NATO Science & Technology Strategy

Sustaining Technological Advantage

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The rapidly evolving and globally expanding technological landscape, in combination with the increasingly complex security environment facing NATO and the Nations, necessitates the development of a new science and technology (S&T) Strategy for the Alliance.

This updated Strategy refines the vision and mission of the NATO S&T community and establishes **three overarching goals** to help sustain NATO's traditional technological advantage: (1) accelerate capability development; (2) deliver timely, targeted advice; and (3) build capacity through partnerships.

These goals are to be addressed by the Nations and NATO entities working in concert along **five lines of effort**: (1) stay at the forefront of S&T; (2) forge and nurture effective partnerships; (3) promote prototyping and technology demonstrations; (4) enhance Alliance decision making; and (5) focus on Alliance needs to boost impact.

Enabling these lines of effort are **investments in four areas**: (1) enhance the network of experts; (2) intensify strategic communications; (3) improve the programmes of work; and (4) promote coherence.

Working within this framework, the NATO S&T community can more effectively and efficiently contribute to the Alliance's capability to fulfil its core tasks of collective defence, crisis management and cooperative security.

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1. Introduction

The Alliance is confronted with a security environment that is more diverse, complex, fast moving and demanding than at any time since the end of the Cold War.[1] There is an arc of uncertainty and instability along its periphery and beyond. Further, advanced science and technology (S&T) is being developed and globally employed at a rapidly increasing speed. Since the 2013 publication of NATO's S&T Strategy[2], the Alliance's knowledge and technological advantage has been challenged by major advances in dual-use technology, the commercialization and global proliferation of technology, as well as an increase in the civil sector investments[3] and offshore research and development[4]. Discovering, developing, and utilising advanced knowledge and cutting-edge S&T is fundamental towards maintaining the Alliance's technological edge.

Maintaining these advantages depends upon leveraging advanced knowledge and emerging disruptive technologies, which present both opportunities and threats to the Alliance. In the business domain, disruptive innovations create a new market and value network which eventually disrupts the existing market and value network, thus displacing established market leading firms, products, and alliances.[5] For the military, disruptive technologies transform defence capabilities and methods, shifting the force balance and unhinging opponent capabilities. These emerging and disruptive technologies are heavily driven by commercial investments and interests, and clearly must be leveraged to meet military capability requirements and minimize vulnerability to potential threats.

In this challenging, dynamic environment, this strategy sets the direction for NATO S&T to reap the benefits of global S&T by: accelerating capability development; providing timely and targeted scientific advice to the Nations and NATO leadership; and building a thriving and diverse S&T community. Achieving these goals requires strengthening the NATO S&T network, including increasing participation of non-traditional players from Industry and Academia. It also involves: focusing the NATO S&T programmes of work on critical Alliance capabilities; actively pursuing disruptive and emerging S&T; connecting, converging and consolidating high-impact projects; producing more prototypes; promoting demonstrations; and utilizing the novel and time-relevant S&T results toward National and NATO capabilities and decision-making.

In order to support the Alliance's core tasks and sustain its knowledge and technological advantage, NATO S&T requires a comprehensive approach, building on collaboration and coherence. Thus, this new NATO S&T Strategy is rolled out as strategic guidance to influence the Alliance as a whole, comprising S&T programmes and activities in both Nations and NATO bodies.

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1 MC 0400 2017 *Military Committee Guidance for the Military Implementation of NATO's Strategic Concept*.
2 PO(2013)0020, *NATO Science & Technology Strategy*, January 2013.
3 Organisation for Economic Cooperation Development, Business Enterprise R&D data, 2004-2015.
4 B. Jaruzelski, K. Schwartz, and V. Staack, *The 2015 Global Innovation 1000*, Price-Waterhouse-Cooper.
5 C. M. Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*, Boston, MA: Harvard Business School Press, 1997.

2. Mission

For over 60 years, NATO has been able to achieve its mission objectives by staying at the forefront of technology. NATO must maintain that technological advantage to ensure success in future defence and security operations. The primary mission of NATO S&T is:

> ***to maintain NATO's scientific and technological advantage by generating, sharing and utilizing advanced scientific knowledge, technological developments and innovation to support the Alliance's core tasks.***

Fulfilling this purpose will position NATO at the forefront of infusing S&T in political and military planning, decision-making, and operations.

2.1 The NATO S&T Community

NATO S&T delivers a wide spectrum of research and technology development activities to support the full range of NATO missions across the Alliance's core tasks of collective defence, crisis management and cooperative security. The Alliance and its Partners will continue to benefit from a strong, agile and responsive S&T base by exploiting the scientific knowledge and technology innovation that is generated by Allies, by Partners, and by NATO bodies.

NATO S&T incorporates national capacities, both people and infrastructure, as well as NATO's own research and experimentation capacity, for example at the STO Centre for Maritime Research & Experimentation (CMRE), and the NATO Communications and Information Agency (NCIA) facilities. NATO S&T is a federation of networks leveraging expertise and infrastructure in the Nations and NATO. NATO S&T brings together S&T providers who fulfil requirements with users who define requirements and employ the results. The breadth of S&T activities includes scientific research, technology development, systems engineering, prototyping and demonstration, operational research and analysis, and the synthesis, integration and validation of knowledge through the scientific method. S&T is broadly inclusive of physical, biological, behavioural, planetary, and formal sciences.

The NATO Science & Technology Board (STB) has the responsibility to promote NATO-wide coherence of NATO S&T by: setting objectives through the NATO S&T Strategy; focusing S&T work through the NATO S&T Priorities; and being the focal point for coordination of NATO S&T programmes of work through a multitude of formats.[6] The NATO S&T community is composed of Nations and NATO bodies that contribute to the wide spectrum of NATO S&T activities.

[6] The STB is chartered to directly govern the NATO Science & Technology Organization (STO) and provide unified governance for NATO S&T.

The NATO S&T community is composed of Nations and NATO bodies with specific S&T interests, presented here in four areas:

- Armaments,
- Military,
- NATO Consultation, Command & Control (C3), and
- Security.

NATO S&T related programmes of work are displayed radially.

The S&T related programmes include: STO's Collaborative Programme of Work (CPoW) and the Centre for Maritime Research and Experimentation (CMRE), NATO Industrial Advisory Group (NIAG), ACT's Concept Development & Experimentation (CD&E), Committee of the Chiefs of Military Medical Services (COMEDS); C3 Board Lines of Development (LoDs) for Capability Panels (CaPs) and Capability Teams (CaTs); NATO Communications and Information Agency (NCIA); Defence Against Terrorism (DAT) Programme of Work (PoW) and the Science for Peace and Security (SPS) Programme.

2.2 Value of NATO S&T

Allies, Partner Nations, and NATO bodies each choose to engage in NATO S&T programmes for a variety of reasons ranging from accelerating capability development to economics to capacity building to partnership building. The underlying shared values that drive this collaboration include the following:

NATO S&T enables burden sharing. No single Nation can afford to cover the full spectrum of scientific and technological issues essential to Alliance defence and security. Engagement in NATO S&T leverages the expertise and infrastructure of NATO and the participating Nations to maximize the effectiveness and efficiency of complementary National investments. In essence, strengthening the Nations strengthens the Alliance.

NATO S&T enhances capacity. NATO S&T provides a learning environment for scientists, engineers, and analysts, helping them to grow in both their scientific and technical knowledge and skills and in their understanding of the linkage to military capabilities and operational impacts. This directly contributes to their ability to identify and exploit emerging technologies and phenomena to address National and NATO needs and priorities.

NATO S&T fosters interoperability. Early collaboration in the development, adaptation or adoption of militarily relevant technologies, facilitates common design approaches, architectural considerations, and operational applications. Shared understanding of the relevant technological options enhances the likelihood of selection of synchronized solutions and evolution of common standards.

NATO S&T provides quality assurance. Peer review of ideas, research, and experimentation and demonstration results by international experts in the NATO S&T community ensures quality superiority of NATO S&T products. The quality of NATO S&T products are reviewed to make certain that they are fit for purpose, answering meaningful research questions and drawing accurate conclusions based on professionally executed experiments.

NATO S&T promotes innovation. The NATO S&T culture nurtures cross-discipline collaboration and research in which a rich exchange of ideas and research results inspire innovative approaches, capabilities and technology utilization. Further**,** access to the broad network of NATO scientists and engineers enhances the likelihood that Nations and NATO, are in an advantageous position to exploit commercial innovations rapidly and for mutual benefit.

NATO S&T builds trust. Collaboration in the S&T environment strengthens the relationships within the Alliance and can provide a springboard for broader engagement with Partner Nations. The NATO S&T community serves as a platform for bridge building among the NATO Nations and with Partner Nations, creating conditions for bilateral and multilateral collaboration.

3. Vision

NATO S&T strengthens Nations and NATO for mission success.

NATO S&T is at the forefront of technology development for the Alliance. As emphasised in the Wales Summit of 2014 and reinforced at the Warsaw Summit in 2016, **maintaining a technological edge** demands agile, robust and resilient operational concepts and flexible suites of National and NATO military capabilities that can be tailored to meet mission demands. In addition to the capabilities of the military systems, success will also rely on the readiness of the forces, decision making skills of leaders, and innovative concepts and approaches for their utilisation. Robust training and advanced decision support systems to prepare, sustain and support the relevant knowledge and skills of the operators and leaders are also vital components to **mission success**.

The Alliance is faced with a **growing demand for scientific knowledge, evidence-based advice, and technology innovation**. Now is the time for the Alliance to exploit its **culture of cooperation** to promote the efficient and effective use of available resources. As new National and NATO S&T investments are made, established frameworks for S&T collaboration help to maximize utility, through burden sharing and by ensuring results directly support **National and NATO capability development**. The full breadth of S&T capacity in each Nation, from armed forces, industry and academia, is needed to maximise **S&T impact for the Nations**.

4. Strategic Approach

4.1 Goals

The Alliance must and will continue to fulfil three essential core tasks: collective defence, crisis management, and cooperative security. For NATO S&T, these core tasks drive three strategic goals, which cut across the core tasks and collectively support Alliance objectives. While these strategic goals are interrelated, each deserves distinct attention, as all three are equally relevant to the vision and mission for NATO S&T.

Accelerate Capability Development – NATO S&T supports capability development by bringing scientific knowledge and technological innovation to bear on the definition, development, demonstration, improvement, cost reduction and evaluation of sustainable, connected and interoperable defence and security capabilities. This benefits the Nations and NATO, in line with NATO defence planning priorities, in the short-, medium-, and long-term, by identifying and supporting near-term technology insertion and informing longer-term capability development programmes. Acceleration is achieved through the early identification of relevant technologies and robust demonstrations and experimentation with advanced prototypes to enable rapid transition.

Deliver Timely, Targeted Advice – NATO S&T provides targeted and timely evidence-based knowledge, analysis, and advice, in response to requests or proactively, using and developing appropriate tools such as Operational Research and Analysis, to contribute effectively to political and military planning and decision-making across the full spectrum of Nations' and NATO activities. This includes strategic communications to increase the visibility of technology opportunities and threats and to increase decision makers' awareness of relevant S&T activities.

Build Capacity Through Partnerships – NATO S&T builds capacity and contributes to political consultation and partnership objectives by conducting cooperative S&T activities between the Allied and Partner Nations, from government, industry and academia. Strategic and technological interoperability, and thus capacity are built up over concerted, continuous and cooperative science and technology activities. NATO S&T enhances security dialogue, builds capacity and mitigates threats by cultivating a trusted, thriving, global S&T community, even in situations where direct political dialogue is difficult.

4.2 Lines of Effort

Responding to the challenges driven by the global S&T environment, NATO S&T will be focused and directed along five Lines of Effort to achieve these three strategic goals.

Stay at the Forefront of S&T. In order to identify S&T trends with potential defence and security relevance at the earliest possible stage, the NATO S&T community must maintain broad situational awareness of S&T knowledge, technology and innovative developments in the rapidly changing global S&T landscape. It is essential to continuously and proactively undertake forward-looking activities, such as the STO's Technology Watch and Horizon Scanning, or ACT's Foresight Analysis, to identify topics before they become issues or threats, analyse in context, enable exploitation of emerging opportunities, and to orient future activities and investments.

Forge and Nurture Effective Partnerships. As the S&T landscape is global and increasingly driven by commercial investments, it is critical to forge and nurture effective partnerships with Partner Nations and non-traditional partners from industry and academia, as well as other international organizations such as the European Union and the United Nations, for the purpose of building capacity and broadening collaboration. Further, the NATO S&T community must build and nurture mutually beneficial relationships with academic researchers and industry partners, in Allied Nations as well as Partner Nations, through collaborative research, experimentation, exercises, training and educational activities. The S&T community will increase interaction with partners to identify and assess technological developments as well as innovative solutions. A key interlocutor for industry engagement will be the NATO Industrial Advisory Group, which shares pre-competitive knowledge and provides consolidated industry views.

Promote Prototyping and Technology Demonstrations. NATO S&T will support the acceleration of capability development through more prototyping and technology demonstrations without diminishing the foundational activities in knowledge generation and dissemination. This will require the active support of the Alliance. NATO S&T will promote and reinforce activities that provide direct pathways to utilisation, such as prototyping and technology demonstrations (e.g., Cooperative Demonstrations of Technology in the STO's Collaborative Programme of Work, CMRE prototyping), as well as concept development, and experimentation via exercises and experimentation in Nations and NATO. These efforts inform National and NATO acquisition programmes, providing proven options for technical baselines and technology insertions, informed by warfighter experience with their operational relevance and impact.

Enhance Alliance Decision Making. Knowledge, tools and methods derived from National and NATO S&T investments and programmes must support and inform critical decisions across a spectrum of domains. These range from policy to operations to acquisition and investment decisions. Policy decisions are supported by S&T results such as model-based impact assessments (economic, environmental, social, etc.), performance indicators, and S&T trends. Operations decisions can be informed and enhanced through fact-based analyses and assessments of alternative strategies and potential outcomes, visualizations of complex data and relevant factors, and analytic assessments of operational results. Acquisition and investment decisions in capability development are supported through S&T activities such as characterization of technological alternatives, definition of technical baselines and identification of technology insertion opportunities. Providing the relevant NATO S&T data, analytical methods, and tools to support this wide array of decision makers requires close engagement, regular communication, and a clear understanding of near to far term needs. In addition, at the NATO Headquarters level, the NATO Chief Scientist delivers advice to senior leaders through periodic and focused updates on relevant S&T issues, activities and impacts to the NATO senior leadership to include, the Military Committee, Conference of National Armaments Directors, and the North Atlantic Council.

Focus on Alliance Needs to Boost Impact. NATO S&T activities are largely focused to support capability development. The STB has therefore established a set of S&T priorities and initiatives that are firmly rooted in the Alliance's needs, as expressed in the NATO Defence Planning Process. The NATO S&T Priorities are driven by broad applicability to military capability requirements, as well as opportunities arising from emerging and disruptive advances in science and technology, in order to guide medium to long-term S&T planning. The STB's S&T initiatives focus S&T activities on time-sensitive Alliance needs as expressed through the Defence Planning Priorities, Summits and Ministerial meetings.

NATO S&T Priorities in 10 S&T Areas

4.3 Investment Areas

National and NATO investment in four areas is critical to enable achieving the strategic goals and maintaining the Alliance's technological advantage.

Enhance the Network of Experts. The Nations must cultivate and foster S&T capacity, providing qualified specialists to participate in NATO's S&T network of experts. This involves engaging scientists and engineers with knowledge and skills in emergent S&T areas in order to broaden and deepen the knowledge base in the S&T programmes of work. The experts must be supported through state-of-the-art tools and facilities for effective collaboration. This includes advanced information technology to facilitate multiple-purpose remote interactions, and laboratories and meeting facilities to execute studies, experiments, and demonstrations.

Intensify Strategic Communications. Invest in strategic communications to deliver S&T advice, research products, and situational awareness to the Nations and NATO, informing decision making in the Nations and by NATO senior leadership. Analysis of the S&T customers, their S&T needs and development of interactive and timely communication tools will increase the impact of S&T results. Frequent and targeted publication of recent S&T findings must be delivered promptly to Nations and NATO. The NATO Chief Scientist is entrusted to deliver regular and impromptu, targeted advice and S&T updates to NATO and National leadership.

Improve the Programmes of Work. Enhance interaction between the NATO S&T executing entities. Implement a thematic approach to drive increased programme activity on high priority technologies and operational challenges. Launch additional initiatives to focus S&T work, firmly rooted in defence priorities. Connect, converge and consolidate high-impact projects to enhance overall coherence and increase the efficiency and effectiveness of S&T investments and activities. Nations' and NATO bodies provide clear guidance and resources to support experts' collaborative pursuit of disruptive and emerging S&T, establish quick-turn studies and publish timely results.

Promote Coherence. Enhance the connectivity across the Nations' S&T capacities, and with NATO's own capacity, at all levels. Foster cross-fertilization across Nations' S&T programmes and with NATO's own activities. Promote interdisciplinary research across the traditional scientific domains to minimize duplication and enhance innovation. The coordination of NATO's business processes should ensure that NATO-funded S&T activities are efficiently aligned within NATO S&T.

5. Way Ahead

The implementation of this Strategy requires continuous efforts of the entire NATO S&T community. All members of NATO S&T are invited to embrace the Strategy and reflect it in their S&T plans and execution. The STB will maintain the overall coherence and focus of this Strategy, annually reviewing the progress achieved and issue guidance on further implementation.

The STB will annually invite representatives of the NATO S&T community to present an update of their programme activities, using the goals, lines of effort, and investment areas as a framework for characterizing their efforts, as well as highlighting the linkages of their technical activities to the NATO S&T Priorities. The use of this common framework will aid in promoting coherence and transparency across the NATO S&T community, with the intent of achieving greater efficiency and effectiveness in the delivery of knowledge and technology in support of NATO and the Nations. Following this annual review, the STB will report to Council on progress achieved.

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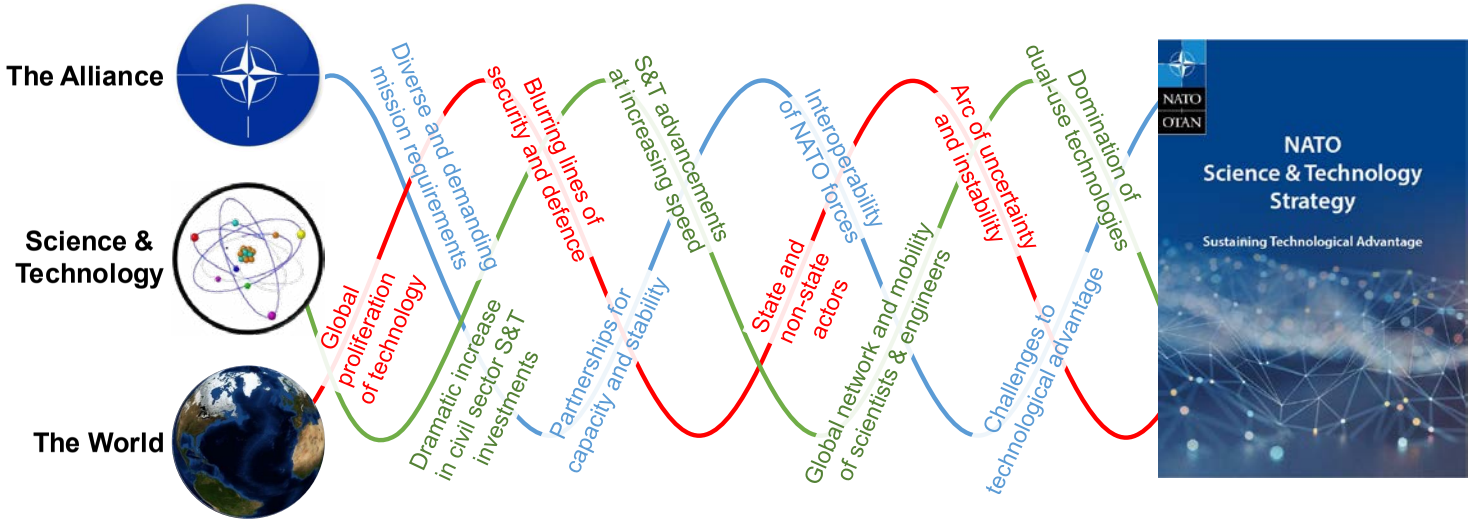
The Alliance
Science & Technology
The World
Diverse and demanding mission requirements
Global proliferation of technology
Dramatic increase in civil sector S&T investments
Blurring lines of security and defence
Partnerships for capacity and stability
S&T advancements at increasing speed
State and non-state actors
Interoperability of NATO forces
Global network and mobility of scientists & engineers
Arc of uncertainty and instability
Challenges to technological advantage
Domination of dual-use technologies
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