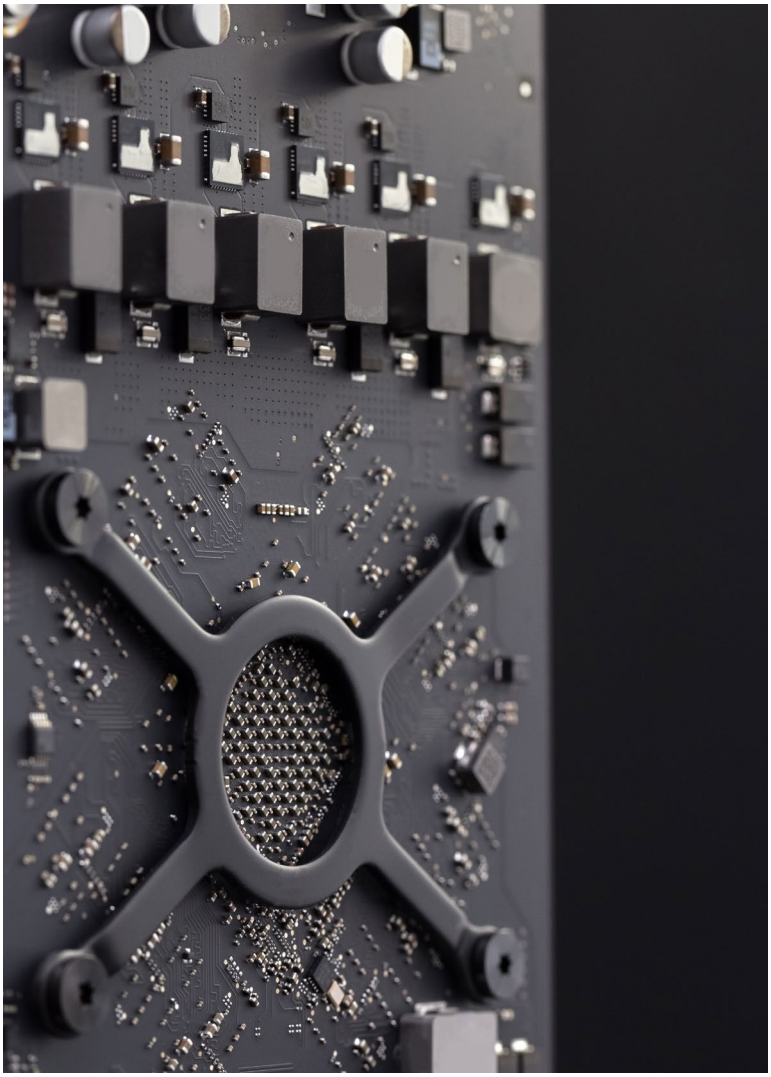
Aside from the S&T Priorities that provide valuable orientation to develop standard CPoW activities, the STB acknowledged the need for more tailored tools and procedures to focus on specific strategic cross-domain areas, topics or problems. The Strategic Initiatives, comprising the Themes and the Von Karman Horizon Scanning (VKHS) studies (or any possible ad hoc process delivering the same results), address this need. Their purpose is to focus the attention of the NATO S&T community on important emerging technical challenges and opportunities, to address them from a comprehensive perspective, and to achieve results that are beyond the reach of individual stakeholders or specialized Panels and Group. In a practical sense, the themes help create Communities of Interest in specific domains across the whole S&T community, and they capitalize on, orient, and bring coherence to the Panels and Group activities, while dealing with strategic S&T matters. Conversely, the VKHS studies are different in nature and their purpose is to deliver short-term focused studies (usually one-year long) to enlighten the senior leadership of NATO and Nations on emerging and/or disruptive S&T issues.

[1] Precision Engagement, Advanced Human Performance & Health, Cultural, Social & Organizational Behaviors, Information Analysis & Decision Support, Data Collection & Processing, Communications & Networks, Autonomy, Power & Energy, Platforms & Materials, Advanced Systems Concepts.

The above-mentioned set of guiding documents, tools, and procedures provide the STO community with the relevant and necessary means and frameworks to address the increasing emphasis that the NATO political and military leadership places on Emerging and Disruptive Technologies (EDTs). Seven EDTs[2] have been selected and included in a (classified) Roadmap document approved by the Alliance Defense Ministers in October 2019. Other EDTs – such as Novel Materials – are likely to be addressed in the future. The STB has been tasked to regularly report on emerging and disruptive technology trends and their military implications, and to deliver initial S&T assessments by June 2020. To achieve this task, with the goal to inform and develop knowledge and understanding, the STO will make full use of its tools at hand: issuing Tech Watch Cards on EDTs and related sub-topics, dedicating chapters to EDTs in the STO Technology Trends document, launching Von Karman Horizon Scans on focused issues, or supporting new theme initiatives to coordinate current or future efforts in the CPoW on EDTs domains.

The NATO S&T Strategy, the S&T Priorities, the Strategic Initiatives, and the Emerging and Disruptive Technologies Roadmap are key strategic guidance to address vital NATO S&T requirements and ultimately to successfully frame and execute the Collaborative Programme of Work.

This is the What, the Why and the How to do it.



[2] Space, Data, Artificial Intelligence, Autonomy, Hypersonics, Quantum technology, Biotechnology

APPLIED VEHICLE TECHNOLOGY PANEL (AVT)

APPLIED VEHICLE TECHNOLOGY PANEL

Panel Chair: Prof Dr. David Lecompte
Panel Vice-Chair: Mr. Stan Cole
Panel Executive: Mr. Christoph Mueller

Panel Assistants: Dr. Veronika Gumpinger
Mr. Donatas Rondomanskas (temporary)

MISSION

The Applied Vehicle Technology (AVT) panel strives to improve the performance, reliability, affordability, and safety of vehicles through advancement of appropriate technologies. The AVT panel addresses platform technologies for vehicles operating in all domains – land, sea, air, and space – for both new and aging systems.

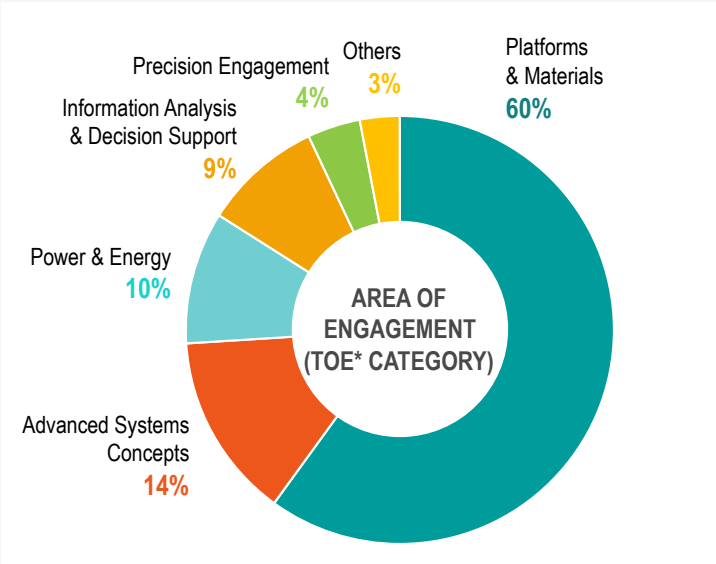
To accomplish this mission, the members of the AVT community, comprising more than 1,200 participants, exploit their joint expertise in the fields of (1) Mechanical Systems, Structures, and Materials; (2) Propulsion and Power Systems; and (3) Performance, Stability and Control, and Fluid Physics. This expertise is augmented by committees that bolster strategic guidance, scientific excellence, and bi-national support.

By carrying out biannual Business Meeting Weeks that include all of its sponsored activities, the AVT panel guarantees the use of NATO and national resources in the most effective and efficient way. The AVT panel's work ethic is based on generating synergies through multi-disciplinary and domain-overarching approaches; building productive partnerships by using a healthy mix of academic scientists, governmental researchers, military operators, and industrial engineers; providing timely and targeted advice to NATO and nations; and striving for scientific excellence.

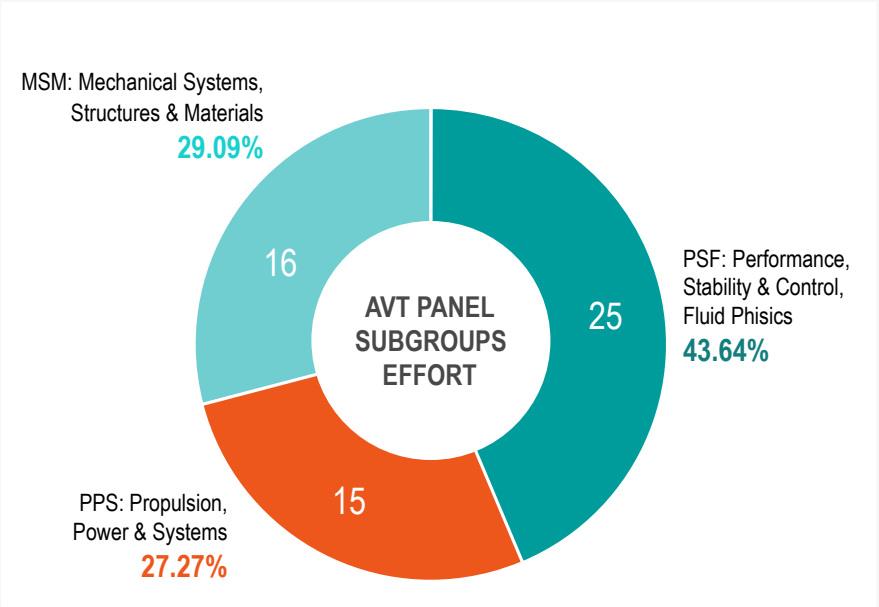
MAIN INTEREST

The expertise of the AVT panel covers a broad range of cross-cutting and technical focus areas. In alignment with its mission statement, the AVT panel is the STO's focal point for:

- Assessment and multi-disciplinary cooperation on Hypersonic Vehicles;
- Further development and integration of Autonomous Vehicles in all domains;
- Screening and evaluating 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 compiling of innovative Propulsion and Power System Technologies for military purposes;
- Coordination and development of a Future Rotorcraft Requirement trade-space, including maturation of key technologies;
- Assessing and advancing Warship and Fleet Design capabilities;
- Standardization and implementation of a Sustainable Use of Munitions across their life-cycles;
- Evaluation and integration of Software-Based Applications on the design, handling, and service of platforms; and
- Sustainment and Life-Cycle Costs considerations of new and aging platforms, as well as fleet considerations.



*TOEs – Terms of Emphasis – 2017 NATO Science & Technology Priorities



AVT CPOW COMPOSITION

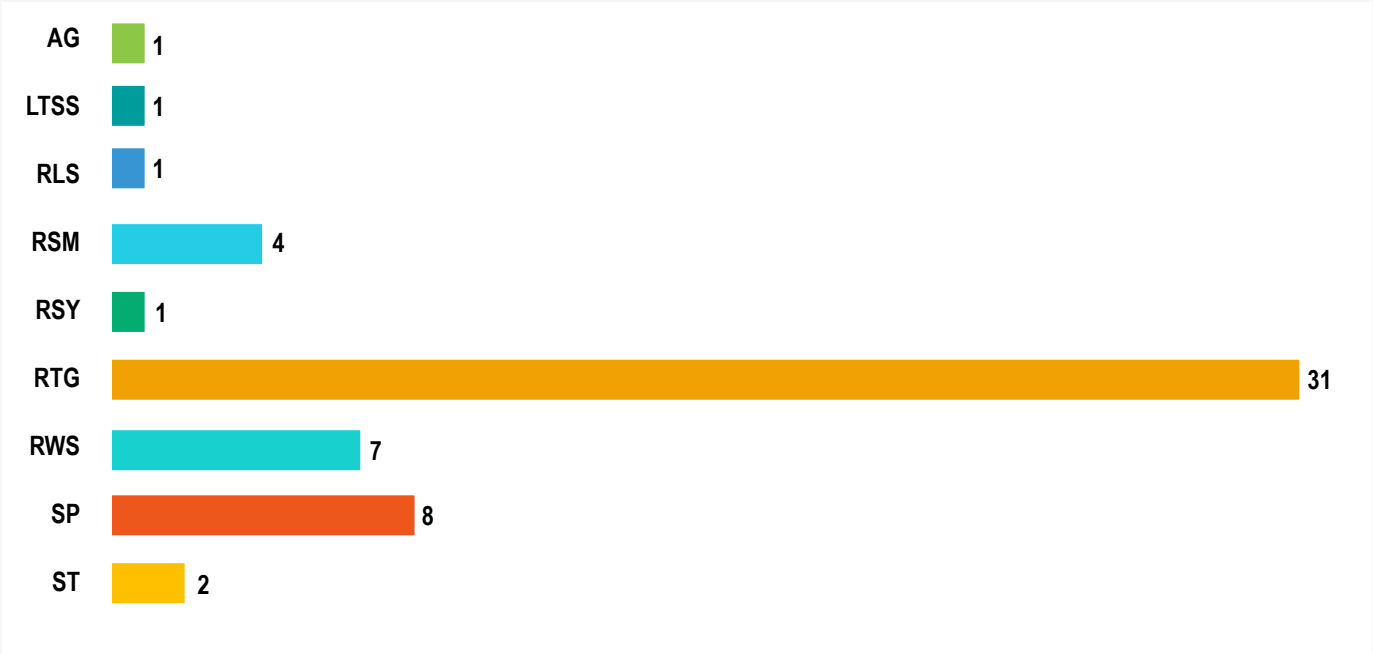


Table 4: AVT Activities Continuing in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
AVT-283	AG	Advances in Wind Tunnel Boundary Correction and Simulation
AVT-324	RSM	Multi-disciplinary design approaches and performance assessment of future combat aircraft
AVT-335	RSM	Range Design and Management for Sustainable Live Fire Training Ranges
AVT-336	RSM	Enabling Platform Technologies for Resilient Small Satellite Constellations for NATO Missions
AVT-338	RSM	Advanced Wind Tunnel Boundary Simulation II
AVT-290	RTG	Standardization of Augmented Reality for Land Platforms in Combat Environments
AVT-291	RTG	Range Design and Management for reduced Environmental Impact
AVT-292	RTG	Munition Health Management Technologies: Effects on Operational Capability, Interoperability, Life-Cycle Cost and Acquisition of missile stockpiles of NATO nations
AVT-293	RTG	Effect of Environmental Regulation on Energetic Systems and the Management of Critical Munitions Materials and Capability
AVT-294	RTG	Towards Improved Computational Tools for Electric Propulsion
AVT-295	RTG	Demonstration of Innovative Control Effectors for Maneuvering of Air Vehicles
AVT-296	RTG	Rotorcraft Flight Simulation Model Fidelity Improvement and Assessment
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-299	RTG	Assessment of Anti-Icing and De-Icing Technologies for Air and Sea Vehicles
AVT-300	RTG	Naval Ship Maneuverability in Ice
AVT-301	RTG	Flow-field prediction for maneuvering underwater vehicles
AVT-308	RTG	Cooperative Demonstration of Technology (CDT) for Next-Generation NATO Reference Mobility Model (NG-NRMM)
AVT-309	RTG	Implication of Synthetic Fuels on Land Systems and on NATO Single Fuel Policy
AVT-310	RTG	Hybrid/Electric Aircraft Design and Standards, Research and Technology (HEADSTART)
AVT-311	RTG	Availability and Quality Issues with Raw Materials for Rocket Propulsion Systems and Potential Consequences for NATO
AVT-312	RTG	Airworthiness Tools and Processes for Complex Rotorcraft Systems Safety
AVT-313	RTG	Incompressible Laminar-to-Turbulent Flow Transition Study
AVT-314	RTG	Assessment and reduction of installed propeller and rotor noise from unmanned aircraft
AVT-315	RTG	Comparative Assessment of Modeling and Simulation Methods of Shipboard Launch and Recovery of Helicopters
AVT-316	RTG	Vortex Interaction Effects Relevant to Military Air Vehicle Performance

AVT-317	RTG	Trade-space exploration to support the early stage design of effective & affordable (fleets of) warships
AVT-318	RTG	Low noise aero-acoustic design for turbofan powered NATO air vehicles
AVT-319	RTG	High Speed Rotorcraft Analysis and Evaluation
AVT-320	RTG	Assessments of Numerical Simulation Methods for Turbulent Cavitating Flows
AVT-327	RTG	Standardization Recommendation (STANREC) Development for Next-Generation NATO Reference Mobility Model (NRMM)
AVT-332	RTG	In-Flight Demonstration of Ice-phobic Coating and Ice Detection Sensor Technologies
AVT-334	RTG	CDT on Augmented Reality (AR) to Enhance Situational Awareness for Armored Fighting Vehicle Crew
AVT-337	RWS	Anti-tamper protective systems for NATO operations
AVT-339	RWS	Robotics and Laser/Plasma – paint interaction in paint removal
AVT-340	RWS	Preparation and Characterization of Energetic Materials
AVT-SP-001	SP	Development and Evaluation of an advanced PACVD TiN/TiCN coating for military vehicle bearing applications
AVT-SP-002	SP	Turbulence and the Aerodynamic Optimization of Nonplanar Lifting Systems
AVT-SP-003	SP	Investigation of sub-idle gas turbine performance
AVT-SP-004	SP	Assessment of environmental and toxicological impacts associated with ammunition: life-cycle approach to assist the REACH regulation
AVT-SP-005	SP	Measurement of soil mechanical properties related to the traffic-ability of military vehicles on typical Estonian soils
AVT-SP-007	SP	Novel Active Fire Modelling and Prediction methods using Manned and Unmanned Aircraft Vehicles
AVT-ST-007	ST	Modification of NATO STANAGs to Incorporate Range Characterization
AVT-ST-008	ST	Hypersonic Operational Threats

Table 5: AVT Activities Starting in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
AVT-329	LTSS	NexGen Rotorcraft Impact on Military Operations
AVT-358 VKI	RLS	Advanced computational fluid dynamics methods for hypersonic flows
AVT-356	RSY	Physics of Failure for Military Platform Critical Subsystems
AVT-330	RTG	Impact of underwater dumped munitions and maritime safety, security and sustainable remediation
AVT-331	RTG	Goal-driven, multi-fidelity approaches for military vehicle system-level design
AVT-333	RTG	Integration of Propulsion, Power, and Thermal Subsystem Models into Air Vehicle Conceptual Design
AVT-354	RWS	Multi-fidelity methods for military vehicle design
AVT-355	RWS	Intelligent Solutions for Improved Mission Readiness of Military UxVs
AVT-357	RWS	Technologies for future distributed engine control systems (DECS)
AVT-SP-006	SP	Development of Simulation Model for selecting optimum Maintenance Strategy of Combat Vehicles
AVT-SP-008	SP	Determination of the traffic-ability of military vehicles in typical forests

Table 6: AVT Activities Starting in 2021

ACTIVITY	ACTIVITY TYPE	TITLE
AVT-341	RTG	Mobility Assessment Methods and Tools for Autonomous Military Ground Systems
AVT-342	RTG	Interoperability of Additive Manufacturing in NATO operations
AVT-343	RTG	Novel Materials to Mitigate Rare Earth (RE) Criticality in High Speed Motors
AVT-344	RTG	Assessment of Micro Technologies for Air and Space Propulsion
AVT-345	RTG	Unified Tactical Missile Kinetic Performance Model
AVT-346	RTG	Predicting Hypersonic Boundary-Layer Transition on Complex Geometries
AVT-347	RTG	Large-Amplitude Gust Mitigation Strategies for Rigid Wings
AVT-348	RTG	Assessment of Experiments and Prediction Methods for Naval Ships Maneuvering in Waves
AVT-349	RTG	Non-Equilibrium Turbulent Boundary Layers in High Reynolds Number Flow at Incompressible Conditions
AVT-350	RTG	Innovative Control Effectors for Maneuvering of Air Vehicles – Advanced Concepts
AVT-351	RTG	Enhanced Computational Performance and Stability & Control Prediction for NATO Military Vehicles
AVT-352	RTG	Measurement, Modeling and Prediction of Hypersonic Turbulence
AVT-353	RWS	Artificial Intelligence in Cockpits for UAVs

HUMAN FACTORS AND MEDICINE PANEL (HFM)

HUMAN FACTORS AND MEDICINE PANEL

Panel Chair: Ms. Alison Rogers
Panel Vice-Chair: Dr. Janet Blatny
Panel Executive: LtCol Erik Laenen
Panel Assistant: Ms. Marie Linet

MISSION

The mission of the Human Factors and Medicine (HFM) panel is to provide the science and technology base for optimizing health, human protection, and the well-being and performance of humans in operational environments, with consideration of affordability. This involves understanding and ensuring the physical, physiological, psychological, and cognitive compatibility among military personnel, technological systems, missions, and environments. This is accomplished by information exchange, collaborative experiments, and shared field trials.

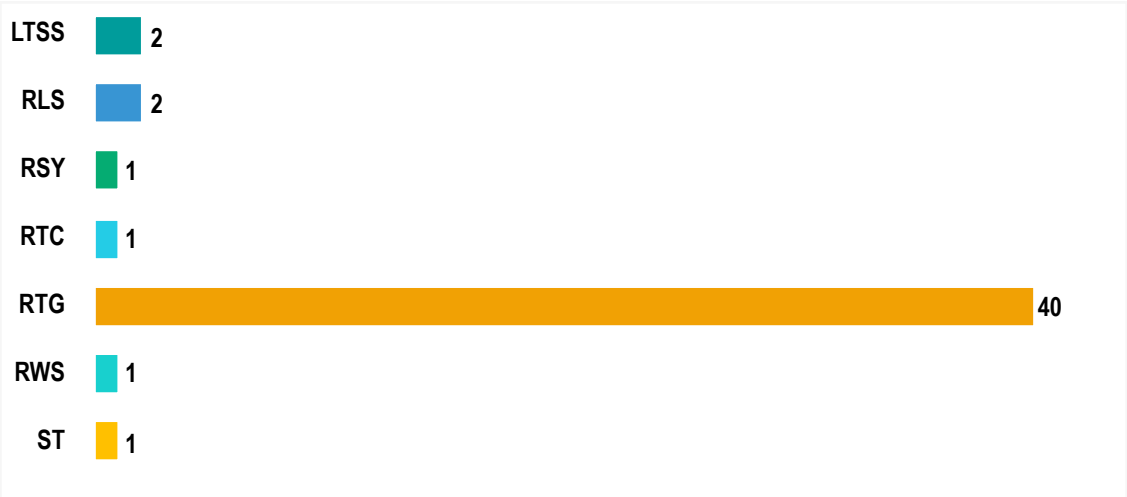
MAIN INTEREST

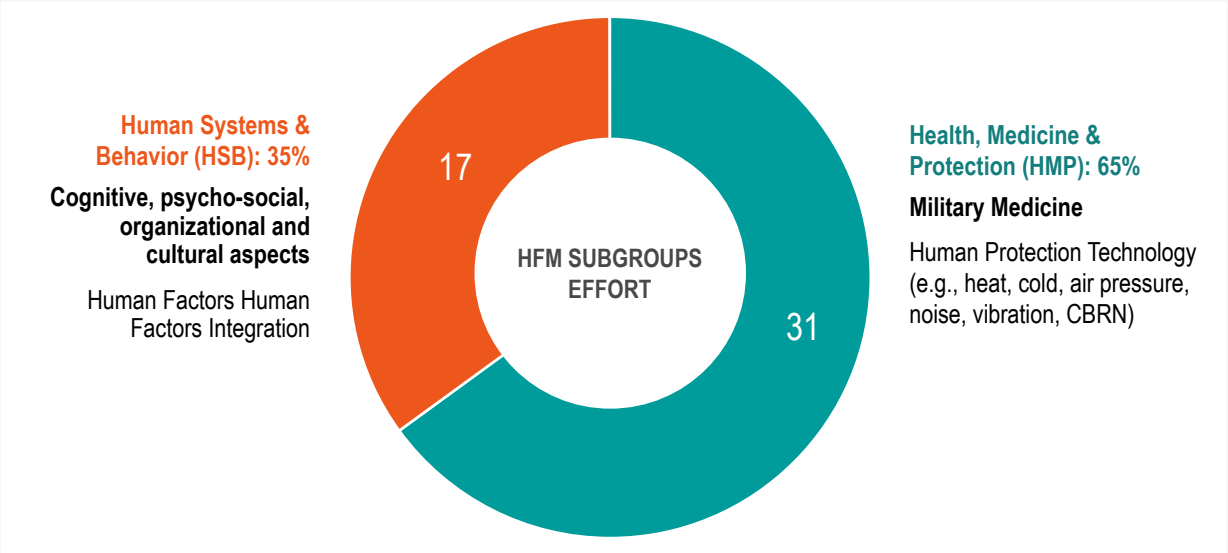
Combat Casualty Care: Change and innovation in science and technology development in the field of combat casualty care must keep pace with the advancement of weapon systems and battlespace tactics, techniques, and procedures that will create novel military operational environments. Current combat casualty care and medical planning guidelines are based on rapid evacuation to damage control surgery and critical care. Future operational environments will considerably affect the ability of NATO forces to adhere to these guidelines and medically evacuate casualties to provide life-, limb-, and eyesight-saving treatments in a timely manner.

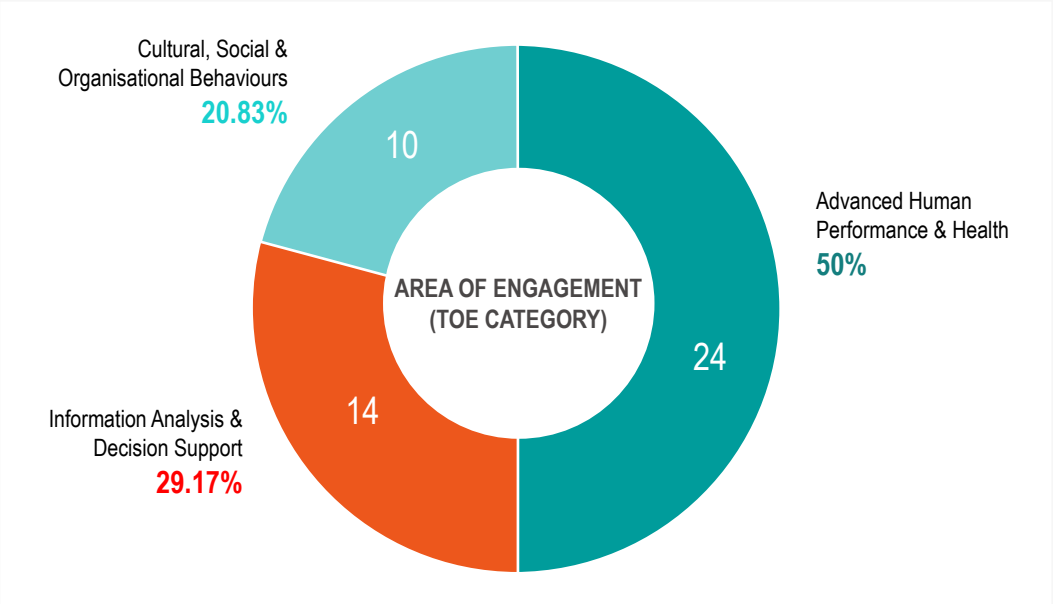
Chemical, Biological and Radiological Defence: Major changes in the security policy and the geopolitical and military situation, as well as evolving agent and weapon technologies, influence the chemical, biological, radiological, and nuclear (CBRN) threat and defence against it. Consequently, CBRN defence requires closer collaboration between the military and civilian sectors. Based on the threat out to 2030, S&T areas that can support CBRN defence need to be identified.

Human-Autonomy Teaming: Based on progress in robotics, artificial intelligence, and human performance modelling, Human-Agent-Robot Teamwork (HART) systems are being developed and tested in which humans and autonomous systems dynamically adjust and cooperate to accomplish a joint objective, often in shared spaces. In these systems, team members' responsibilities and commitments are managed such that the human and autonomous system jointly enhance performance and manage contingencies.

HFM CPOW COMPOSITION




Human Systems & Behavior (HSB): 35%
Cognitive, psycho-social, organizational and cultural aspects
Human Factors Human Factors Integration
17
HFM SUBGROUPS EFFORT
31
Health, Medicine & Protection (HMP): 65%
Military Medicine
Human Protection Technology (e.g., heat, cold, air pressure, noise, vibration, CBRN)


Cultural, Social & Organisational Behaviours
20.83%
10
AREA OF ENGAGEMENT (TOE CATEGORY)
24
Advanced Human Performance & Health
50%
14
Information Analysis & Decision Support
29.17%


N PLAN
20X/0.40
HCX

Table 7: HFM Activities Continuing in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
HFM-273	LTSS	Chemical, Biological and Radiological Defence
HFM-317	LTSS	Solutions for Combat Casualty Care
HFM-314	RLS	Aircrew Neck Pain Prevention and Management Lecture Series
HFM-328	RLS	Collaborations between Military & Civilian Personnel in Defence Organizations
HFM-324	RSY	Symposium; Solutions for Combat Casualty Care
HFM-321	RTC	Aerospace Medicine: New technologies-New approach RAMS USAF/NATO STO HFM
HFM-263	RTG	Health Risk Assessment for Chemical Exposures of Military Interest
HFM-270	RTG	Framework for Modeling and Simulation of Human Lethality, Injury, and Impairment from Blast-Related Threats
HFM-271	RTG	Injury assessment methods for vehicle occupants in blast-related events
HFM-274	RTG	The Impact of Hypobaric Exposure on Aviators and High-Altitude Special Operations Personnel
HFM-276	RTG	Human Factors and ISR Concept Development and Evaluation
HFM-277	RTG	Leadership Tools for Suicide Prevention
HFM-278	RTG	Preventing and countering radicalisation to violence
HFM-281	RTG	Personalized Medicine in Mental Health and Performance
HFM-283	RTG	Reducing Musculo-Skeletal Injuries
HFM-285	RTG	Speech Understanding of English language in Native and non-Native speakers/listeners in NATO with and without Hearing Deficits
HFM-286	RTG	Leader Development for NATO Multinational Military Operations
HFM-287	RTG	Developing a Culture and Gender Inclusive Model of Military Professionalism
HFM-290	RTG	Advances in Military Personnel Selection
HFM-291	RTG	Ionizing Radiation Bioeffects and Countermeasures
HFM-292	RTG	Understanding and Reducing Skill Decay
HFM-293	RTG	Digital and Social Media Assessment for Effective Communication and Cyber Diplomacy
HFM-294	RTG	Big Data In The Military: Integrating Genomics into the Pipeline of Standard-care Testing & Treatment
HFM-295	RTG	Sexual Violence in military
HFM-297	RTG	Assessment of Augmentation Technologies for Improving Human Performance
HFM-298	RTG	Injury thresholds of high power pulsed radiofrequency emissions
HFM-299	RTG	Pulmonary Screening and Care in Aviators

HFM-301	RTG	Military Diversity: Ethnic Tolerance and Intolerance
HFM-304	RTG	Factors Impacting Ethical Leadership
HFM-305	RTG	Synthetic Biology in Defence: Opportunities and Threats
HFM-306	RTG	Translating Medical Chemical Defence Research Into Operational Medical Capabilities Against Chemical Warfare Agent Threats
HFM-307	RTG	Integrating Gender and Cultural Perspectives in Professional Military Education Programmes
HFM-308	RTG	Optimizing Human Performance in NATO SOF Personnel Through Evidence-Based Mental Performance Programming
HFM-310	RTG	Human Performance and Medical Treatment and Support During Cold weather Operations
HFM-311	RTG	Cognitive Neuroenhancement: Techniques and Technology
HFM-312	RTG	Unexplained Physiologic Events in High-Performance Aircraft
HFM-313	RTG	Re-introduction of phage therapy in military medicine
HFM-316	RTG	Expert panel for state of the art cardiovascular risk assessment in aircrew and other high risk occupations.
HFM-319	RTG	Measuring the Cognitive Load on the Soldier
HFM-320	RTG	Fatigue Management in Aircrew
HFM-329	RTG	A psychological guide for leaders across the deployment cycle.
HFM-322	RWS	Meaningful Human Control of AI-based Systems: Key Characteristics, Influencing Factors and Design Considerations
HFM-MSG-323	ST	Guidelines for Mitigating Cybersickness in Virtual Reality Systems

Table 8: HFM Activities Starting in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
HFM-318	RTG	Personnel Retention in the Armed Forces
HFM-325	RTG	Performance Nutrition for Fresh Feeding during Military Training and Operations
HFM-327	RTG	Development of a NATO STANREC for Physiological Status Monitoring to Mitigate Exertional Heat Illness
HFM-328	RLS	Collaborations between Military & Civilian Personnel in Defence Organizations
HFM-329	RTG	A psychological guide for leaders across the deployment cycle.
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

INFORMATION SYSTEMS TECHNOLOGY PANEL (IST)

INFORMATION SYSTEMS TECHNOLOGY PANEL

Panel Chair: Dr. Michael Wunder
Panel Vice-Chair: Dr. Nikolai Stoianov
Panel Executive: Mr. Bernard Garcin
Panel Assistant: Ms. Agata Swiatkiewicz

MISSION

The Information Systems Technology (IST) Panel implements the STO Mission with respect to Information Systems Technology, on behalf of the Science & Technology Board.

The mission of the IST Panel is to advance and exchange techniques and technologies to provide timely, affordable, dependable, secure, and relevant information to war fighters, planners, and strategists. IST is also responsible for improving C3I systems, focusing on AI, interoperability, decision support, network connectivity, and cyber security.

MAIN INTEREST

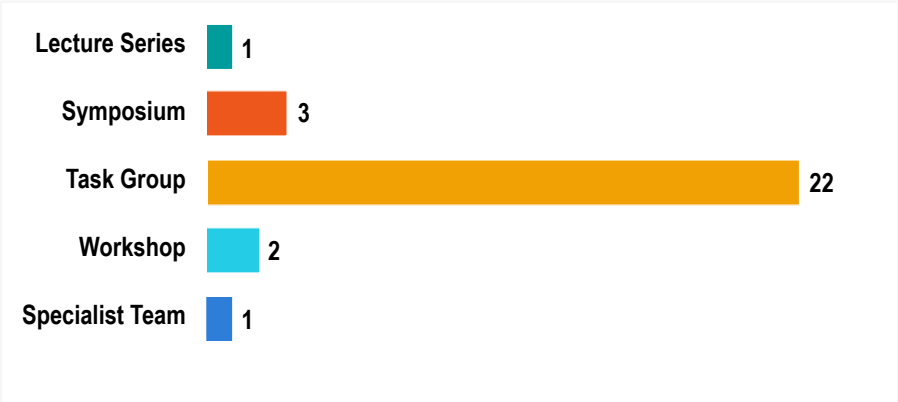
IST's scope of responsibility consists of Architecture & Intelligence Information Systems (AI2S), Communications & Networks (COM), and Information Warfare & Assurance (IWA), which are also the three focus groups of the IST Panel.

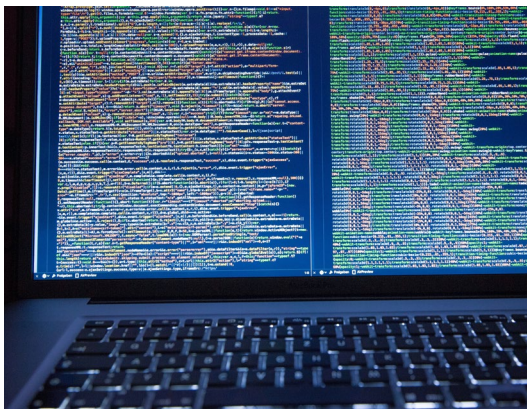
The Architecture & Intelligence Information Systems (AI2S) strand focuses on knowledge management for NATO warfighters, decision support and interoperability, looking into machine learning and big data, social media exploitation for C2, autonomy of a multitude of devices, and human-machine teaming.

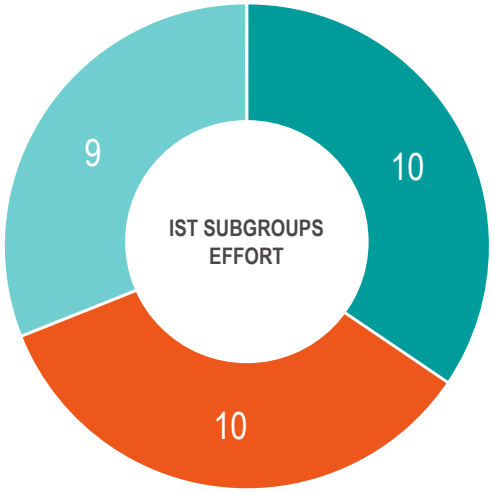
The Communications and Networks (COM) strand focuses on connectivity across all NATO Command levels, looking into seamless integration of heterogeneous items, usage optimization of available bandwidths including cognitive radio and 5G, and electronic warfare.

The Information Warfare & Assurance (IWA) strand focuses on protecting information for information dominance, accomplishing security and trust, looking into predictive analysis, cyber awareness, and trust.

IST CPOW COMPOSITION







AI2S: Architecture & Intelligent Information Systems: 31.03%

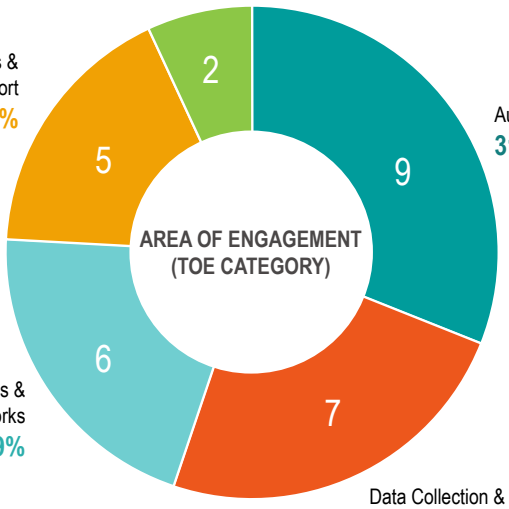
Knowledge Management for NATO Warfighter, Decision Support, Interoperability

IWA: Information Warfare and Assurance: 34.48%

Protecting Information for Information Dominance, accomplish security & trusts

COM: Communications and Networks : 34.48%

Connectivity across all NATO Command Levels



Other
6.90%

Information Analysis & Decision Support
17.24%

Autonomy
31.03%

Communications & Networks
20.69%

Data Collection & Processing
24.14

Table 9: IST Activities Continuing in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
IST-141	RTG	Exploratory Visual Analytics
IST-142	RTG	Software Defined Network Architectures for the Federated Mission Networks
IST-146	RTG	Electromagnetic Environment Situational Awareness for NATO
IST-151	RTG	Cyber Security of Military Systems
IST-157	RTG	Human in the Loop Considerations for Artificial Intelligence
IST-161	RTG	Efficient Group and Information Centric Communications in Mobile Military Heterogeneous Networks
IST-163	RTG	Deep Machine Learning for Cyber Defense
IST-164	RTG	Securing Unmanned and Autonomous Vehicles for Mission Assurance
IST-165	RTG	High-level fusion of Hard and Soft Information for Intelligence
IST-168	RTG	Adaptive Information Processing and Distribution to Support Command and Control
IST-170	RLS	Cyber Security Science and Engineering 2.0
IST-171	RTG	FMN Cloud-based Coalition Security Architecture
IST-172	RTG	Airborne Beyond Line of Sight Communication Network
IST-173	ST	Mission-Oriented Research for AI and Big Data for Military Decision Making
IST-174	RTG	Secure Underwater Communications for Heterogeneous Network-enabled Operations
IST-175	RTG	Full Duplex Radio Technology for Military Applications
IST-176	RTG	Federated Interoperability of Military C2 and IoT Systems
IST-177	RTG	Social Media Exploitation for Operations in the Information Environment
IST-178	RWS	Big Data Challenges: Situation Awareness and Decision Support
IST-179	RTG	Interoperability for Semi-Autonomous Unmanned Ground Vehicles

Table 10: IST Activities Starting in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
IST-162	RTG	Cyber Monitoring and Detection Capability for Military Systems
IST-169	RTG	Robustness and Accountability in Machine Learning Systems
IST-180	RTG	Network Management & Cyber Defense (NMCD) for Federated Mission Networking (FMN)
IST-181	RSM	Terahertz-band Communications and Networking
IST-183	RWS	Deep Machine Learning For Cyber Defense
IST-184	RTG	Visual Analytics for Complex Systems
IST-185	RSM	Communication Networks and Information Dissemination for the Tactical Edge
IST-186	RSM	Blockchain Technology for Coalition Operations
IST-HFM-182	RTG	Synthetic Legal Adviser - AI-based Decision Making in HyperWar

NATO MODELLING AND SIMULATION GROUP (NMSG)

NATO MODELLING AND SIMULATION GROUP

Group Chair: Mr. Agatino Mursia
Group Vice-Chair: Dr. Robert Siegfried
Group Head: CDR Santiago Fernandez Dapena
Group Technical Officer: Mr. Adrian Voiculet
Group Assistant: Mrs. Renata Japertaite

MISSION

The NATO Modelling and Simulation Group (NMSG) is the STO Scientific and Technical Committee in which all NATO Modelling and Simulation (M&S) stakeholders and subject matter experts meet to coordinate and oversee the implementation of the NATO M&S Master Plan (NMSMP).

The NMSMP is the NATO policy document that provides a global strategic vision and guidance for coordinating and utilizing M&S in NATO. The NATO vision for modelling and simulation is to exploit M&S to its full potential across NATO and the Nations to enhance both operational and cost effectiveness.

The mission of the NMSG is to promote cooperation among Alliance bodies, NATO, and partner nations to maximize the effective utilization of M&S. This includes M&S standardization, education, and associated science and technology. The NMSG, as nominated by the Conference of NATO Armaments Directors (CNAD), is the delegated tasking authority for standardization in the NATO modelling and simulation domain.

MAIN INTEREST

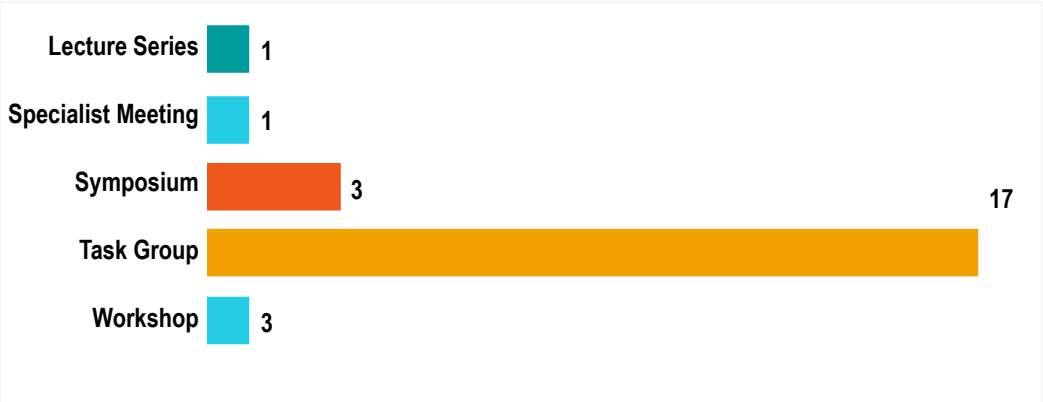
The NMSMP articulates the NATO vision and guiding principles regarding the use of M&S in support of the NATO mission, discusses the impact that achieving this vision will have on NATO M&S application areas, and identifies governance mechanisms and bodies, as well as the primary NATO M&S stakeholders.

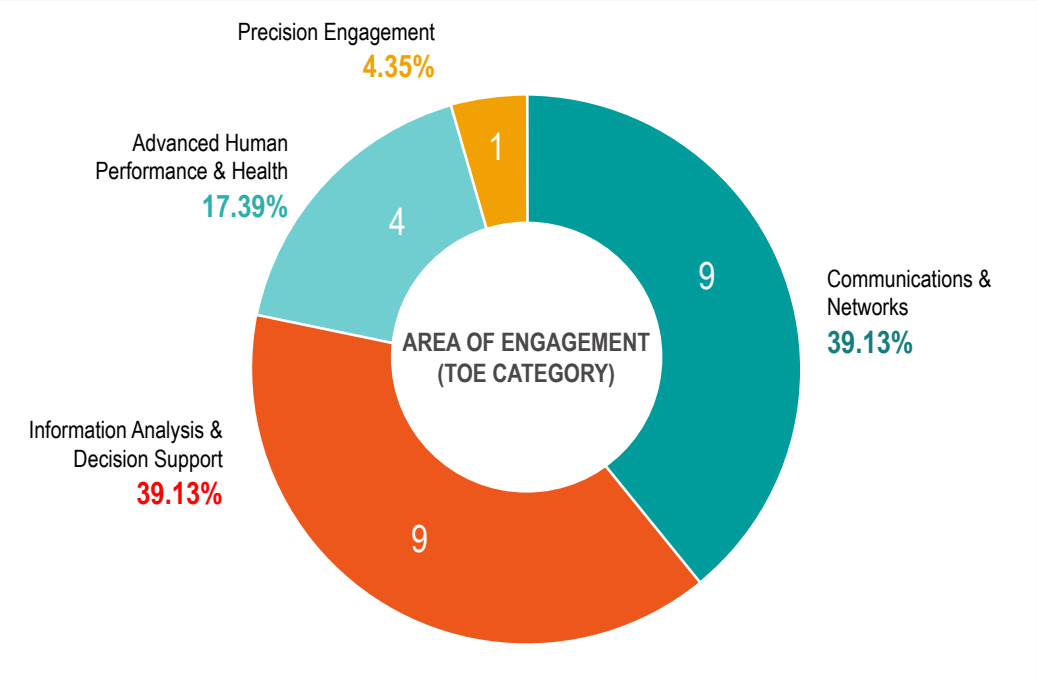
The NMSMP identifies several application areas that can capitalize on M&S: support to operations, capability development, mission rehearsal, training and education, and procurement.

Under the umbrella of establishing a common technical framework, increasing interoperability, and developing models, simulations, and standards for M&S, the main focus areas of work for the NMSG are education and training, decision making, AI & big data, cyber defence, and acquisition.

The NMSG's three permanent sub-groups (Military Operational Requirements Subgroup, M&S Standards Subgroup, and the Planning and Programmes Committee) investigate, plan, update and propose the future programme of work.

MSG COMPOSITION




Precision Engagement
4.35%
1
Advanced Human Performance & Health
17.39%
4
9
Communications & Networks
39.13%
AREA OF ENGAGEMENT (TOE CATEGORY)
Information Analysis & Decision Support
39.13%
9

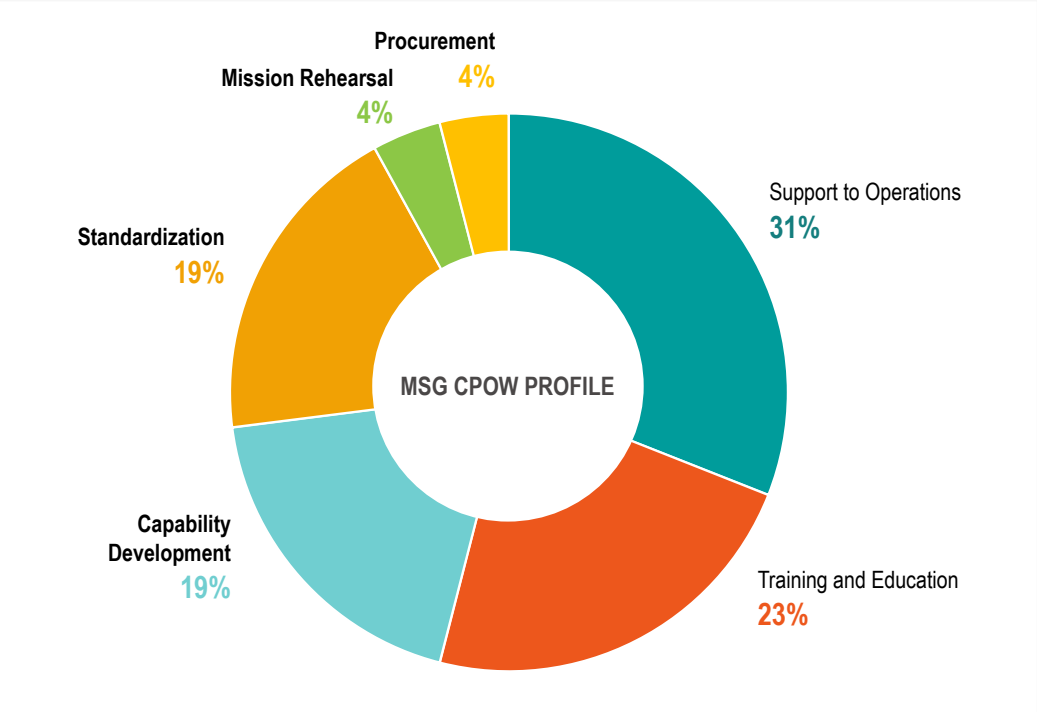

Procurement
4%
Mission Rehearsal
4%
Support to Operations
31%
Standardization
19%
MSG CPOW PROFILE
Capability Development
19%
Training and Education
23%

Table 11: NMSG Activities Continuing in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
MSG-145	RTG	Operationalization of Standardized C2-Simulation Interoperability
MSG-147	RTG	M&S Support for Crisis and Disaster Management Processes and Climate Change Implications
MSG-152	RTG	NATO Modelling and Simulation Professional Corps Development
MSG-154	RTG	Low Slow Small Threats Modelling and Simulation
MSG-155	RTG	Data Farming Services (DFS) for Analysis and Simulation-Based Decision Support
MSG-156	RTG	Dynamic Synthetic Environments for Distributed Simulation
MSG-157	RTG	NATO M&S Resources/Standards Support Team - II
MSG-163	RTG	Evolution of NATO Standards for Federated Simulation
MSG-164	RTG	Modelling and Simulation as a Service - Phase 2
MSG-165	RTG	Incremental Implementation of Mission Training through Distributed Simulation for Joint and Combined Air Operations
MSG-168	RLS	Modelling and Simulation as a Service (MSaaS)
MSG-172	RTG	NATO Modelling and Simulation Master Plan Implementation Update
MSG-173	RTG	Simulation for Training and Operation Group – Next Generation (STOG-NG)
MSG-174	RTG	Urban Combat Advanced Training Technology Live Simulation Standards (UCATT-LSS) - 2
MSG-176	RSY	MSG/MSCO Support to International Training & Education Conferences ITEC, I/ITSEC and CAX Forum 2020
MSG-177	RSY	NMSG Annual Symposium 2020
MSG-179	RTG	Modelling and Simulation for Acquisition
MSG-180	RTG	Implementation of Live Virtual Constructive – Training (LVC-T) in the Maritime Domain
MSG-181	RTG	Physics-Based Electro-Optic/Infrared Simulations – Best Practice Recommendations for Decision Support
MSG-185	RSY	MSG/MSCO Support to International Training & Education Conferences IT2EC, I/ITSEC and CA2X2 Forum 2021
MSG-SAS-178	RTG	Using Simulation to Better Inform Decision Making for Warfare Development, Planning, Operations and Assessment
MSG-SET-183	RSM	Drone Detectability: Modelling the Relevant Signature

Table 12: NMSG Activities Starting in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
MSG-176	RSY	MSG/MSCO Support to International Training & Education Conferences ITEC, I/ITSEC and CAX Forum 2021
MSG-177	RSY	NMSG Annual Symposium 2021
MSG-182	RWS	NATO Simulation Interoperability – Certification, Tools and Standards for Federated Simulation
MSG-185	RSY	MSG/MSCO Support to International Training & Education Conferences IT2EC, I/ITSEC and CA2X2 Forum 2021

Table 13: NMSG Activities Starting in 2021

ACTIVITY	ACTIVITY TYPE	TITLE
MSG-184	RSY	NMSG Annual Symposium 2021

SYSTEM ANALYSIS AND STUDIES PANEL (SAS)

SYSTEM ANALYSIS AND STUDIES

Panel Chair: Dr. Ana Barros
Panel Vice-Chair: Mr. Espen Skjelland
Panel Executive: LtCol Timothy Povich, PhD
Panel Assistant: Mr. Jeroen Groenevelt

MISSION

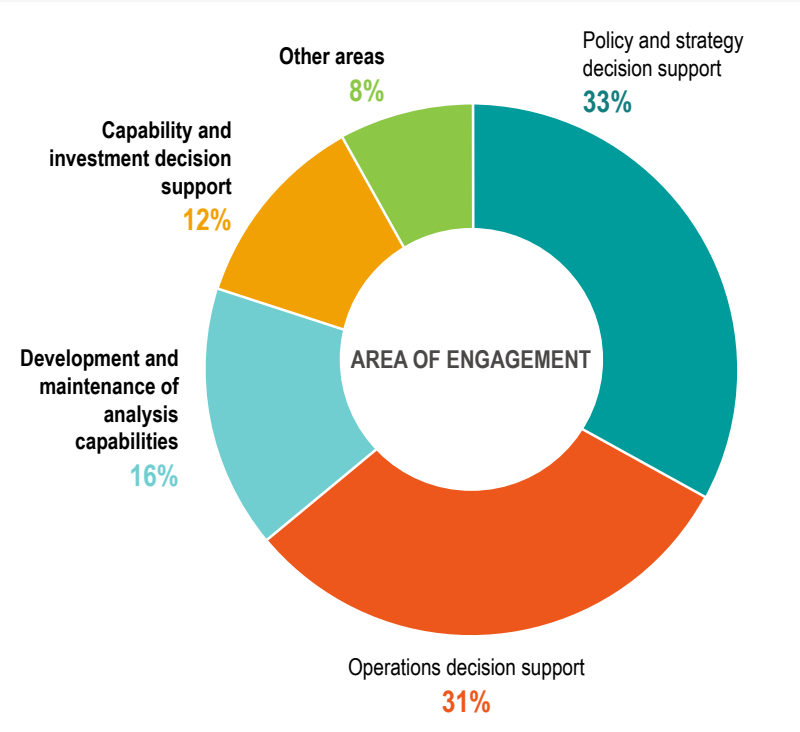
The System Analysis and Studies (SAS) panel – STO's expert panel on analytical advice – conducts studies and analysis for better decisions in strategy, capability development, and operations within NATO, NATO Nations. and partner Nations. Key drivers in the SAS panel's work are the exploitation of new technologies, new forms of organization, and new concepts of operation.

Currently, the SAS panel consists of 43 senior scientific representatives from 23 NATO Nations, 2 Partnership for Peace Nations, 1 Global Partner, and 3 NATO organizations. The SAS panel leverages analysts and scientist from academia, government, and industry to conduct research.

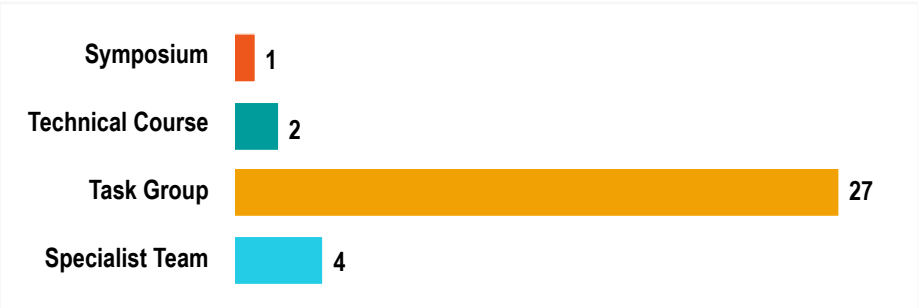
MAIN INTEREST

The SAS panel focuses on undertaking Operations Analysis (OA) activities related to challenges in the evolving strategic environment and the responses that both individual nations and NATO as a whole are making to tackle them. The research can be clustered into 4 focus areas: Policy and Strategy Decision Support, Operations Decision Support, Capability and Investment Decision Support, and Development and Maintenance of Analysis Capabilities.

The development and maintenance of analysis capabilities forms the basis of the SAS panel's work and is essential to providing NATO with innovative and academically sound analytical capabilities that will ensure informed defence decision making. Activities include the development of analytical methods to address upcoming security challenges, information exchange on OA modelling concepts and best practices, research into new methodological approaches, and the development and exchange of models.



SAS PANEL CPOW COMPOSITION



The SAS panel leverages its broad range of analysis capabilities to provide decision support at all levels and in different areas. For example, the SAS panel identifies and assesses the impacts of geo-political drivers, regional contexts, futures, and technology changes to support policy and strategy decisions. It conducts analysis to improve operational tactics, training, and procedures, and develops better methods to support operational planning. Finally, it supports the development of systems, force elements, and enabler capability options, including the collection and collation of cost and performance data, and defining the necessary missions for these individual systems and capabilities.

The main source for new research projects are proposals made by NATO Nations represented at the SAS panel. The SAS panel also addresses requests for such analysis and studies from a variety of other sources. These include the Science and Technology Board (STB) and other NATO bodies, such as the Military Committee, the Conference of National Armament Directors (CNAD), the Main Armaments Groups, Allied Command Operations (ACO), Allied Command Transformation (ACT), the NATO Communications and Information Agency (NCIA), and the NATO Industrial Advisory Group (NIAG).

SAS PANEL THEMATIC APPROACH

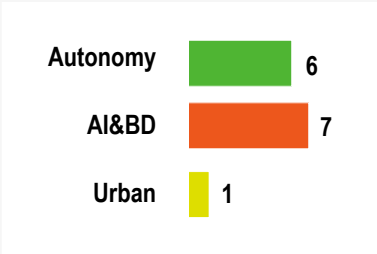


Table 14: SAS Activities Continuing in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
SAS-149	RTC	Basics of complex modern urban functions and characteristics
SAS-118	RTG	Enhancing Strategic Awareness of Energy Security- A Holistic Approach
SAS-120	RTG	Integration of Women into Ground Combat Units
SAS-123	RTG	Futures Assessed alongside socio-Technical Evolutions (FATE)
SAS-124	RTG	Visualization Design for Communicating Defence Investment Uncertainty and Risk
SAS-125	RTG	Comparative Analysis of National Acquisition Processes
SAS-128	RTG	Modelling Personnel Flows; Identifying Potential Solutions to Recruiting and Retention Challenges
SAS-129	RTG	Gamification of Cyber Defence/Resilience
SAS-130	RTG	Course of Action Analysis in the 21st Century
SAS-133	RTG	Assessment/analysis support to facilitate the introduction of NLW by addressing line of development obstacles
SAS-134	RTG	Linking Strategic Investments & Divestments to Defence Outcomes
SAS-136	RTG	Optimization of Investment in Simulation-Based Military Training
SAS-139	RTG	NATO Analytical War Gaming - Innovative Approaches for Data Capture, Analysis and Exploitation
SAS-140	RTG	Directed Energy Weapons Concepts and Employment
SAS-143	RTG	Agile, Multi-Domain C2 of Socio-Technical Organizations in Complex Endeavors
SAS-144	RTG	Code of Best Practice for Conducting Survey Research in a Military Context
SAS-145	RTG	SWEAT (Soldier System Weapon & Equipment Assessment Tool)
SAS-147	RTG	Analysis of Anti-Access Area Denial (A2/AD)
SAS-151	RTG	Solutions Enabling Intermediate Force/Non-lethal Weapon Contributions to Mission Success
SAS-152	RTG	Conceptual framework for Comprehensive National Defence System
SAS-153	RTG	Best practices on Cost Analysis of Information And Communication Technology
SAS-154	RTG	Strategic Environment Assessment: Framework for Analysis
SAS-142	ST	Development of an internet exploitation grading system
SAS-148	ST	Recruitment and Retention of Young Civilian Scientists
SAS-150	ST	Advanced Analytics and Artificial Intelligence for Defence Enterprise Resource Planning
SAS-155	ST	Providing OR&A model sharing guidance to the Alliance

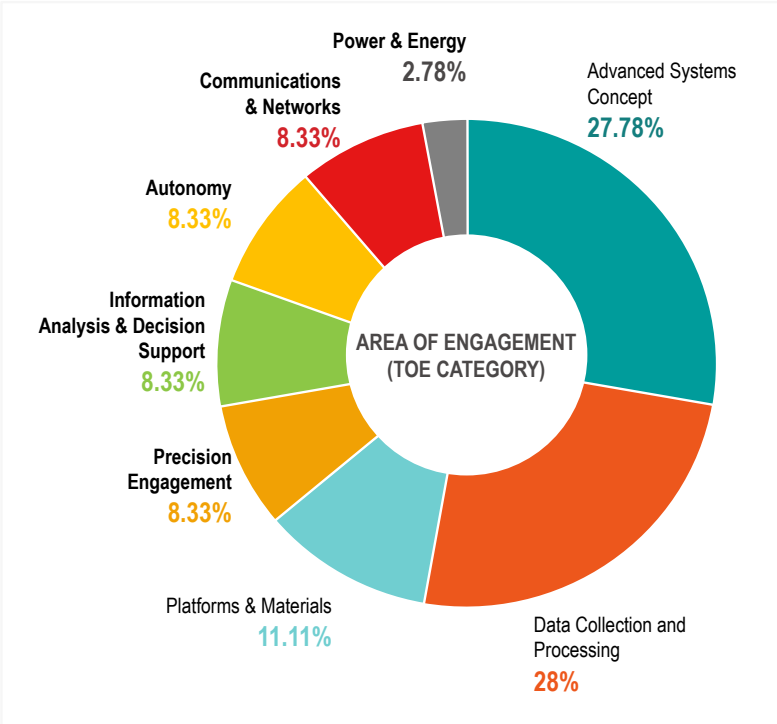
Table 15: SAS Activities Starting in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
SAS-156	RTG	Developing a Standard Methodology for Assessing Multinational Interoperability
SAS-157	RTG	Automation in the Intelligence Cycle
SAS-158	RTG	Employing AI to Federate Sensors in Joint Settings
SAS-159	RTG	How could Technology Development Transform the Future Operational Environment
SAS-160	RTG	Ethical, legal and moral (ELM) impacts of novel technologies on NATO's operational advantage – the "ELM Tree"
SAS-161	RTG	Military Aspects of Countering Hybrid Warfare: Experiences, Lessons, Best Practices

SYSTEMS CONCEPTS AND INTEGRATION PANEL SCI (SCI)

SYSTEMS CONCEPTS AND INTEGRATION PANEL

Panel Chair: Dr. Karin Stein
Panel Vice-Chair: Mr. Allan Chan
Panel Executive: LtCol Ryan Snider
Panel Assistant: Ms. Carlotta Rossi



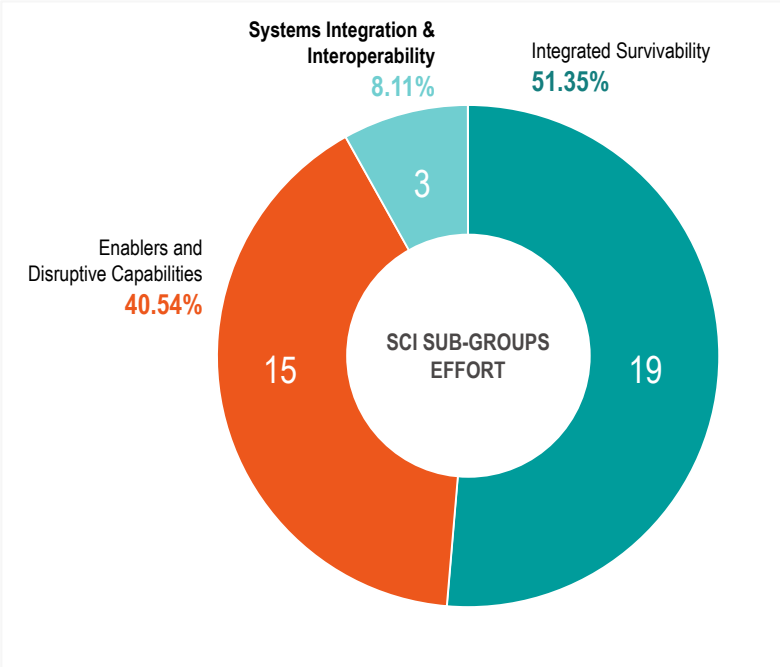
MISSION

The mission of the Systems, Concepts and Integration (SCI) panel is to advance knowledge concerning advanced system concepts, integration, engineering techniques, and technologies across the spectrum of platforms and operating environments to ensure cost-effective mission area capabilities. Integrated defence systems, including air, land, sea, and space systems (manned and unmanned), and associated weapon and countermeasure integration are covered. The SCI panel's activities focus on NATO and national mid- to long-term system level operational needs.

MAIN INTEREST

The scope of the SCI panel's activities covers a multidisciplinary range of theoretical concepts, design, development, and evaluation methods applied to integrated defence systems. Areas of interest include:

- Integrated mission systems including weapons and countermeasures
- System architecture/mechanization
- Vehicle integration
- Mission management
- System engineering technologies and testing



SCI PANEL CPOW COMPOSITION

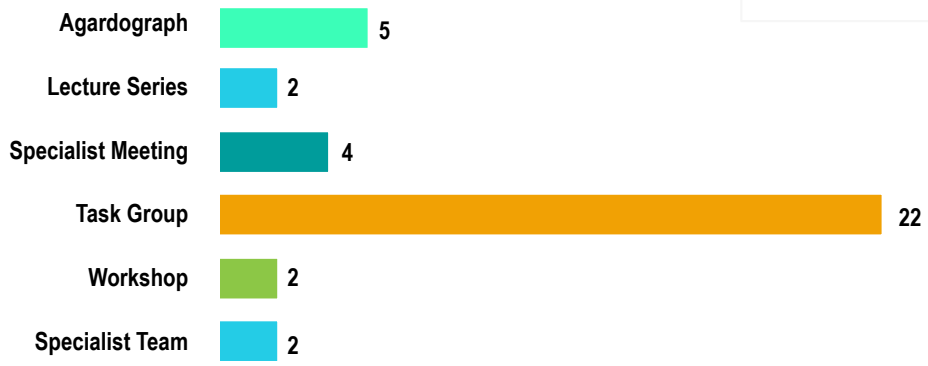


Table 16: SCI Activities Continuing in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
SCI-303	AG	AG-300 V.33 Flight Test Techniques for the Assessment of Fixed-Wing Aircraft Handling Qualities
SCI-306	AG	AG-300 V.34 Reduced Friction Runway Surface Flight Testing: Issue 2
SCI-314	AG	AG-300 V.35 Ground and Flight Test Methods Used to Assure Aero-elastic Stability of Fixed Wing Aircraft
SCI-315	AG	AG-300 V.36 Flight Testing of Helmet Mounted Displays
SCI-SET-323	RSM	Above Water EO/IR Signature Requirements from an Operational Perspective
SCI-294	RTG	Demonstration and Research of Effects of RF Directed Energy Weapons on Electronically Controlled Vehicles, Vessels and UAVs
SCI-295	RTG	Development of Methods for Measurements and Evaluation of Natural Background EO Signatures
SCI-297	RTG	Distributed EW Operations in the Modern Congested RF Environment
SCI-298	RTG	Identification and Neutralization Methods and Technologies for C-IED
SCI-301	RTG	Defeat of Low Slow and Small (LSS) Air Threats
SCI-302	RTG	DIRCM Concepts and Performances
SCI-304	RTG	Optimized and Reconfigurable Antennas for Future Vehicle Electronic Counter Measures
SCI-307	RTG	FAMOS Framework for Avionics Mission Systems
SCI-310	RTG	Expanded Countermeasure Methods against IR Anti-Ship Threats in Varied Parameter and Scenario Engagements Using all-digital Tools Sets
SCI-311	RTG	Collaborative Space Domain Awareness Data Collection and Fusion Experiment
SCI-312	RTG	EO-IR Countermeasures
SCI-320	RTG	Scientific Support to NNAG Above Water Warfare Capability Group
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-326	RTG	Electronic Support (ES) Techniques Enabling Cognitive Electronic Warfare (EW)
SCI-327	RTG	Countermeasure Concepts against Anti-Aircraft Dual band EO/IR Imaging Seekers
SCI-331	ST	Fostering and Managing the STO Autonomy Portfolio
SCI-339	ST	Allied Future Surveillance & Control (AFSC) High Level Technical Concepts (HLTCs) Technology Readiness Level (TRL) Assessments

Table 17: SCI Activities Starting in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
SCI-338	AG	Flight Testing of Unmanned Aerial Vehicles
SCI-330	RLS	Multinational Capability Development Campaign (MCDC) Analysis on Autonomous Unmanned Systems (UAxS)
SCI-340	RLS	HEL Weapon Technology, Opportunities, and Challenges
SCI-329	RSM	Capabilities for Sensing, Search, and Surveillance in the Arctic
SCI-335	RSM	Autonomy from a System Perspective – Version 2.0
SCI-SET-323	RSM	Above Water EO/IR Signature Requirements from an Operational Perspective
SCI-316	RTG	High Energy Laser Weapons: Quantifying the Impact of Atmospherics and Reflections
SCI-325	RTG	Methods of Identifying and Evaluation the Camouflage and Deceptive Properties of the Military Equipment in Land Field Trials
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-336	RTG	Cyber-Physical Systems Resilience for NATO Operations
SCI-324	RWS	Realization and Evaluation of Robotic Multispectral Decoys for Land Equipment
SCI-337	RWS	Combination of Field Measurements and M&S Assessment Methods

SENSORS AND ELECTRONICS TECHNOLOGY PANEL (SET)

SENSORS AND ELECTRONICS TECHNOLOGY (SET) PANEL

Panel Chair: Dr. David Blacknell
Panel Vice-Chair: Mr. Frank van den Bogaart
Panel Executive: LtCol Francesco Santoro
Panel Assistant: Ms. Illeana Ganz

MISSION

The mission of the Sensors and Electronics Technology (SET) panel is to foster co-operative research, the exchange of information, and the advancement of science and technology among the NATO Nations in the field of sensors and electronics for defence and security. The SET panel addresses the development and enhancement of both passive and active sensors, as well as electronic technology capabilities, multi-sensor integration, and fusion as they pertain to Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR), Remote Sensing, Electronic Warfare, Communications, and Navigation. To fulfil this mission, the SET panel is organized into three Focus Groups: Radio-Frequency Technology (RFT), Optical Technology (OT), and Multi-Sensors & Electronics (MSE).

MAIN INTEREST

The research activities of the SET panel predominantly address topics related to target signatures, propagation and battlespace environments, sensors (e.g., electro-optic, radio-frequency, acoustic, magnetic), antennas, signal and image processing, components, sensor hardening, electromagnetic compatibility, and any other phenomena associated with sensors and electronics that may assist NATO war-fighters during future warfare and peace-keeping scenarios.

In principle, the Focus Groups are addressing the following domains:

- Multi Sensors and Electronics:
- Sensing for ISR
- C-IED
- Swarms
- Navigation

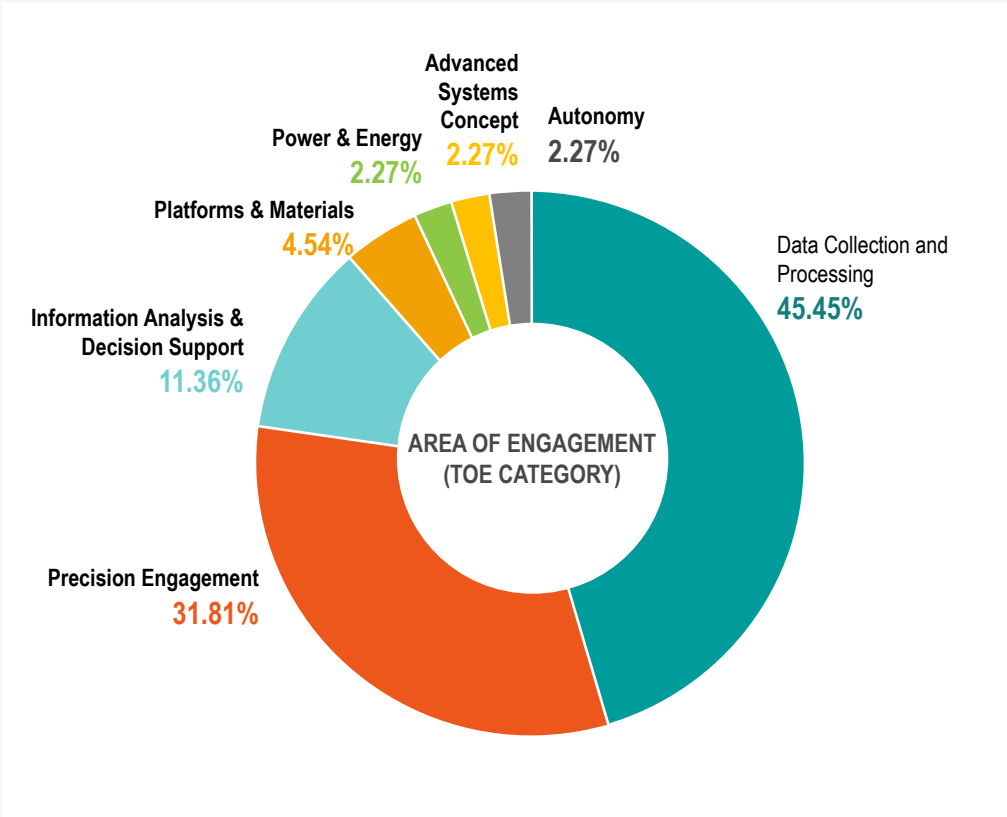
Radio Frequency Technology:

- Radar (including Active, Passive, SAR, Noise, Cognitive, Multi-and Bi-static, Multi-function, SW Defined)
- ATR/NCTR
- Radar Imaging
- Radar Signatures
- Spectrum Management

Optical Technology:

- Infrared and Spectral Sensing
- Laser Radar Technology
- Performance Modeling
- Target SignaturesPerformance Modeling
- Target Signatures

SET CPOW COMPOSITION


Advanced Systems Concept
2.27%
Autonomy
2.27%
Power & Energy
2.27%
Platforms & Materials
4.54%
Data Collection and Processing
45.45%
Information Analysis & Decision Support
11.36%
AREA OF ENGAGEMENT (TOE CATEGORY)
Precision Engagement
31.81%

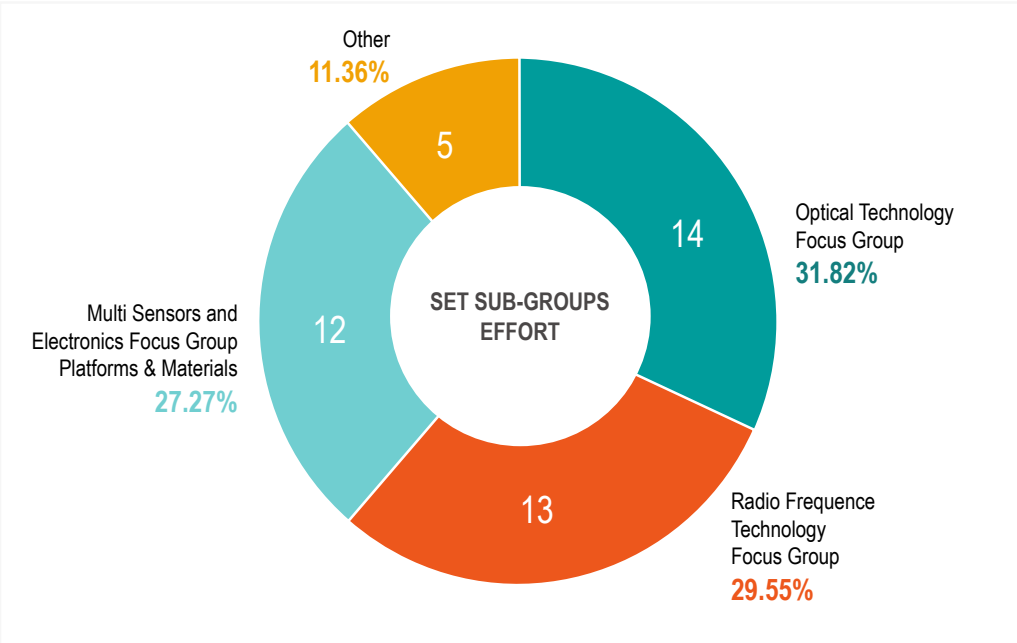

Other
11.36%
5
14
Optical Technology Focus Group
31.82%
SET SUB-GROUPS EFFORT
12
Multi Sensors and Electronics Focus Group Platforms & Materials
27.27%
13
Radio Frequence Technology Focus Group
29.55%

Table 18: SET Activities Continuing in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
SET-273	RSM	Multidimensional Radar Imaging and ATR
SET-264	RSY	Quantum Position Navigation and Timing for NATO platforms
SET-275	RSY	Cooperative Navigation in GNSS Degraded and Denied Environments
SET-217	RTG	Assessing and Modeling the Performance of Digital Night Vision Image Fusion
SET-229	RTG	Cooperative Navigation in GNSS Degraded and Denied Environments
SET-234	RTG	Environmental limitations of Fielded EO-TDAs
SET-237	RTG	Printed Standards for Stand-off Detection
SET-238	RTG	Side-Attack Threat Detection Strategies, Technologies and Techniques
SET-240	RTG	Exploitation of Longwave Infrared Airborne Hyperspectral Data
SET-242	RTG	Passive Coherent Locators on Mobile Platforms
SET-245	RTG	Radar Based Non-Cooperative Target Recognition (NCTR) in the Low Airspace and Complex Surface Environments
SET-246	RTG	Short Wave Infrared Technology: a standardized irradiance measurement and compatibility model to evaluate reflective band systems
SET-249	RTG	Laser Eye Dazzle Threat Evaluation and Impact on Human Performance
SET-250	RTG	Multi-Dimensional Radar Imaging
SET-251	RTG	Ship Radar Signature Management Benefit to Ships
SET-252	RTG	Development of a validation model of a stealth UCAV
SET-256	RTG	Interoperability & Networking of Disparate Sensors and Platforms for ISR Applications
SET-258	RTG	DMPAR Deployment and Assessment in Military Scenario
SET-260	RTG	Assessment of EO/IR Technologies for Detection of Small UAVs in an Urban Environment
SET-263	RTG	Swarms Systems for Intelligence Surveillance & Reconnaissance
SET-266	RTG	Multi-functional EO/IR sensors for counter-surveillance
SET-268	RTG	Bi-/Multi-static radar performance evaluation under synchronized conditions
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-271	RTG	Airborne Maritime Radar Based Submarine Periscope Detection and Discrimination at High Grazing Angles
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 CMs
SET-277	RWS	Workshop on Phenomenology and Exploitation of Hyperspectral Sensing within NATO
SET-276	ST	Quality Assurance and Assessment Team for SPS on DEXTER (Detection of Explosives and firearms to counter Terrorism)

Table 19: SET Activities Starting in 2020

ACTIVITY	ACTIVITY TYPE	TITLE
SET-274	RLS	Cooperative Navigation in GNSS Degraded and Denied Environments
SET-290	RLS	AI for Military ISR Decision Makers
SET-284	RSM	Enhanced Situation Awareness using Active-Passive Radar Systems in Military Scenarios
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-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-293	RTG	RF Sensing for Space Situational Awareness
SET-294	RTG	Advanced Mid-Infrared Laser Technology
SET-295	RTG	Radar Signature Measurements of Maritime Platforms
SET-289	RWS	Nanotechnology for Optics & Infrared Photo Detection

SYMPOSIA / WORKSHOPS / SPECIALISTS MEETINGS FOR 2020

Symposia (RSY), workshops (RWS), and specialists meetings (RSM) aim to promote the exchange of state-of-the-art knowledge within an audience on an important scientific or applied topic. A Long-Term Scientific Study (LTSS) provides recommendations to NATO and National Authorities on an assessment of the impact on military operations that might be expected from developments in science and technology over both the medium and long term (10-20 years). Specialist Teams (ST) are established in response to an urgent high-priority, short-term task. Table 20 presents the list of aforementioned activities to be conducted in 2020.

Table 20 provides a forecast of STO Collaborative Program Lecture Series, Technical Courses, Symposia, and Workshop activities in 2020 for which the broadest possible participation is desired and highly encouraged. To aid in participation planning, the dates and locations for the activities have been included.

Table 20: Symposia / Workshops / Specialists Meetings for 2020

ACTIVITY INDEX	ACTIVITY TYPE	ACTIVITY TITLE	MEETING DATE	MEETING LOCATIONS	DISTRIBUTION AND PARTNER PARTICIPATION
AVT-324	RSM	Multi-disciplinary design approaches and performance assessment of future combat aircraft	16-20 April 2018 (TBP)	Torino, ITA	NATO Unclassified open to Australia and Sweden
			TBD	TBD	
AVT-335	RSM	Range Design and Management for Sustainable Live Fire Training Ranges	27 April - 01 May 2020	CAN	NATO Unclassified open to PfP EOP MD JPN NZL BRAZIL
AVT-336	RSM	Enabling Platform Technologies for Resilient Small Satellite Constellations for NATO Missions	05-07 October 2020	SWE	NATO Unclassified open to EOP NZL
IST-181	RSM	Terahertz-band Communications and Networking	TBD	TBD	NATO Unclassified open to EOP
IST-185	RSM	Communication Networks and Information Dissemination for the Tactical Edge	Spring	TBD	NATO Unclassified open to Finland and Sweden
IST-186	RSM	Blockchain Technology for Coalition Operations	13-14 October 2020	Bled, Slovenia	NATO Unclassified open to EOP PfP
MSG-SET-183	RSM	Drone Detectability: Modelling the Relevant Signature	21-23 October 2020	Prague, CZE	NATO Unclassified open to EOP PfP Republic of Korea, New Zealand, Switzerland
SCI-329	RSM	Capabilities for Sensing, Search, and Surveillance in the Arctic	26-27 May 2020	Nuuk, GRL during PBM	NATO Unclassified open to Australia, Finland, New Zealand and Switzerland
SCI-335	RSM	Autonomy from a System Perspective – Version 2.0	first prep MTG 29/01/2020	USA	NATO Unclassified open to Australia, Finland and Switzerland
			4Q 2020	CSO, FRA	

ACTIVITY INDEX	ACTIVITY TYPE	ACTIVITY TITLE	MEETING DATE	MEETING LOCATIONS	DISTRIBUTION AND PARTNER PARTICIPATION
SCI-SET-323	RSM	Above Water EO/IR Signature Requirements from an Operational Perspective	5-6 May 2020	DRDC Valcartier, Québec City, CAN	NATO Secret
SET-273	RSM	Multidimensional Radar Imaging and ATR	12-13 October 2020	Switzerland	NATO Unclassified open to Australia, Finland, Sweden, Switzerland and South Africa
SET-284	RSM	Enhanced Situation Awareness using Active-Passive Radar Systems in Military Scenarios	20 April 2020 in conjunction with the 45th PBM	Warsaw, POL	NATO Unclassified open to EOP and Switzerland
HFM-324	RSY	Symposium; Solutions for Combat Casualty Care	Fall 2019 PBM	Lisbon	NATO Unclassified open to EOP PfP MD ICI GP Other
MSG-176	RSY	MSG/MSCO Support to International Training & Education Conferences ITEC, I/ITSEC and CAX Forum 2020	TBD	DEU	NATO Unclassified open to EOP PfP GP
MSG-177	RSY	NMSG Annual Symposium 2020	TBD	GBR	NATO Unclassified open to EOP PfP GP Brazil Singapore India
MSG-185	RSY	MSG/MSCO Support to International Training & Education Conferences IT2EC, I/ITSEC and CA2X2 Forum 2021	TBD	USA	Public Release
SET-264	RSY	Quantum Position Navigation and Timing for NATO platforms	4/20/2020	Portland, Oregon, USA	NATO Unclassified open to Australia, Finland, Sweden
SET-275	RSY	Cooperative Navigation in GNSS Degraded and Denied Environments	Fall 2020	USA, TUR, SWE or Croatia	Public Release
AVT-337	RWS	Anti-tamper protective systems for NATO operations	Fall 2020	SWE	NATO Unclassified open to EOP
AVT-339	RWS	Robotics and Laser/Plasma – paint interaction in paint removal	April 29- May 1 2020	Quebec City, CAN	NATO Unclassified open to Pfp EOP GP
AVT-340	RWS	Preparation and Characterization of Energetic Materials	April 29- May 1 2020	Quebec City, CAN	NATO Unclassified open to EOP
HFM-322	RWS	Meaningful Human Control of AI-based Systems: Key Characteristics, Influencing Factors and Design Considerations	Planning Meeting	Stockholm, SWE	NATO Unclassified open to EOP PfP MD ICI GP Other
IST-183	RWS	Deep Machine Learning For Cyber Defense	TBD	TBD	NATO Unclassified open to Finland and Sweden
MSG-182	RWS	NATO Simulation Interoperability – Certification, Tools and Standards for Federated Simulation	TBD	Orlando, FL, USA	NATO Unclassified open to PfP GP

ACTIVITY INDEX	ACTIVITY TYPE	ACTIVITY TITLE	MEETING DATE	MEETING LOCATIONS	DISTRIBUTION AND PARTNER PARTICIPATION
SCI-324	RWS	Realization and Evaluation of Robotic Multispectral Decoys for Land Equipment	20-21 January 2020	CSO, FRA	NATO Unclassified open to Australia, Finland, Sweden and Switzerland
			9/1/2020	Tentatively Brno, CZE	
SCI-337	RWS	Combination of Field Measurements and M&S Assessment Methods	23-24 June 2020	Boston, USA	NATO Unclassified open to STOEOP, Switzerland
SET-277	RWS	Workshop on Phenomenology and Exploitation of Hyperspectral Sensing within NATO	14-15 October 2019	Brussels, BEL	NATO Secret
SET-289	RWS	Nanotechnology for Optics & Infrared Photo Detection	Spring 2020	Paris, FRA	Public Release

A **Long-Term Scientific Study (LTSS)** technical team activity provides recommendations to NATO and National Authorities based on an assessment of the impacts on military operations that might be expected from developments in science and technology over both the medium- and long-term (typically 10 – 20 years). This would include how emerging technologies, systems, and methods may affect tactical concepts and doctrines. Reciprocally, recommendations could be provided on how the evolution of the military doctrine should influence Science and Technology priorities. An LTSS is chartered for a maximum of three years after the initial meeting. Table 21 provides the list of LTSSs to be carried out in 2020.

Table 21: Long-Term Scientific Studies (LTSS) in 2020

ACTIVITY INDEX	ACTIVITY TYPE	ACTIVITY TITLE	MEETING DATE	MEETING LOCATIONS	DISTRIBUTION AND PARTNER PARTICIPATION
AVT-329	LTSS	NexGen Rotorcraft Impact on Military Operations	27 April - 01 May 2020	CAN	NATO Secret
HFM-273	LTSS	Chemical, Biological and Radiological Defence	Kick off Meeting May 2016	CSO, FRA	NATO Unclassified open to EOP
HFM-317	LTSS	Solutions for Combat Casualty Care	TBD	CSO, FRA	NATO Unclassified open to EOP PfP MD ICI GP Other

A **Specialist Team (ST)** may be set up on an ad hoc basis to respond to an urgent high priority, short-term task. These tasks may originate from within the Panel/Group or may be in response to an outside request, such as from the STB, CNAD, or Military Committee. Outside requests will come to the Panel/Group through the CSO. A list of Specialist Teams in 2020 is presented in Table 22.

Table 22: Specialist Teams in 2020

ACTIVITY INDEX	ACTIVITY TYPE	ACTIVITY TITLE	MEETING DATE	MEETING LOCATIONS	DISTRIBUTION AND PARTNER PARTICIPATION
AVT-ST-007	ST	Modification of NATO STANAGs to Incorporate Range Characterization	TBD	TBD	NATO Unclassified open to STOEOP, Switzerland, Ireland, New Zealand
AVT-ST-008	ST	Hypersonic Operational Threats	TBD	TBD	NATO Confidential
HFM-MSG-323	ST	Guidelines for Mitigating Cyber-sickness in Virtual Reality Systems	TBD	Milan, ITA	NATO Unclassified open to EOP PfP MD ICI GP Other
IST-173	ST	Mission-Oriented Research for AI and Big Data for Military Decision Making	TBD	TBD	NATO Unclassified
SAS-142	ST	Development of an Internet Exploitation Grading System	12/1/2017	CSO, FRA	NATO Secret
SAS-148	ST	Recruitment and Retention of Young Civilian Scientists	Q1 2019	CSO, FRA	Public Release
SAS-150	ST	Advanced Analytics and Artificial Intelligence for Defence Enterprise Resource Planning	2/1/2020	Ottawa, CAN	NATO Unclassified open to EOP PfP
SAS-155	ST	Providing OR&A model sharing guidance to the Alliance	N/A	N/A	Public Release
SCI-331	ST	Fostering and Managing the STO Autonomy Portfolio	27-28 August 2019	CSO, FRA	NATO Unclassified open to EOP
SCI-339	ST	Allied Future Surveillance & Control (AFSC) High Level Technical Concepts (HLTCs) Technology Readiness Level (TRL) Assessments	10-11 December 2019	CSO, FRA	NATO Restricted
SET-276	ST	Quality Assurance and Assessment Team for SPS on DEXTER (Detection of Explosives and firearms to counter Terrorism)	TBD	TBD	NATO Unclassified open to EOP, Ukraine, Serbia, Republic of Korea

THEMATIC APPROACH

Themes are urgent multi-disciplinary topics described as a military capability (or group of capabilities) that NATO Nations need to be able to accomplish. Themes are cross-panel in nature and are meant to identify areas where NATO should increase S&T and establish new Communities of Interest across the Panel/Group structures.

In the Spring of 2017, three themes were identified:

- Autonomy
- Artificial Intelligence (AI) and Big Data for Military Decision Making
- Operations in a Contested Urban Environment

The tables below list the current activities that support these yhemes.

Table 23: Autonomy

ACTIVITY	ACTIVITY TYPE	TITLE
AVT-310	RTG	Hybrid/Electric Aircraft Design and Standards , Research and Technology (HEADSTART)
AVT-336	RSM	Enabling Platform Technologies for Resilient Small Satellite Constellations for NATO Missions
AVT-341	RTG	Mobility Assessment Methods and Tools for Autonomous Military Ground Systems
AVT-353	RWS	Artificial Intelligence in Cockpits for UAVs
HFM-311	RTG	Cognitive Neuro-enhancement: Techniques and Technology
HFM-322	RWS	Meaningful Human Control of AI-based Systems: Key Characteristics, Influencing Factors and Design Considerations
HFM-330	RTG	Human Systems Integration for Meaningful Human Control over AI-based systems
IST-164	RTG	Securing Unmanned and Autonomous Vehicles for Mission Assurance
IST-174	RTG	Secure Underwater Communications for Heterogeneous Network-enabled Operations
IST-179	RTG	Interoperability for Semi-Autonomous Unmanned Ground Vehicles
IST-183	RWS	Deep Machine Learning For Cyber Defense
IST-186	RSM	Blockchain Technology for Coalition Operations
IST-HFM-182	RTG	Synthetic Legal Adviser - AI-based Decision Making in HyperWar
MSG-154	RTG	Low Slow Small Threats Modelling and Simulation
SAS-139	RTG	NATO Analytical War Gaming - Innovative Approaches for Data Capture, Analysis and Exploitation
SAS-143	RTG	Agile, Multi-Domain C2 of Socio-Technical Organizations in Complex Endeavors
SAS-152	RTG	Conceptual framework for Comprehensive National Defence System
SAS-157	RTG	Automation in the Intelligence Cycle
SAS-159	RTG	How could Technology Development Transform the Future Operational Environment
SAS-160	RTG	Ethical, legal and moral (ELM) impacts of novel technologies on NATO's operational advantage – the "ELM Tree"
SCI-301	RTG	Defeat of Low Slow and Small (LSS) Air Threats

SCI-321	RTG	UAV Applications for Military Search
SCI-324	RWS	Realization and Evaluation of Robotic Multispectral Decoys for Land Equipment
SCI-328	RSY	Flight Testing of Unmanned Aerial Systems (UAS)
SCI-330	RLS	Multinational Capability Development Campaign (MCDC) Analysis on Autonomous Unmanned Systems (UAxS)
SCI-331	ST	Fostering and Managing the STO Autonomy Portfolio
SCI-334	RTG	Evaluation of Swarm System for Military Applications
SCI-335	RSM	Autonomy from a System Perspective – Version 2.0
SCI-338	AG	Flight Testing of Unmanned Aerial Vehicles
SET-263	RTG	Swarms Systems for Intelligence Surveillance & Reconnaissance
SET-272	RTG	Automated Scene Understanding for Battlefield Awareness
SET-290	RLS	AI for Military ISR Decision Makers

Table 24: Artificial Intelligence and Big Data for Military Decision Making

ACTIVITY	ACTIVITY TYPE	TITLE
AVT-334	RTG	CDT on Augmented Reality (AR) to Enhance Situational Awareness for Armored Fighting Vehicle Crew
AVT-353	RWS	Artificial Intelligence in Cockpits for UAVs
AVT-356	RSY	Physics of Failure for Military Platform Critical Subsystems
AVT-SP-007	SP	Novel Active Fire Modelling and Prediction methods using Manned and Unmanned Aircraft Vehicles
HFM-276	RTG	Human Factors and ISR Concept Development and Evaluation
HFM-281	RTG	Personalized Medicine in Mental Health and Performance
HFM-293	RTG	Digital And Social Media Assessment For Effective on Communication And Cyber Diplomacy
HFM-294	RTG	Big Data In The Military: Integrating Genomics into the Pipeline of Standard-care Testing & Treatment
HFM-305	RTG	Synthetic Biology in Defence: Opportunities and Threats
HFM-311	RTG	Cognitive Neuro-enhancement: Techniques and Technology
HFM-316	RTG	Expert panel for state of the art cardiovascular risk assessment in aircrew and other high-risk occupations.
HFM-317	LTSS	Solutions for Combat Casualty Care
HFM-322	RWS	Meaningful Human Control of AI-based Systems: Key Characteristics, Influencing Factors and Design Considerations
HFM-324	RSY	RSY; Solutions for Combat Casualty Care
HFM-330	RTG	Human Systems Integration for Meaningful Human Control over AI-based systems
IST-141	RTG	Exploratory Visual Analytics
IST-146	RTG	Electromagnetic Environment Situational Awareness for NATO
IST-157	RTG	Human in the Loop Considerations for Artificial Intelligence
IST-159	RTG	Cyber Intelligence and Social Media
IST-163	RTG	Deep Machine Learning for Cyber Defense

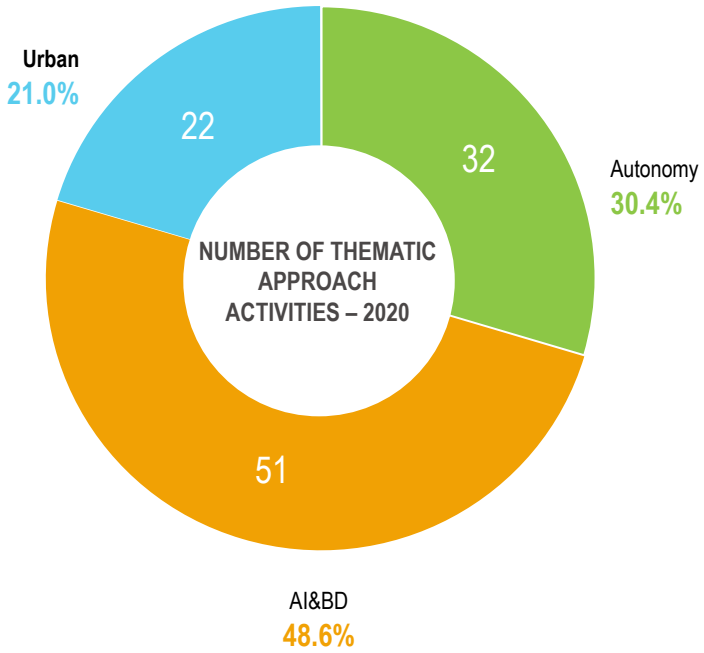
IST-165	RTG	High-level Fusion Of Hard And Soft Information For Intelligence
IST-169	RTG	Robustness and Accountability in Machine Learning Systems
IST-171	RTG	FMN Cloud-based Coalition Security Architecture
IST-172	RTG	Airborne Beyond Line of Sight Communication Network
IST-177	RTG	Social Media Exploitation for Operations in the Information Environment
IST-178	RWS	Big Data Challenges: Situation Awareness and Decision Support
IST-183	RWS	Deep Machine Learning For Cyber Defense
IST-HFM-182	RTG	Synthetic Legal Adviser - AI-based Decision Making in HyperWar
MSG-155	RTG	Data Farming Services (DFS) for Analysis and Simulation-Based Decision Support
SAS-139	RTG	NATO Analytical War Gaming - Innovative Approaches for Data Capture, Analysis and Exploitation
SAS-143	RTG	Agile, Multi-Domain C2 of Socio-Technical Organizations in Complex Endeavors
SAS-150	ST	Advanced Analytics and Artificial Intelligence for Defence Enterprise Resource Planning
SAS-157	RTG	Automation in the Intelligence Cycle
SAS-158	RTG	Employing AI to Federate Sensors in Joint Settings
SAS-159	RTG	How could Technology Development Transform the Future Operational Environment
SAS-160	RTG	Ethical, legal and moral (ELM) impacts of novel technologies on NATO's operational advantage – the "ELM Tree"
SCI-331	ST	Fostering and Managing the STO Autonomy Portfolio
SCI-334	RTG	Evaluation of Swarm System for Military Applications
SCI-339	ST	Allied Future Surveillance & Control (AFSC) High Level Technical Concepts (HLTCs) Technology Readiness Level (TRL) Assessments
SET-245	RTG	Radar Based Non-Cooperative Target Recognition (NCTR) in the Low Airspace and Complex Surface Environments
SET-250	RTG	Multi-Dimensional Radar Imaging
SET-256	RTG	Interoperability & Networking of Disparate Sensors and Platforms for ISR Applications
SET-263	RTG	Swarms Systems for Intelligence Surveillance & Reconnaissance
SET-272	RTG	Automated Scene Understanding for Battlefield Awareness
SET-273	RSM	Multidimensional Radar Imaging and ATR
SET-277	RWS	RWS on Phenomenology and Exploitation of Hyperspectral Sensing within NATO
SET-278	RTG	Machine Learning for Wide Area Surveillance
SET-279	RTG	Space-based SAR and Big Data Technologies to support NATO Operations
SET-283	RTG	Advanced Machine Learning ATR using SAR/ISAR data
SET-286	RTG	Acoustic and Seismic Sensing of Threats in Urban Environments
SET-290	RLS	AI for Military ISR Decision Makers

Table 25: Operations in Contested Urban Environment

ACTIVITY	ACTIVITY TYPE	TITLE
AVT-310	RTG	Hybrid/Electric Aircraft Design and Standards , Research and Technology (HEADSTART)
AVT-314	RTG	Assessment and reduction of installed propeller and rotor noise from unmanned aircraft
AVT-318	RTG	Low noise aero-acoustic design for turbofan powered NATO air vehicles
AVT-337	RWS	Anti-tamper protective systems for NATO operations
AVT-SP-007	SP	Novel Active Fire Modelling and Prediction methods using Manned and Unmanned Aircraft Vehicles
HFM-273	LTSS	LTSS on Chemical, Biological and Radiological Defence
IST-150	RTG	NATO Core services profiling for Hybrid tactical networks
MSG-156	RTG	Dynamic Synthetic Environments for Distributed Simulation
MSG-174	RTG	Urban Combat Advanced Training Technology Live Simulation Standards (UCATT-LSS) - 2
MSG-SET-183	RSM	Drone Detectability: Modelling the Relevant Signature
SAS-149	RTC	Basics of complex modern urban functions and characteristics
SCI-324	RWS	Realization and Evaluation of Robotic Multispectral Decoys for Land Equipment
SCI-333	RTG	Multi-sensor Fusion Architecture for the Detection of Person-borne-Improvised Explosive Devices (PB-IEDs)
SET-246	RTG	Short Wave Infrared Technology: a standardized irradiance measurement and compatibility model to evaluate reflective band systems
SET-250	RTG	Multi-Dimensional Radar Imaging
SET-256	RTG	Interoperability & Networking of Disparate Sensors and Platforms for ISR Applications
SET-260	RTG	Assessment of EO/IR Technologies for Detection of Small UAVs in an Urban Environment
SET-266	RTG	Multi-functional EO/IR sensors for counter-surveillance
SET-272	RTG	Automated Scene Understanding for Battlefield Awareness
SET-274	RLS	Cooperative Navigation in GNSS Degraded and Denied Environments
SET-275	RSY	Cooperative Navigation in GNSS Degraded and Denied Environments
SET-286	RTG	Acoustic and Seismic Sensing of Threats in Urban Environments

Table 26: Thematic Approach Composition

	AVT	HF	IST	MSG	SAS	SCI	SET	TOTAL
Autonomy	4	3	6	1	6	9	3	32
AI&BD	4	11	13	1	7	3	12	51
Urban	5	1	1	3	1	2	9	22
TOTAL	**13**	**15**	**20**	**5**	**14**	**14**	**24**	**105**



2020 ONGOING EXPLORATORY TEAMS

Exploratory Teams (ETs) are approved at the Panel/Group level when a particular expertise is required to assist or advise on the technical merit or feasibility of a specific proposal for a technical activity.

Table 27: Exploratory Teams Continuing in 2020

#	ET INDEX	TITLE
1	AVT-ET-187	Test Protocol Development for New Paint Removal Technologies
2	AVT-ET-198	Advanced Selectable Yield Unitary (SYU) Warheads
3	AVT-ET-201	Certification of Bonded Repair on Composite Aircraft Structures
4	AVT-ET-202	Environmentally Compliant Maintenance, Repair and Overhaul for Military Vehicles
5	AVT-ET-203	Emerging Technologies for Proactive Corrosion Maintenance
6	AVT-ET-204	Data Fusion and Assimilation for Scientific Sensing and Computing
7	AVT-ET-205	Next Generation EO Vehicle Signature Prediction Algorithms
8	AVT-ET-206	Vehicle Vibrations Assessment and Reduction using Innovative Methods
9	AVT-ET-207	Improving the Understanding of Risks from Exposure to Munition Combustion Products
10	AVT-ET-208	More Electric Aircraft and Rotorcraft Gas Turbine Engines
11	HFM-ET-183	Human Impact Exposure On-board High Speed boats
12	HFM-ET-184	Capability Life Cycle Management
13	HFM-AVT-ET-185	Air Vehicle Crew's Neuro-psychophysiological-based Real-time Stress Monitoring for Human Machine Interfaces Workload Evaluation Enforcing Mission Execution
14	HFM-ET-182	Operational Ethics: Preparation and Interventions for the Future Security Environment
15	HFM-ET-175	Minimum Requirement of Education and Training of Surgeons Deployable in Multinational Missions
16	HFM-ET-173	Evidence-Based Aerospace Medicine
17	HFM-ET-166	Evaluation of Treatments of Post-amputation Phantom Limb Pain
18	IST-ET-109	Orchestration and Scalability of AI-driven Systems
19	IST-ET-111	Knowledge Representation and Reasoning
20	IST-ET-112	Machine Learning Ecosystem for the Rapid Research, Development, and Deployment of Artificial Intelligence and Machine Learning Capabilities
21	IST-ET-113	Unsupervised Machine Learning in the Military Domain
22	IST-ET-114	Cyber Security in Virtualized Networks
23	IST-ET-105	Digital Employees for Network Management and Control
24	IST-ET-108	Communication in Contested EW Environment
25	IST-ET-110	Blockchain Technology for Coalition Operations
26	MSG-ET-051	Development of a Standard for a Generic Tactical Data Link Model
27	SAS-ET-EM	21st Century Force Development

#	ET INDEX	TITLE
28	SAS-ET-EN	Assessing the implications of emerging technologies for military logistics
29	SAS-ET-EO	Analysis of Cyber Operations in High Intensity Military Operations
30	SAS-ET-EC	Analytical Methods for Casualty Rate Estimation
31	SAS-ET-EH	Coalition Sustainment Interoperability Study
32	SAS-ET-EL	Energy Security in the Era of Hybrid Warfare
33	SAS-ET-EP	Wargaming Multi-Domain Operations in the European Theatre
34	SCI-ET-049	Establishing a Common Approach to Cyber-physical System Security
35	SCI-ET-050	Future Multi-Sensor Threat Defeat Concepts
36	SCI-ET-052	EOD Tele-manipulation Robot Technology Roadmap Development; Operators Remotely Handling Objects with Dexterity, 3D Perception and Haptic Feedback
37	SCI-ET-054	SMART IED Threat Mitigation Technology Assessments (SMiTMiTA)
38	SET-ET-119	Assessment of EO/IR Compressive Sensing and Computational Imaging Systems
39	SET-ET-120	NATO PNT Open System Architecture & Standards to Ensure PNT in NAVWAR Environments
40	SET-ET-108	Active and Passive 3D EO/IR Sensing for Urban Operations
41	SET-ET-111	Integrating Compressive Sensing and Machine Learning Techniques for Radar Applications
42	SET-ET-112	Simulation of Low Photon Lidar in Complex Environments (SimPL)
43	SET-ET-113	Advanced Infrared Laser Component Technology
44	SET-ET-116	Military Applications of Extreme Laser Fields
45	SET-ET-117	Panoramic Vision Systems For Military Applications
46	SET-ET-118	Modelling, Measuring and Mitigating Optical Turbulence: M3T

Table 28: Exploratory Teams Starting in 2020

#	ET INDEX	TITLE
1	AVT-ET-206	Vehicle Vibrations Assessment and Reduction using Innovative Methods
2	AVT-ET-207	Improving the Understanding of Risks from Exposure to Munition Combustion Products
3	AVT-ET-208	More Electric Aircraft and Rotorcraft Gas Turbine Engines
4	IST-ET-112	Machine Learning Ecosystem for the Rapid Research, Development, and Deployment of Artificial Intelligence and Machine Learning Capabilities
5	IST-ET-113	Unsupervised Machine Learning in the Military Domain
6	IST-ET-114	Cyber Security in Virtualized Networks
7	MSG-ET-051	Development of a standard for a generic Tactical Data Link Model
8	SCI-ET-054	SMART IED Threat Mitigation Technology Assessments (SMiTMiTA)
9	SET-ET-119	Assessment of EO/IR Compressive Sensing and Computational Imaging Systems
10	SET-ET-120	NATO PNT Open System Architecture & Standards to Ensure PNT in NAVWAR Environments

Table 29: New 2020 Lecture series (RLS)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
AVT-358 (VKI)	Advanced computational fluid dynamics methods for hypersonic flows	BEL, 2020; USA, 2021;	Public Release	
HFM-328	Collaborations between Military & Civilian Personnel in Defence Organizations	USA, May 20-22, 2020; BEL, Sep. 14-15, 2020; SWE, Sep. 21-22, 2020;	Public Release	STOEOP, PfP, MD, ICI, GP, Other
SCI-330	Multinational Capability Development Campaign (MCDC) Analysis on Autonomous Unmanned Systems (UAxS)	Hague, NLD, 2Q 2020 Warsaw, POL, 2Q 2020; Bucharest, ROU, 3Q 2020)	Public Release	Australia, Finland, Sweden, Switzerland
SCI-340	HEL Weapon Technology, Opportunities, and Challenges	TBD	NATO Unclassified	STOEOP
SET-274	Cooperative Navigation in GNSS Degraded and Denied Environments	Dayton, USA, Apr. 23–24 2020; Ankara, TUR, Apr. 27–28 2020; Linkoping, Sweden, Apr. 30 – May 1, 2020	Public Release	STOEOP, PfP, Singapore
SET-290	AI for Military ISR Decision Makers	Wachtberg, DEU Rome, ITA Stockholm, SWE, 2020	NATO Unclassified	STOEOP, Switzerland

Table 30: New 2020 Task Groups (RTG)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
AVT-330	Impact of underwater dumped munitions and maritime safety, security and sustainable remediation	Canada, 27 Apr–01 May 2020	NATO Unclassified	STOEOP, PfP
AVT-331	Goal-driven, multi-fidelity approaches for military vehicle system-level design	Canada, 27 Apr–01 May 2020	NATO Unclassified	STOEOP
AVT-333	Integration of Propulsion, Power, and Thermal Subsystem Models into Air Vehicle Conceptual Design	Canada, 27 Apr–01 May 2020	NATO Unclassified	STOEOP
HFM-318	Personnel Retention in the Armed Forces	CSO-Paris, FRA	Public Release	STOEOP, PfP, MD, ICI, GP, Other
HFM-325	Performance Nutrition for Fresh Feeding during Military Training and Operations	CSO-Paris, FRA	Public Release	STOEOP, PfP, MD, ICI, GP, Other
HFM-327	Development of a NATO STANREC for Physiological Status Monitoring to Mitigate Exertional Heat Illness.	CSO-Paris, or because of ICSPP in Feb 2020, Canada.	Public Release	STOEOP, PfP, MD, ICI, GP, Other
HFM-329	A psychological guide for leaders across the deployment cycle.	CSO-Paris, FRA	Public Release	STOEOP, PfP, MD, ICI, GP, Other
HFM-330	Human Systems Integration for Meaningful Human Control over AI-based systems	CSO-Paris, FRA	NATO Unclassified	STOEOP
HFM-331	Biomedical Bases of Mental Fatigue and Military Fatigue Countermeasures	CSO-Paris, FRA	Public Release	STOEOP, PfP, MD, ICI, GP, Other
IST-162	Cyber Monitoring and Detection Capability for Military Systems	CSO-Paris, FRA	Public Release	STOEOP
IST-169	Robustness and Accountability in Machine Learning Systems	CSO-Paris, FRA	NATO Unclassified	STOEOP
IST-180)	Network Management & Cyber Defense (NMCD) for Federated Mission Networking (FMN)	CSO-Paris, FRA	NATO Unclassified	STOEOP
IST-184	Visual Analytics for Complex Systems	CSO-Paris, FRA	Public Release	FIN,SWE
IST-HFM-182	Synthetic Legal Adviser - AI-based Decision Making in HyperWar	NATO HQ	NATO Unclassified	STOEOP, PfP
SAS-156	Developing a Standard Methodology for Assessing Multinational Interoperability	CSO-Paris, FRA, 2 QTR	NATO Secret	STOEOP, NZL
SAS-157	Automation in the Intelligence Cycle	CSO-Paris, FRA, 1 QTR	NATO Restricted	PfP, STOEOP
SAS-158	Employing AI to Federate Sensors in Joint Settings	CSO-Paris, FRA,1 QTR	NATO Secret	STOEOP
SAS-159	How could Technology Development Transform the Future Operational Environment	CSO-Paris, FRA, 1 QTR	NATO Unclassified	STOEOP

SAS-160	Ethical, legal and moral (ELM) impacts of novel technologies on NATO's operational advantage – the "ELM Tree"	CSO-Paris, FRA, 1 QTR	NATO Unclassified	STOEOP, PfP, GP
SAS-161	Military Aspects of Countering Hybrid Warfare: Experiences, Lessons, Best Practices	CSO-Paris, FRA, 1 QTR	NATO Unclassified	STOEOP, PfP, NZL, UKR
SCI-316	High Energy Laser Weapons: Quantifying the Impact of Atmospherics and Reflections	CSO-Paris, FRA, 14-15 Jan 2020	NATO Secret	AUS
SCI-325	Methods of Identifying and Evaluation the Camouflage and Deceptive Properties of the Military Equipment in Land Field Trials	CSO-Paris, FRA, 22-24 Jan 2020	NATO Unclassified	STOEOP, CHE
SCI-332	Radio Frequency-based Electronic Attack to Modern Radar	CSO-Paris, FRA, 1 QTR	NATO Secret	STOEOP
SCI-333	Multi-sensor Fusion Architecture for the Detection of Person-borne-Improvised Explosive Devices (PB-IEDs)	CSO-Paris, FRA, 2 QTR	NATO Confidential	STOEOP
SCI-334	Evaluation of Swarm System for Military Applications	CSO-Paris, FRA, 2 QTR	NATO Unclassified	STOEOP
SCI-336	Cyber-Physical Systems Resilience for NATO Operations	CSO-Paris, FRA, 2 QTR	Public Release	STOEOP, NZL, CHE
SET-283	Advanced Machine Learning ATR using SAR/ISAR data	CSO-Paris, FRA, 27 Jan 2020	NATO Secret	STOEOP
SET-285	Multifunction RF Systems	CSO-Paris, FRA, 5-6 May 2020	NATO Unclassified	STOEOP, CHE, NZL
SET-286	Acoustic and Seismic Sensing of Threats in Urban Environments	CSO-Paris, FRA, 12 Jan 2019 (TBC)	NATO Unclassified	STOEOP, PfP
SET-288	Integrating Compressive Sensing and Machine Learning Techniques for Radar Applications	CSO-Paris, FRA 25-26 Feb 2020	NATO Unclassified	STOEOP, CHE
SET-291	Sensitivity of EO TDAs to Environmental Factors	CSO-Paris, FRA, 2 QTR	NATO Restricted	STOEOP
SET-292	Enhanced Raman Spectroscopy for Defense Applications	CSO-Paris, FRA	NATO Unclassified	STOEOP, CHE
SET-293	RF Sensing for Space Situational Awareness	CSO-Paris, FRA	NATO Secret	STOEOP, CHE
SET-294	Advanced Mid-Infrared Laser Technology	CSO-Paris, FRA	NATO Secret	STOEOP, CHE
SET-295	Radar Signature Measurements of Maritime Platforms	CSO-Paris, FRA	NATO Secret	STOEOP

Table 31: New 2020 Specialists Meetings (RSM)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
IST-181	Terahertz-band Communications and Networking	TBD	NATO Unclassified	STOEOP
IST-185	Communication Networks and Information Dissemination for the Tactical Edge	TBO during a TIDE SPRINT	NATO Unclassified	FIN, SWE
SCI-329	Capabilities for Sensing, Search, and Surveillance in the Arctic	Nuuk, GRL During 45th SCI PBM	NATO Unclassified	STOEOP, NZL
SCI-335	Autonomy from a System Perspective – Version 2.0	CSO-Paris, FRA 4Q 2020	NATO Unclassified	STOEOP,
SCI-SET-323	Above Water EO/IR Signature Requirements from an Operational Perspective	Valcartier, Québec City, CAN, 5-6 May 2020	NATO Secret	STOEOP, NZL
SET-284	Enhanced Situation Awareness using Active-Passive Radar Systems in Military Scenarios	20 April 2020 (45th PBM in Warsaw, POL)	NATO Unclassified	STOEOP, CHE

Table 32: New 2020 Workshops (RWS)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
AVT-353	Artificial Intelligence in Cockpits for UAVs	Turin, Italy, 21-24 September 2020	NATO Unclassified	STOEOP
IST-183	Deep Machine Learning For Cyber Defense	TBD	NATO Unclassified	FIN, SWE
MSG-182	NATO Simulation Interoperability – Certification, Tools and Standards for Federated Simulation	Orlando FL, USA	Public Release	PfP, GP
SCI-324	Realization and Evaluation of Robotic Multispectral Decoys for Land Equipment	CSO, Paris, FRA, 20-21 January 2020	NATO Unclassified	STOEOP, CHE
SCI-337	Combination of Field Measurements and M&S Assessment Methods	4Q 2020 or 1Q 2021	NATO Unclassified	STOEOP, CHE
SET-289	Nanotechnology for Optics & Infrared Photo Detection	CSO, Paris, FRA, Spring 2020	Public Release	STOEOP, CHE, JPN

Table 33: New 2020 Symposiums (RSY)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
AVT-356	Physics of Failure for Military Platform Critical Subsystems	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	STOEOP
MSG-176	MSG/MSCO Support to International Training & Education Conferences ITEC, I/ITSEC and CAX Forum 2020	DEU	Public Release	STOEOP, PfP, GP
MSG-177	NMSG Annual Symposium 2020	GBR	Public Release	STOEOP, PfP, GP, BRA, IND, SGP
MSG-185	MSG/MSCO Support to International Training & Education Conferences IT2EC, I/ITSEC and CA2X2 Forum 2021	USA	Public Release	STOEOP, PfP, GP

Table 34: New 2020 Agardograph (AG)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
SCI-338	Flight Testing of Unmanned Aerial Vehicles	CSO, Paris, FRA, 1 Q 2020	Public Release	STOEOP

Table 35: New 2020 Support Programs (SP)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
AVT-SP-006	Development of Simulation Model for selecting optimum Maintenance Strategy of Combat Vehicles	Munich, DEU, Spring 2020	NATO Unclassified	
AVT-SP-008	Determination of the traffic-ability of military vehicles in typical forests	Brno, CZE	NATO Unclassified	

NEW 2021 ACTIVITIES BY TYPE

Table 36: New 2021 Task Groups (RTG)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
AVT-341	Mobility Assessment Methods and Tools for Autonomous Military Ground Systems	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	STOEOP, South Africa, Chile
AVT-342	Interoperability of Additive Manufacturing in NATO operations	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	STOEOP, NSPA
AVT-343	Novel Materials to Mitigate Rare Earth (RE) Criticality in High Speed Motors	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	STOEOP, JPN
AVT-344	Assessment of Micro Technologies for Air and Space Propulsion	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	STOEOP, CHE
AVT-345	Unified Tactical Missile Kinetic Performance Model	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	PfP, STOEOP
AVT-346	Predicting Hypersonic Boundary-Layer Transition on Complex Geometries	Texas, USA, Spring 2021	NATO Unclassified	STOEOP, JPN
AVT-347	Large-Amplitude Gust Mitigation Strategies for Rigid Wings	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	PfP, STOEOP
AVT-348	Assessment of Experiments and Prediction Methods for Naval Ships Maneuvering in Waves	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	STOEOP
AVT-350	Innovative Control Effectors for Maneuvering of Air Vehicles – Advanced Concepts	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	PfP, STOEOP
AVT-351	Enhanced Computational Performance and Stability & Control Prediction for NATO Military Vehicles	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	PfP, STOEOP
AVT-352	Measurement, Modeling and Prediction of Hypersonic Turbulence	Texas, USA, Spring 2021	NATO Unclassified	STOEOP, JPN

Table 37: New 2021 Workshops (RWS)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
AVT-354	Multi-fidelity methods for military vehicle design	TUR (TBD)Fall 2021	NATO Unclassified	STOEOP
AVT-355	Intelligent Solutions for Improved Mission Readiness of Military UxVs	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	STOEOP
AVT-357	Technologies for future distributed engine control systems (DECS)	Berlin, DEU, May 17 - 21, 2021	NATO Unclassified	STOEOP, UKR

Table 38: New 2021 Symposiums (RSY)

ACTIVITY	TITLE	MEETING DATES AND LOCATIONS	CLASSIFICATION	INVITEES
MSG-184	NMSG Annual Symposium 2021	Amsterdam, NLD	Public Release	STOEOP, PfP, GP, BRA, IND, SGP

CPOW BY THE NUMBERS

Number of Activities per country in 2019 (NATO Nations plus Australia, Finland and Sweden)

NAME	ACTIVITIES
United States	243
Germany	209
United Kingdom	206
Netherlands	179
Canada	163
France	136
Turkey	120
Norway	112
Sweden	105
Italy	101
Belgium	62
Finland	60
Australia	56
Poland	56
Denmark	46
Czech Republic	37
Romania	30
Portugal	28
Spain	27
Estonia	23
Bulgaria	19
Slovenia	16
Croatia	14
Greece	14
Lithuania	13
Latvia	7
Hungary	6
Slovakia	3
Albania	1
Iceland	1
Luxembourg	1
Montenegro	1

Number of Activities in the years 2012 – 2020 (note: additional activities in 2020 will start after being approved during the next Spring Panel Business Meetings Cycle – expected number of new activities to launched after next the Spring PBM Cycle is 30)

YEAR	ACTIVITIES
2012	186
2013	210
2014	222
2015	220
2016	264
2017	250
2018	254
2019	265
2020	269

Number of RTGs (Research Task Groups)

YEAR	TASK GROUPS
2012	147
2013	163
2014	154
2015	160
2016	193
2017	192
2018	198
2019	194
2020	194

Number of publications

YEAR	TECHNICAL REPORTS	MEETING PROCEEDINGS	EDUCATIONAL NOTES	TOTAL NUMBER OF PUBLICATIONS
2012	42	22	6	70
2013	5	20	8	33
2014	40	22	8	70
2015	32	16	8	56
2016	37	23	8	68
2017	20	19	9	48
2018	65	21	3	89
2019	70	17	3	90

ACRONYMS AND ABBREVIATIONS

(C)-IEDs	(Countering) Improvised Explosive Devices
(NG)-NRMM	(Next-Generation) NATO Reference Mobility Model
A2/AD	Anti-Access/Area Denial
ACG3/SG2	Aerospace Capability Group 3 Sub-Group 2
ACO	Allied Command Operations
ACT	Allied Command Transformation
AFSC	Allied Future Surveillance & Control
AGARDograph	Advanced Guidance for Alliance Research and Development
AI & BD	Artificial Intelligence and Big data
AI2S	Architecture and Intelligence Information Systems
AR	Augmented Reality
ATR	Automatic/Assisted Target Recognition
AVT	Applied Vehicle Technology Panel
C2	Command and Control
C3I	Command, Control, Communications and Intelligence
CA2X2	Computer Aided Analysis, Exercise, Experimentation Forum
CAX Forum	Computer Assisted Exercise Forum
CBRN	Chemical, Biological, Radiological and Nuclear
CC&D	Camouflage, Concealment and Deception
CCDO	Camouflage, Concealment, Deception and Obscuration
CDT	Cooperative Demonstration of Technology
CMRE	Centre for Maritime Research and Experimentation
CMs	Counter-Measures
CNAD	Conference of National Armament Directors
COM	Communications & Networks
COMEDS	Committee of Chiefs of Military Medical Services in NATO
CPoW	Collaborative Program of Work
CSO	Collaboration Support Office
D&D	Denial and Deception
DECS	Distributed Engine Control Systems
DEW	Directed Energy Weapons
DEXTER	Detection of Explosives and firearms to counter Terrorism
DFS	Data Farming Services
DMPAR	Deployable Multi-band Passive/Active Radar
EDTs	Emerging and Disruptive Technologies
EDTs	Emerging Disruptive Technologies
ELM	Ethical, Legal and Moral
EO/IR	Electro-Optic and Infrared
EOD	Explosive Ordnance Disposal
EOP	Enhanced Opportunity Partner
EO-TDAs	Electro-Optical Tactical Decision Aids
ES	Electronic Support
ET	Exploratory Team
EW	Electronic Warfare
FATE	Futures Assessed alongside socio-Technical Evolutions
FMN	Federated Mission Networking
FT3	Flight Test Technical Team
GNSS	Global Navigation Satellite Systems
HART	Human-Agent-Robot Teamwork
HEADSTART	Hybrid/Electric Aircraft Design and Standards, Research and Technology
HFM	Human Factors and Medicine Panel
HLTCs	High Level Technical Concepts
HMP	Health, Medicine & Protection
HSB	Human Systems & Behavior
I/ITEC	Interservice/ Industry Training, Simulation and Education Conference
IMS	International Military Staff
IoT	Internet of Things
ISAR	Inverse Synthetic Aperture Radar
ISR	Intelligence, Surveillance and Reconnaissance
IST	Information Systems Technology Panel
ISTAR	Target Acquisition and Reconnaissance
IT2EC	International Training Technology Exhibition & Conference
IWA	Information and Knowledge Management
LoEs	Lines of Effort
LSS	Low Slow and Small
LTSS	Long-Term Scientific Study
LVC-T	Implementation of Live Virtual Constructive – Training
M&S	Modelling and Simulation
M3T	Modelling, Measuring and Mitigating Optical Turbulence
MAS	Military Application Study
MCDC	Multinational Capability Development Campaign
MD	Mediterranean Dialogue
MNE	Multinational Exercise
MSaaS	Modelling and Simulation as a Service

MSE	Multi-Sensors & Electronics
MSG (NMSG)	NATO Modelling and Simulation Group
NAVWAR	Navigation Warfare
NCIA	NATO Communications and Information Agency
NCIA/O	NATO Communications and Information Agency/Organization
NCTR	Non-cooperative target recognition
NIAG	NATO Industrial Advisory Group
NIAG	NATO Industrial Advisory Group (IS)
NMCD	Network Management & Cyber Defense
NMSMP	NATO M&S Master Plan
OSC	Office of the Chief Scientist
OT	Optical Technology
PB-IEDs	Person-borne-Improvised Explosive Devices
PBMs	Panel (Group) Business Meetings
PfP	Partnership for Peace
PNT	Positioning, Navigation and Timing
PPW	Plans and Programmes Workshop
RE	Rare Earth
RF	Radio-Frequency
RFT	Radio-Frequency Technology
RLS	Research Lectures Series
RSM	Research Specialist's Meeting
RSY	Research Symposia
RTC	Research Technical Course
RTG	Research Task Group
RWS	Research Workshop

SAR	Synthetic Aperture Radar
SAS	System Analysis and Studies Panel
SCI	Systems Concepts and Integration Panel
SEAD	Suppression of Enemy Air Defence
SET	Sensors and Electronics Technology
SimPL	Simulation of Low Photon Lidar
SMiTMiTA	SMART IED Threat Mitigation Technology Assessments
SOF	Special Operations Forces
SP	Support Project
ST	Specialist Team
STANAG	NATO Standardization Agreement
STANREC	Standardization Recommendation
STB	Science and Technology Board
STO	Science & Technology Organization
STOG-NG	Simulation for Training and Operation Group – Next Generation
SW defined	software-defined
SYU	Selectable Yield Unitary
TAP	Technical Activity Proposal
TOE	Technologies of Emphasis
ToEs	Targets of Emphasis
TRL	Technology Readiness Level
UAxS	Unmanned Autonomous Systems
UCATT-LSS	Urban Combat Advanced Training Technology Live Simulation Standards
UCAVs	Unmanned Combat Aerial Vehicles (UAV – Unmanned aerial vehicle)
VKHS	Von Karman Horizon Scanning