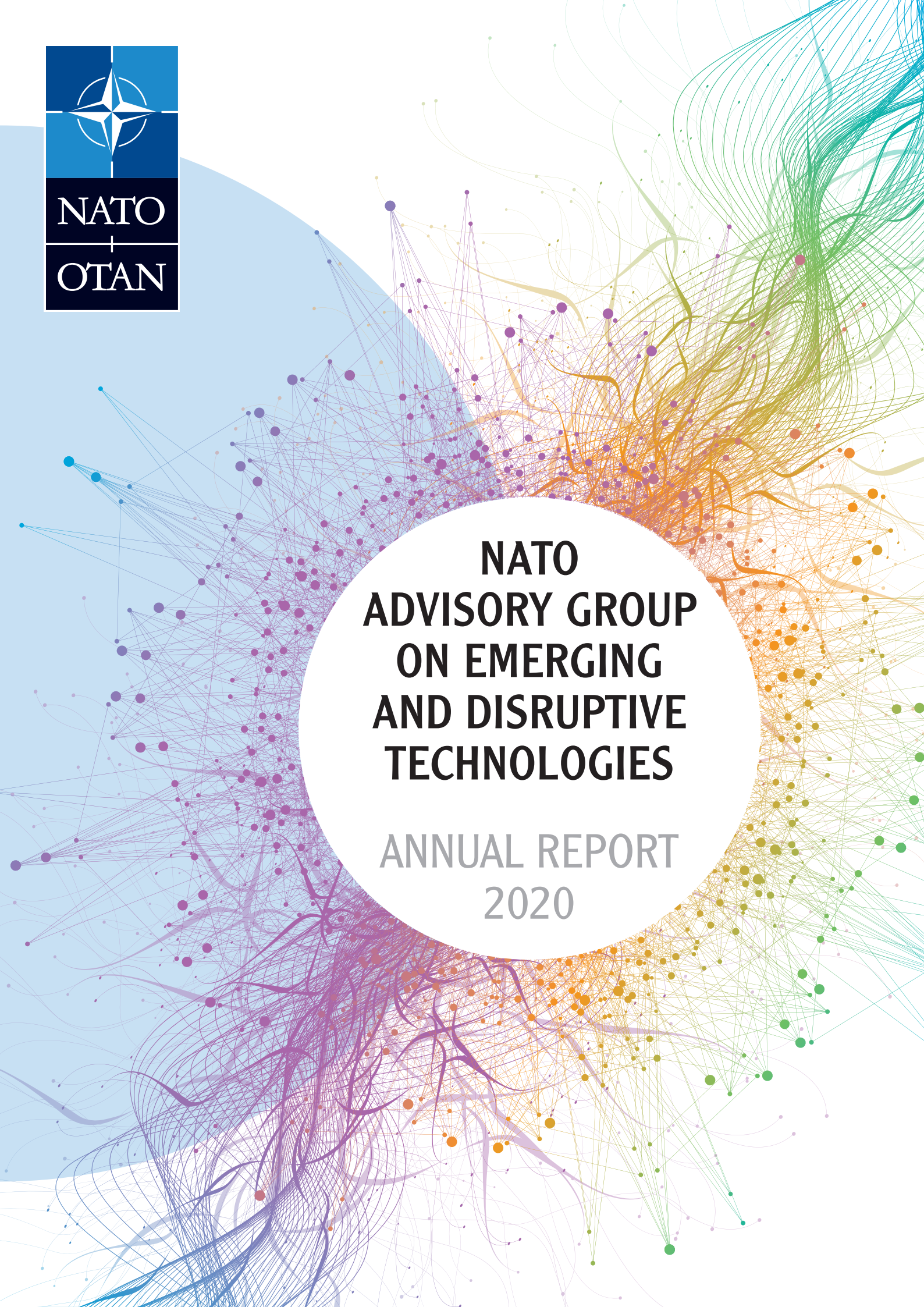


NATO ADVISORY GROUP ON EMERGING AND DISRUPTIVE TECHNOLOGIES

ANNUAL REPORT 2020

Contents

Foreword

The adoption of emerging and disruptive technologies requires NATO to operate at a pace of relevance that matches the dynamic technology landscape that surrounds it and to cooperate with a variety of non-traditional actors to achieve this. The success of such an ambitious process is built upon Allied best practices, innovative thinking and honest and critical discussions on current procedures.

In July 2020, the NATO Secretary General Jens Stoltenberg announced the creation of an Advisory Group on Emerging and Disruptive Technologies (EDTs). Composed of 12 experts from the private sector and academia, the group provides advice to NATO's innovation efforts and challenges existing approaches when it comes to the adoption of new technologies. The twelve experts from across the Alliance have led cutting-edge research, driven policy developments on emerging technologies and have been responsible for the delivery of innovation programmes in their respective domains.

Our principal aim is to provide Allies and NATO with recommendations on how to take action in the adoption of new technologies considering both long-term goals and concrete steps that could be taken in months rather than years. This annual report sets out initial reflections collected over the last months of 2020 and the Group is looking at further developing these in the months ahead. The report opens with a scene-setter on NATO and innovation in an age of EDTs, proceeds with outlining overarching recommendations and then looks at four cross-cutting work strands to make the Alliance more adaptable. We close this report with a biographical presentation of the twelve members of the Advisory Group.

We wish you a pleasant read.

Professor Deeph Chana

Chairperson of the NATO Advisory Group on Emerging and Disruptive Technologies

NATO and innovation in an age of EDTs

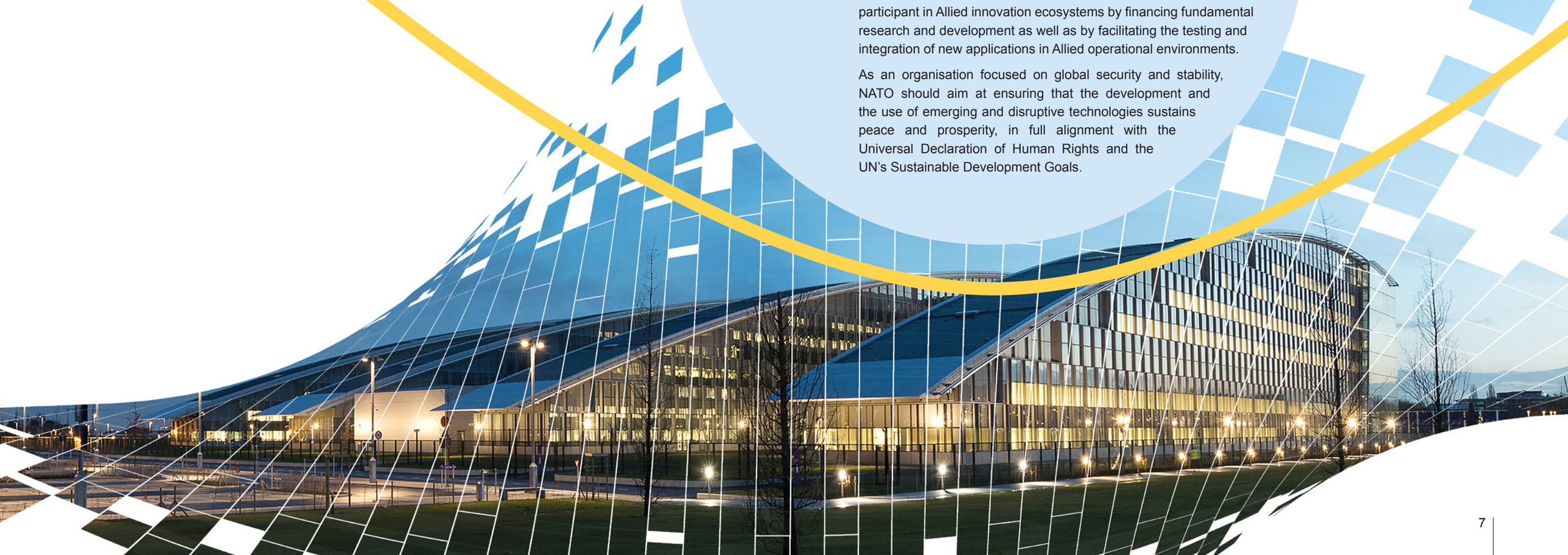
Policy and diplomacy are key to trigger and sustain innovation initiatives and processes.

NATO should act as a convening voice, encouraging collaboration and creating synergies. Where necessary, instruments, mechanisms and facilities to aid the development of public-private co-development and investment should be established.

These should include testing facilities and agreements that enable rapid joint prototyping, spiral development, integration and acquisition.

Building on its founding principles, NATO is exceptionally well placed to be a global driver of a values-based innovation agenda. To this end, NATO will need to take a more active role as an influencer and participant in Allied innovation ecosystems by financing fundamental research and development as well as by facilitating the testing and integration of new applications in Allied operational environments.

As an organisation focused on global security and stability, NATO should aim at ensuring that the development and the use of emerging and disruptive technologies sustains peace and prosperity, in full alignment with the Universal Declaration of Human Rights and the UN's Sustainable Development Goals.



Chapter I

Overarching recommendations

In its first recommendations, the Advisory Group highlighted five key areas of importance to the wider Alliance efforts when considering the development and adoption of Emerging and Disruptive Technologies (EDTs). Importantly, the Group resisted focussing solely on technical considerations, but delivered its outputs by considering the societal contexts within which EDTs exist and how NATO might maintain relevance and pace within this environment:

1. Key science and technology domains

The Group identified the following high-priority interrelated science and technology domains of direct interest to the Alliance.[1]

- **Advances in Machine Learning and Artificial intelligence**: Encompassing the development of the technology itself and advances in its application, this domain concerns the potential impact of innovations such as neuromorphic computing, generative adversarial neural networks and the ability to reveal unexpected insights from data that has been gathered or is yet to be gathered.
- **Harnessing the quantum scale**: There is an ongoing translation of knowledge gained from the study of quantum processes to useable quantum enabled technologies including quantum computing, quantum sensing as well as quantum cryptographic systems and the manipulation/development of material at the quantum scale.
- **Data security**: Algorithms and systems for securing and compromising the security of communications, data transactions and data storage; including quantum proof encryption methods, blockchain and distributed ledger architectures and the field of cyber-security in general.
- **Computing enabled hardware**: Developments in miniaturisation, power harvesting and energy storage. This domain encompasses the physical systems necessary to deliver digitally enabled critical infrastructure on a global scale (Internet of Things) and the widespread use of robotics. The true scale of global disruption that these developments will bring is yet to be fully revealed/understood.
- **Biological and synthetic materials**: Including the design, synthesis and manipulation of materials at the atomic/molecular level to innovations at mesoscopic and macroscopic scales. Enablers include bioengineering, chemical engineering, gene-level manipulation, additive manufacturing and generative design.

1 This is not an exhaustive list and is not ordered in terms of relative importance.

2. The Socio-Technical context

The Group foresees the continued proliferation of cyber-physical systems; where computing systems directly affect change in the physical world and evolve autonomously through sensing and data. Advances in autonomy, the ubiquity of high-speed communications and other advances will rapidly drive human-machine teaming. The rise in communication platforms and the importance of data transactions will simultaneously motivate citizen expectations concerning digital inclusion/isolation and the needs for protecting personal digital assets – including private data and private computing tools.

3. The Battle for Resources

As the global population increases, the struggle for classically defined resources such as water, food, energy and raw materials will continue to grow and heighten. Data as a resource will add a significant new stress dimension to these pre-existing drivers of conflict, creating and reinforcing global asymmetries in opportunity and prosperity. Geographic data pooling has the potential to create data poverty in the world, data gathering without rights and consent has the potential to create optimal conditions for data exploitation and the insights gained from data analysis risk increasing disadvantage when it comes to accessing more conventional resources. These conditions are likely to precipitate digital and physical conflicts over data and data systems in the future – cyber-physical conflict.

Importantly, Science, Technology, Engineering, Mathematics and Business (STEM-B) talent and competence will be the human resource of global value and key strategic importance. Allied and partner countries need to be shaped to develop, attract and retain such talent.

4. The emerging theatre of EDT activity: Space

Space will be the key theatre of the future within which NATO must lead in the development of a technologically proliferated environment that is demonstrably driven by values and ideals. Primarily, the domain of Space should be viewed as an opportunity to deliver on its global good objectives (e.g. UN Sustainable Development Goals, NATO 2030) rather than a platform for perpetuating archaic conflict narratives. The opportunity for global thought leadership in EDTs presents itself and should be taken.

5. Necessary organisational traits

NATO will need to embrace certain organisational traits to capitalise on and cope with the developments and trends outlined above. Importantly, NATO will have to commit financial and human resources to this effort. The Alliance will need to develop its capability to horizon scan effectively, experiment at pace and embrace the idea of controlled failure to achieve greater agility. NATO will need to develop ontologies and taxonomies to structure EDT knowledge across the Alliance. The organisation will need to develop internal competence in innovative technologies and innovation and actively participate in developing triple-helix ecosystems in order to optimally leverage the brightest minds from industry, government and academia. In addition, NATO will urgently need to develop novel means and methods of achieving modularity and interoperability at pace through experimentation, testing, standards development and best practice.

Common international rules and regulations on transfer, use and access to data and technologies will shape alliances and trust in the age of digitization. The active role of NATO in the discussion on international policy will be key for the security and peace amongst Allies.

NATO must establish itself as a recognisable thought leader amongst the technology literate, engaging with civil and defence applications across the public and private domains. leading the mission to use Emerging and Disruptive Technologies to defend the ideals, ethics and norms of free, open, tolerant and transparent societies that seek to protect human dignity and diversity. EDTs bring the risk of significant erosion of these ideals if misused.

In the following section, the Advisory Group provided initial recommendations on how to achieve these organisational traits.

Chapter II

Pathways to make NATO an Emerging and Disruptive Technologies ready organisation

A clear challenge that emerges from the Group's deliberations is the need for NATO to become an organisation that is able to adapt and adopt new technologies at a pace that is appropriate to the rapidly evolving EDT landscape. In order to achieve this aim NATO will have to embrace the organisational traits of agility within a coherent Innovation Programme, which include:

- Widening of the distribution of technology literacy throughout the organisation;
- Establishing an efficient network of Innovation Centres – drawing on NATO's existing innovation capabilities;
- Design, facilitation and participation in novel, flexible financing mechanisms, enabling NATO to embrace not only innovation driven by large companies but, importantly, by agile and disruptive tech SMEs;
- Development of an Allied Innovation Ecosystem – creating innovation partnership initiatives with external EDT stakeholders from industry and academia.

Education and talent development

EDTs, by their very nature, represent a complex space that decision makers, contractors, politicians and users with limited technical insight will struggle to navigate. This presents numerous risks related to the due diligence of technology development and adoption and motivates the need for an organisation-wide level of technical literacy to move NATO towards being a 'technology ready' organisation. The motivation for achieving this increase in organisational competence is clear when the high pace of technology development and adoption within and outside of NATO's membership is considered.

NATO must be able to maximise the opportunities new technologies represent through the competence and skills of its personnel and their understanding of how to use technology effectively within their respective fields. It is important to note that in most cases, the need for a deep level of technical competence is both unrealistic and unnecessary. In the general context a more appropriate aim would be to increase the base levels of awareness and technical literacy within all levels of the organisation. NATO already possesses advanced training centres that may be utilised to design and deliver an appropriate education programme to meet this need.

Broadly, the level of technical literacy among Allied and NATO staff could be raised by the following:

- Development of educational programmes for raising awareness on new technologies among operational, technical or political staff that can be tailored for national use by Allies.
- Organisation of educational events at NATO and in Allied countries (information days, exhibitions, fairs) dedicated to emerging technologies.
- Inclusion of operational scenarios in training activities to provide real-world context for EDT application.
- Dissemination of best practices and curricula for training the trainers across the organisation.
- Establishing challenges or hackathons to actively engage non-specialized NATO or Allied staff on technology-related issues in collaboration with leading private sector technology specialists and technology educational institutions.

In large part the development of EDTs is dominated by STEM-B activities in the private (civilian) and higher education sectors. Furthermore, many of the world's leading organisations within these categories are contained within NATO's membership allowing for the development of external outreach activities such as a programme of "learning expeditions" to relevant industry or academic laboratories to augment professional education.

NATO should also consider the development of opportunities for formal academic qualifications for those outside and within the organisation. A competitive programme of NATO Innovation Scholarships or Fellowships at the MSc and PhD levels connected to partner academic institutions could be readily achieved. This would not only boost talent within the organisation and the broader public-private complex, but also promote NATO as an organisation genuinely committed to STEM.

Innovation networks

Keeping pace with Emerging and Disruptive Technologies necessitates agility and rapid iteration with respect to development and experimentation. These aspects, in-turn, form part of a wider innovation lifecycle that incorporates requirements elicitation, ideation, technology translation and technology transfer – moving research to implementation – involving the active and passive participation of numerous stakeholders. NATO must expend efforts in ensuring that such stakeholder networks are optimised with respect to efficiency and effectiveness in order to augment its aspirations for pace.

In this regard NATO's extant structures such as the NATO Industrial Advisory Group, this Advisory Group, the NATO Science & Technology Organization, the NATO Communications and Information Agency, Allied Command Transformation and the Conference of National Armaments Directors represent a wealth of expertise, talent and capability. Through these structures, the Alliance already has access to comprehensive, state-of-the-art resources in science research, the defence industry and strategic foresight. These resources should be examined within the context of their architectural connection to each other leading to consideration of how effective Innovation Networks might be composed through clustering, for example. Such networks should be well coordinated and have a strong focus on the development of utilisable outputs.

Technology innovation is driven by the private sector, powered by talent and research that emanates from world class STEM-B higher education institutions and academic centres. Generating close working relationships with such entities is fundamental to NATO's engagement with the domain of new technologies. In order to achieve this NATO's needs must be clearly articulated. In this regard NATO should:

- Clearly develop and articulate a set of Innovation Mission Statements accompanied by performance indicators to help networks shape and direct their activities.
- Consider the establishment of a high-level cross-functional Innovation Working Group composed of NATO's civilian and military leadership, external advisors from the private sector and relevant international bodies in order to develop this. This board would serve to prioritize NATO Innovation Missions and concrete projects.
- Set out objectives for harnessing dual-use, multi-use technology developments – capitalising on already existing technology from other domains and driving the development of multi-use outputs.

Best practice in technology development across many Allies often involves a combination of government, academia and the civilian private sector. NATO should proactively engage with these pre-existing Innovation Centres to understand their operation and assess how they might be usefully connected to its Innovation Mission Statements and Networks. At minimum this linkage is likely to greatly augment NATO's ability to conduct and coordinate pro-active horizon scanning as well as to select optimal technology options for solving specific problems.

In order to curate a network of Innovation Centres NATO should:

- Set priorities for affiliated centres based on NATO needs and NATO Innovation Missions.
- Collect, assess and prioritize innovation concepts and outcomes from these existing Centres.

Financing

NATO's strategy on EDTs must include a review of financing and the role that NATO could or should play in this regard. A well-developed and relevant set of financing procedures and initiatives will be necessary to allow NATO to play an active and influential role in any Alliance-wide EDT innovation ecosystem.

A key aspect for consideration is the need for NATO to have the ability to contract and fund at a speed and pace that is matched to the short turnaround times that are essential for small to medium sized enterprises (SMEs). Such entities are increasingly driving EDT innovation, but as profit centres with limited capital of their own engaging with long procurement cycles with onerous or rigid contracting processes is simply not feasible.

Allies should also recognise that funding from defence and security is viewed as carrying ideological reputational risk by many and more should be done to expose the diversity of issues that NATO engages with and to promote a values driven approach to EDTs. In particular, NATO should set out publically available principles of responsible use, when it comes to the operationalization of new technologies for defence and security to build trust and transparency within civilian innovation communities.

NATO should proactively use its significant influence to develop a more vibrant and active private sector investment environment for defence and security innovation by several means including:

- Actively promoting dual and multi-use technologies
- Providing clear market signals pertaining to its EDT interests
- Demonstrating and exposing routes to market/application for innovations of direct and indirect interest – including solutions aimed towards the Universal Declaration of Human Rights and the UN Sustainable Development Goals

The Alliance should view the contribution to reducing uncertainties and barriers to financing for private or public investors across application domains as an important strategic posture. Connecting smart direct investments with the leveraging of private capital and expertise has the potential to create a sustainable Alliance-wide innovation base, incubating creativity to stay at the technology edge.

NATO and Allies must also recognize the critical need for a continuous, longer time-based investment in science across the Alliance as the foundation for looking beyond the currently understood set of EDTs. The EDTs of today have been built on long-term investments in fundamental science and NATO should play a leading role in promoting and mobilizing patient capital investment to secure relevance in technology for the future.

An appropriately designed and orchestrated set of novel financial instruments and processes will contribute greatly to achieving the goal of an agile organisation that is governed by the speed of relevance rather than the speed of approval.

Development of a NATO innovation ecosystem for EDTs

As a means of drawing together the threads covered in this report NATO should consider the establishment of an innovation ecosystem with the aim of better connecting and aligning the EDT innovation activities of industry, government and academia in a triple-helix approach.

The ecosystem should serve to reduce friction in the transference of fundamental scientific research and development to NATO's needs whilst simultaneously aiding the development of NATO's thinking on requirements. The ecosystem should provide the environment within which NATO can exercise, develop and grow its competencies in EDT agility; for example, by embracing and tailoring modern DevSecOps technology development practices.

As an integral component of an ecosystem model the EDT Advisory Group suggests the design of an ambitious EDT agency in the style of the US DARPA programme to create a NATO Advanced Technology Project Agency (NATPA) composed of existing capabilities and centres of excellence. The Agency would be set up as a public executive research and development organisation, tasked with making pivotal investments in breakthrough STEM-B projects for Allied security. In close collaboration with the NATO enterprise and Allied innovation entities, this Agency would coordinate and manage NATO's innovation processes. The Agency would issue calls for proposals to academia, the public and the private sector encouraging the formation of triple-helix consortia activities across the Alliance. The Agency would be responsible for plotting pathways to implementation and adoption, harnessing existing testing and evaluation facilities and processes and developing new ones, where needed. NATO's Military Committee could provide a key source of problem statements to be tackled by the Agency's programme.

NATO should also seek to promote, participate and establish triple-helix centres amongst the Allies and to network these centres to establish a broad, comprehensive, inclusive external EDT structure. Centres within this network should be capable of bidding against published calls and incubating innovative projects and start-up companies. This ecosystem component should act to augment NATO's thought leadership, horizon scanning, talent development and STEM education capabilities and activities.

As a final ecosystem component NATO could consider the establishment of a NATO Investment Bank to fully support broad-scale EDT investment. As the financial hub for EDTs the Bank would fulfil numerous functions including financing innovative projects run by NAPTA using instruments such as subsidies, seed capital, grants or prizes. The Bank would possess its own values-based venture capital fund with a remit to invest in promising solutions, technology companies and start-ups across application domains. As such it would develop a portfolio of ownership spanning products and solutions, equity, and intellectual property and would be able to grant licences for commercialisation. Initial financial contributions to such a Bank would be made by Allies with an aspiration that in time it should be sustained by its investment returns. The Bank's governance would include oversight by the NAC.

In order to avoid duplication, cooperation with EU initiatives and other international organisations, where relevant and possible, should be explored. Connections to the European Innovation Council, the European Defence Fund and other digital investment programmes such as the Digital Europe Programme, for example, would be of benefit.

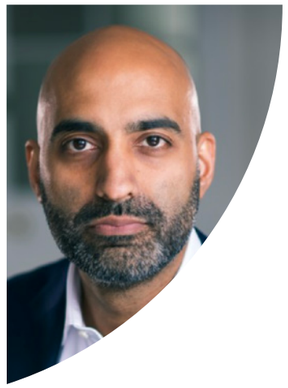
Members of the NATO Advisory Group on Emerging and Disruptive Technologies 2020-2022

Izabela Albrycht is Chair of the leading Polish think tank, The Kosciuszko Institute and the European Cybersecurity Forum – CYBERSEC FORUM's organizing and programme committee. For many years now, she has been involved in the public policy discussion and policy-making processes regarding digital transformation and Cybersecurity, including as a member of the Council for Digitization within the Chancellery of the Prime Minister (the Digital Affairs department) and the Executive Board in DIGITALEUROPE. She is also a member of supervisory boards including of the largest ICT Polish company.

Dr. Galia Angelova is Professor in Computer Science and Doctor of Sciences, Director of the Institute of Information and Communication Technologies, Bulgarian Academy of Sciences. Her major fields of research are: Natural Language Processing, Knowledge Technologies and Artificial Intelligence applications. She has published more than 150 scientific publications in journals, book chapters, and edited Conference volumes. She was the Coordinator or Principal Investigator of more than 25 projects with international or national funding. In 2012-2016 she coordinated the project AComIn "Advanced Computing for Innovation", a 3,2M Euro grant with the European Commission, FP7 Capacity, included by the European Commission in the book "Achievements of FP7: examples that make us proud". She teaches Computational Linguistics to MSc students in Sofia University "St. Kliment Ohridski" and acts as a reviewer and evaluator for the European Commission and other institutions. In 2020 she took part in the development of the Bulgarian AI strategy.

Dr. Bruno Bellier is a graduate of Ecole Polytechnique; he has a PhD in pharmaceutical science, and a master in Public Law & Administration, both from the University of Paris. Currently Head Strategy & Defence Technologies of the recently created French Defence Innovation Agency, he is in charge of coordinating Research&Technology policy and managing upstream R&T defence contracts as well as international cooperation and partnerships with academic institutions supporting defence-oriented research and innovation. His career alternated between expertise and project management activities in his field of specialty (defence against chemical and biological agents), R&T and innovation strategy and policy in a broader scope, and international defence cooperation.

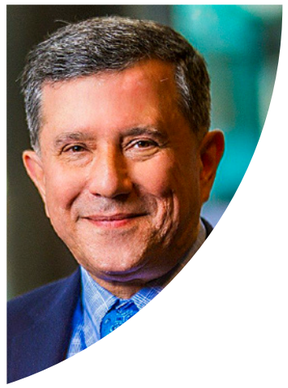
Cecilia Bonefeld-Dahl is Director-General of DIGITALEUROPE, the leading digital technology industry association representing over 36,000 digital companies in Europe. She has for the last two years been lead on the EU Commissions high level group for AI, she is a member of the Stakeholder Cybersecurity Certification Group of ENISA (the European Union Agency for Cybersecurity) and a board member of the European Commission's Digital Skills and Jobs Coalition and the European Parliament-led European Internet Forum and a board member of EIT the European Institute for Innovation and Technology. She was an Executive Board Member of the Royal Danish Export Council and Chair of the Export Grant Committee under the Danish Foreign Ministry. Cecilia Bonefeld-Dahl has more than 25 years of experience in the ICT industry. She previously held international positions at IBM and Oracle as well as with SMEs, building businesses across Europe and China.



Prof. Deeph Chana is Co-Director, Institute for Security Science and Technology & Co- Director, Centre for Financial Technology Imperial College London. Prof Chana has extensive experience of leading science and technology initiatives in academia, industry and government with a focus on global risks. He is interested in low probability high impact events and their ramifications on sustainable security and resilience. He has published on the use of machine learning methods for defensive and offensive cyber security, developed advanced technologies for dealing with safety and security related problems and has consulted and lectured internationally with companies and governments on disruptive technology and the use of science to handle disruptive events. He is actively engaged in a number of technology entrepreneurship activities. Deeph holds MSci and PhD degrees in Physics from King's College London.

Dr. Deborah Frincke is the Associate Laboratory Director for National Security Sciences at the United States Government's Department of Energy Oak Ridge National Laboratory (ORNL). There, she contributes to overall laboratory leadership as well as specifically guiding the research and development of science-based solutions to complex threats that put public safety, national defense, energy infrastructure, and the economy at risk. These include nuclear nonproliferation, cybersecurity threats, geospatial and human dynamics, and both operational and tradecraft missions. Dr. Frincke joined ORNL from the United States Government's National Security Agency (NSA), 2011 to 2020. While at NSA, she served in several roles, to include leadership of the full range of Research in that agency. The role included being dual-hatted as the agency's Science Advisor and first Innovation Champion. She was also a founding member of the NSA Board of Directors. She also launched a cybersecurity company (TriGeo Network Security) and had an academic career through full professor. She has published over 200 articles and technical reports and is a Fellow of the Association for Computing Machines. Her federal awards include the United States Presidential Rank Award, NSA's Distinguished Civilian Service Medal, and the first NSA Research Leadership Excellence in Intelligence Award. She was named a Distinguished Alumnus of the University of California, Davis in 2019.

Dr. Héctor Guerrero is a Defence Senior Researcher of the Spanish Ministry of Defence since 2003. He has lectured on Applied Optics and Physics at public (UCM) and private universities for a decade, where he was an entrepreneur funding a start-up (1991). He joined INTA in 1999 (Instituto Nacional de Técnica Aeroespacial) where he led the Space Optoelectronics Laboratory. He worked in optical communications for ESA (European Space Agency) and optoelectronic, magnetic and radiation sensors for Low-Earth Orbit nanosatellites and small stations for Mars exploration. He was seconded as National Expert to the Space Policy and Research Unit at European Commission (2012-16). Since 2019 he has been at IMDEA Nanociencia, a non-profit Research Foundation funded by the Regional Government of Madrid Region, leading the Office of Strategic Alliances. He is currently involved in activities related to Corporate Intelligence, Strategy Direction and Institutional Partnerships focused on the development of applications based on nanoscience and nanotechnology.



Dr. Kash Khorasani received B.S., M.S., and Ph.D. degrees in Electrical and Computer Engineering from the University of Illinois at Urbana-Champaign in 1981, 1982 and 1985, respectively. From 1985 to 1988 he was an Assistant Professor at the University of Michigan at Dearborn. Since 1988 he has been at Concordia University, Montreal, Canada, where he is currently a Professor and Concordia University Tier I Research Chair in the Department of Electrical and Computer Engineering and Concordia Institute for Aerospace Design and Innovation (CIADI). His main areas of research are in nonlinear and adaptive control, cyber-physical systems and cybersecurity, intelligent and autonomous control of networked unmanned systems, fault diagnosis, isolation and recovery (FDIR), diagnosis, prognosis, and health management (DPHM), satellites, and neural networks/ machine learning. He has authored/co-authored over 450 publications in these areas that have also led to the training of over 125 highly qualified personnel. He has served as an Associate Editor of the IEEE Transactions on Aerospace and Electronic Systems.

Dr. Mark Mattingley-Scott has a Bachelor of Science with Joint Honours in Computing and Electronics, and a Doctor of Philosophy on the subject of Code Division Multiple Access Local Area Networks from the University of Durham, combined with 36 years' experience in the commercial exploitation of technology and research. As a Principal at IBM he is specialised in the identification, nurturing and development of technological innovation, with a primary focus on Big Data Analytics, Neuromorphic Computing and Quantum Computing. In his 31 years at IBM he has developed several new business areas and transferred these into IBM's services and solutions business. Since its inception in 2017, he has been a leading member of IBM's Quantum Ambassador team, responsible for raising awareness of Quantum Computing and developing business opportunities throughout EMEA, and beginning in 2019 he became Quantum Ambassador Leader for EMEA, adding AP to this 2020, and became IBM Quantum Business Leader for DACH in 2020. He currently teaches human & machine learning and quantum computing at the Institute for Cognitive Science at the University of Osnabrück and quantum computing at the Kirchoff Institute at the University of Heidelberg.

Prof. Mart Noorma is the Science and Development Director of Milrem Robotics and Professor of Space and Defense Technology at the University of Tartu, Estonia. He leads strategic research and development at Milrem Robotics, a manufacturer of unmanned ground vehicles for defense and civilian applications. Milrem Robotics works together with armed forces to be better prepared for the changes modern robotics technology will introduce to the military operations. Mart Noorma is a member of the Institute of Electronical and Electronics Engineers' Autonomous Weapon Systems Expert Advisory Committee, Estonian representative to the NATO Science&Technology Organization's Applied Vehicle Panel and team lead for several NATO Industrial Advisory Group and Science&Technology Organization study groups.

Dr. Silvija Seres is a mathematician and a technology investor. She has worked on research in algorithm optimisation at the University of Oxford, development of the search engine Alta Vista in Silicon Valley, product strategy in Fast Search and Transfer in Oslo and Boston, and later operational and strategic management in Microsoft. She is now Chair/Board member in several large companies and she manages an investment fund. She is also keen on popularising new technologies and is the founder of the Norwegian technology podcast LØRN. TECH with more than 2 million listeners.

Dr. Angelo Volpi entered CNR-National Research Council of Italy in 1988 focussing on research on laser diagnostics applied to the combustion of solid rocket propellants. He spent 12 years in Japan as visiting scientist and as Head of the Science Office of the Embassy of Italy in Tokyo. Since 2011 he has been at CNR Liaison Office in Brussels. He has been a Bo Stokes Fellow to the NATO Munitions Safety Information Analysis Center, and member of the Italian national delegations at intergovernmental and G8 meetings. He is the Italian Governmental Expert for the CapTech "Aerial System" of the European Defence Agency.

Emerging Security Challenges Division

NATO Headquarters | Brussels - Belgium

For questions or enquiries,

please contact the Secretariat

of the EDT Advisory Group:

Innovation Unit

Emerging Security Challenges Division

mbx.isesciu@HQ.NATO.INT

0011-21 NATO GRAPHICS & PRINTING