SAFER TOMORROW: NATO'S TECH FUTURE

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On May 23, the Center for the Governance of Change (CGC) at IE University, in partnership with the NATO Public Diplomacy Division, organized an event on the future of NATO in the context of emerging and disruptive technologies (EDTs). The event was part of the Safer Tomorrow: Security starts with YOU(TH) initiative, launched by the CGC on 28 June 2022 to promote security and defense awareness among younger generations. This policy brief highlights the key takeaways from the event and the initiative.

SAFER TOMORROW: NATO'S TECH FUTURE
Policy Brief September 2023

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OPENING REMARKS

Irene Blázquez Navarro

Director – Center for the Governance of Change

On May the 23rd, 2023, the Center for the Governance of Change (CGC) at IE University had the great pleasure and honor to host a very special event about NATO's Tech Future. The event was the culmination of the *Safer Tomorrow: Security Starts with You(th)* initiative that the CGC launched last year on the sidelines of the Madrid NATO Summit.

This initiative aims to promote knowledge generation and cultural awareness regarding the intersection between defense and technology, which is pivotal for NATO and the future of peace. **Without the participation of the younger generations in this debate, any planning and foresight exercises on our security will be rendered futile.**

We are driven by the conviction that technology is altering the balances of power, the conditions of prosperity, peace, and security. **We believe that with the commitment of society and with effective governance, technology can bring about positive change**.

The Madrid Summit played a vital role due to the critical scenario caused by the Russian Federation's aggression against Ukraine, the emergence of diverse systemic threats, as well as for all that an enlarged membership including Sweden and Finland entailed.

It also presented an opportunity to incorporate, for the first time in NATO's strategic roadmap, the recognition of technological acceleration and disruption as factors that are transforming offensive and defensive capabilities. **The new Strategic Concept acknowledges that emerging technologies (such as quantum, biotechnology, and new materials) and disruptive technologies (such as AI and big data) are increasingly critical in global competition.**

With this in mind, we launched the Safer Tomorrow student challenge, in which **we asked students to reflect on these issues and put forward actionable proposals to enhance peace and security conditions.** On May 23rd, we celebrated the global final of the challenge, in which the six finalists pitched their ideas and recommendations for NATO.

The ultimate aim of these ideas and these efforts to generate knowledge in this field is to contribute in some way to NATO's achieving the technological edge that is called for in the Strategic Concept for 2022.

The Vilnius Summit Communiqué issued by NATO Heads of State and Government attending the North Atlantic Council meeting in Vilnius last July is conclusive with the organization's commitment to maintaining its technological edge, including through the integration of innovative technologies. According to the Communiqué, "Emerging and disruptive technologies (EDTs) bring both opportunities and risks. They are altering the character of conflict, acquiring greater strategic importance and becoming key arenas of global competition". **Emphasis is placed on the commitment to principles of responsible use that reflect democratic values and human rights as well as to international law.**

Awareness of the critical role of technology in shaping geopolitics is a trend. The European Commission's Communication on the European Economic Security Strategy, which focuses on geopolitical threats and, in particular, those related to outbound investment in sensitive emerging technologies, should also be interpreted in this sense.

In order for NATO to maintain its technological edge, four aspects are essential: 1) cooperation with the private sector, epitomized by NATO's Defence Innovation Accelerator for the North Atlantic (DIANA), whose first challenge for start-ups focused on energy resilience, sensing and surveillance, and secure information sharing; 2) investment in the innovation ecosystem, fostered by the NATO Innovation Fund, launched at the 2022 Madrid Summit and defined as the world's first multi-sovereign venture capital fund, whose purpose is to invest one billion euros in deep-tech; 3) the digitization of the organization itself, a process of digitization of defense that the European Union has also begun; and 4) a broad security and defense culture that includes a technologically literate community.

It has been an immense honor to partner with NATO and to receive the support of the Spanish Center for National Defense Studies (CESEDEN) on this journey. I would like to extend a special thank you to Dr. Bryan Wells, NATO Chief Scientist, for joining us from Brussels, as well as to Brigadier General Juan Ramón Sabaté Aragonés, Deputy Director Chief of Studies of CESEDEN. **Thank you also to the jury panels that have participated in the competition**: both to IE's fantastic internal jury that selected the finalists and also to the exceptional final jury that selected the winners.

We extend our sincere appreciation to all the students who participated in this challenge, and especially to the finalists from San Francisco, Toronto, Copenhagen, Stockholm, Segovia, and Guam in Micronesia. Your proposals help us pave the way for a safer tomorrow.

FOREWORD

Dr. Bryan Wells

Chief Scientist – NATO Science & Technology Board

Science grows through openness to new ideas and the welcoming of free discussions that refine these thoughts. This embodies the scientific method as it has evolved in the Nations that in turn have become NATO Allies and its Partners. This spirit of openness allows the scientific progress that underpins modern society.

Nothing better encapsulates this spirit of openness than the initiative of the Center for the Governance of Change (CGC) at the IE University in Madrid. Supported by NATO, the CGC harnesses the talents of young students across the globe and brings their fresh ideas to bear on key scientific issues being addressed by NATO: emerging and disruptive technologies, green technologies, and the responsible use of new technologies.

NATO's own scientific organization – the NATO Science and Technology Organization – is actively looking at the areas identified by the CGC as crucial considerations. This demonstrates the relevance of the CGC's initiative for NATO as the organization seeks to engage with young leaders to learn from their insights. **By involving the next generation of academic leaders, NATO can benefit from new thinking as it is emerging.**

In recent decades, the scientific and technological landscape has undergone significant shifts. Private sector investments in science now surpass those made by Governments. Equally, the barriers to entry in various technological domains have decreased, making once-exclusive technologies readily accessible, affordable, and easy to use. Additionally, many technologies are now 'dual-use', serving both civilian and military purposes. Technologies that were designed primarily for the civil market can bring disruptive effects in the defence and security sectors. Furthermore, combinations of new technologies, such as Artificial Intelligence coupled with autonomy and advanced data processing capabilities, underpin numerous developments. **NATO must comprehend and harness these advancements to ensure the safety of its one billion citizens.**

Equally, NATO must use these technologies in ways that are consistent with the norms and values of the Allied and Partner Nations: **our values should drive our technology choices.**

NATO's 2022 Strategic Concept – launched at the NATO Summit in Madrid last year – states that emerging and disruptive technologies bring both opportunities and risks. They are altering the character of conflict, gaining strategic significance, and becoming key arenas of global competition. **Technological primacy increasingly influences success on the battlefield.**

The recently launched report, *Science and Technology Trends 2023-2043* , by the NATO Science and Technology Organization, gives our own thinking into how new technologies are altering the character of conflict. Over time – and we can already see it happening – **future Alliance capabilities will possess four over-arching characteristics: increasing intelligence, interconnectivity, distribution, and digitalization**: intelligent technologies will explore Artificial Intelligence, while interconnected technologies will exploit networks in and across virtual and physical domains. Distributed technologies will employ decentralized and large-scale sensing, computation, and manufacturing; while digital technologies will generate novel disruptive effects from digitally blended human and information domains.

The multi-domain nature of this future requires cross-disciplinary research for understanding and exploitation, an aspect that the CGC initiative has successfully done.

The 2022 NATO Strategic Concept also emphasizes NATO's commitment to enhancing its technological edge. This is the task facing the NATO Science and Technology Organization. With over 300 ongoing research projects valued at approximately EUR 300M annually, this organization represents a significant investment by Allied Nations and Partners. Additionally, with a network of 5,000 researchers globally, it stands as largest international defense scientific collaboration network.

The excellence of these researchers enables NATO to achieve the technological edge called for in the 2022 Strategic Concept. Their research excellence, in turn, relies on the exceptional academic within Allied and Partner Nations, providing both the current thinkers and the future generation of researchers in Government, the private sector, and in academia itself.

NATO scientists collaborate with NATO policy advisers to provide actionable recommendations to political and military leaders. These recommendations ensure that the opportunities of technological developments are harnessed for the Alliance's benefit while remaining consistent with the norms and values of our National leaders. Moreover, these recommendations aim to minimize risks by enhancing NATO's ability to defend against adversarial use of technologies. **The Safer Tomorrow Student Challenge led by the CGC perfectly exemplifies this approach, as it translates original thinking into concrete policy advice for the future of the Alliance.**

As NATO Chief Scientist, it has been a pleasure for me to engage with the CGC initiative. The concept behind it is truly inspirational, bringing together young leaders and current leaders who all share a deep interest in the good of NATO and in its future success.

By fostering openness, embracing new ideas, and collaborating with emerging academic leaders, NATO can continue to adapt and thrive in an ever-evolving scientific and technological landscape. **The future success of the Alliance relies on harnessing the transformative power of science and technology while staying true to its core values and objectives.**

This Policy Brief shows the depth of thinking and innovation generated by the CGC initiative. It combines imaginative new ideas with actionable recommendations for NATO. **Anyone interested in gaining insights into young leaders' views on NATO's development will undoubtedly benefit from this Brief**. I commend the efforts of everyone involved in making this initiative a reality.

THE STUDENT CHALLENGE

On September 26th, 2022, the Center for the Governance of Change (CGC) at IE University launched a Student Challenge **open to any student enrolled in a bachelor, master of PhD program in any university or academic institution worldwide**. The challenge, part of the *Safer Tomorrow: Security Starts with YOU(TH) Initiative*, consisted of a call for papers advancing concrete recommendations (methods, processes and instruments) about how NATO should respond to the security challenges of tomorrow in light of the advent of emerging and disruptive technologies (EDTs).

Students were required to submit a PDF document, responding to a prompt (see p. 12) in English in less than 1000 words by December 18th, 2022. The CGC received an impressive array of proposals from university students worldwide. These submissions underwent an anonymization process before being dispatched to an internal jury within IE University. **The jury evaluated the proposals, basing their assessments on criteria such as innovation, relevance, feasibility, and the potential positive impact on society.** Ultimately, six student finalists were chosen, three per level of education (Bachelor or Master) and two per question.

These finalists were subsequently invited to Madrid for the global final on May 23rd, 2023, where they presented their proposals to an external panel of experts, culminating in the designation of the two ultimate winners. Throughout the event, **finalists, members of the jury and attendees were able to engage in meaningful discussions about NATO's tech future**. Their contributions, outlined in the pages ahead, mirror a shared understanding across generations: even in the face of increasing geopolitical competition, Alliance security and collective defense is to be achieved through the responsible use and governance of EDTs, all while upholding democratic values and prioritizing collaborative efforts between people of all ages, sectors, and nations.

The global final of the student challenge was moderated by **Irene Pujol Chica,** Project Coordinator at the Center for the Governance of Change

MEMBERS OF THE JURY

INTERNAL JURY

EXTERNAL JURY

Cristina Manzano

Former Director
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Former Executive Editor
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On the risks and opportunities of EDTs for the Alliance, and the Safer Tomorrow Initiative

MANZANO: The nature of any defense alliance is to keep up to date with any innovation that may have an impact on security. Keeping track of the threats and opportunities posed by new technologies has always been at the core of NATO, even now, when the speed of change and technological disruption has reached unknown levels and is creating a new environment of uncertainty. This is more so with the emergence of new hybrid threats that involve large parts of the population. **Security and defense are not any longer an exclusive matter for the armies, but an essential aspect of our daily lives as citizens in democratic societies.** In that sense, the Safer Tomorrow competition has shown the high level of awareness and knowledge by students in a large range of disciplines from all over the world. In their proposals, they identify new challenges and propose innovative ideas in areas as diverse as AI, strategic control systems, the monitoring of catastrophic climate events or the access to critical minerals, among others. It will be very interesting to follow up how those ideas evolve in the debate about the role of EDT within NATO.

TESTONI: The weaponization of EDTs is a process that is likely to destabilize the rules of engagement of today's global relations. The intersection of technological innovation, modes of production and warfare has always provoked a stiff confrontation between the world's greatest powers – which has constantly led to increased instability, more trade protectionism and, thus, higher chances of war. This is what happened, in different historical periods, with the introduction of gunpowder, automatic artillery, armored vehicles and battleships, chemical and biological weapons, air power, and nuclear warheads. It is hard to imagine that current circumstances are going to run in a very different way. **The student challenge "Safer Tomorrow" proved to be an excellent opportunity to engage new generations with a sane culture of defense that highlights both the risks and the opportunities of current EDTs** and, at the same time, the importance of keep nurturing the value of an open society and its free and democratic institutions.

RODRIGUEZ: Peace and security are an integral part of the Sustainable Development Goals, but a key question is how to measure it. An eminence in the field once told me that if there was one thing we could measure to determine peace and security, it should be the level of fear. If we were able to compare the level of fear with the level of trust, we would be able to determine if we were moving toward a safer world. If you think about it, **what we are discussing in this initiative is how we can increase levels of trust and decrease levels of fear through the**

management and use of EDTs. Not only how do we do that, but how do we engage civil society, particularly youth, in that process. That was the philosophy behind this competition.

RAUTIO: It is time to assess the risks and opportunities that emerging and disruptive technologies (EDTs) present to NATO. It is well known that AI will permeate our societies, both civilian and military. **NATO needs to develop a vision of what the Alliance's role is in the development, use and regulation of EDTs, how they can contribute to enhancing the security of Allies, and how we can limit the possibilities of its malicious and irresponsible use by adversaries.** The finalists of the Safer Tomorrow project highlighted the challenges and opportunities facing the Alliance, presenting ideas on the potential use of EDTs to enhance situational awareness and defense posture, as well as NATO's approach to new security challenges, including climate change. The necessary governance dilemmas were also well articulated. Today's youth are the decision-makers of the future. The more their vision is taken into account today, the better prepared we will be for the challenges of tomorrow.

MOLTO: Asking young students, the decision-makers of the future, to come up with concrete proposals and recommendations requires a lot of clarity of mind and courage, and the students have shown that they have both. Perhaps no issue is more relevant today than the impact of EDTs on security. **We need new ideas so that this growing attention to technology, security, and defense does not lead us to a less secure international order characterized by a lack of trust among actors. Building trust is something we must all work towards.** All of the final proposals are innovative, relevant, and beneficial to international security, even if not all of them are feasible.

AZNAR: Undoubtedly, new technologies - particularly emergent and disruptive technologies (EDT) - are here to stay; and NATO is aware of this. **We should try to ensure that young people are neither fascinated nor trapped by these EDT, thinking that they are the solution to all problems**. Taking advantage of the best of these technologies, we must prepare young people with the critical tools necessary so that they can discern the ethical, political and legal limits of the use and development of EDT in the immediate future. Once they are clear about the purpose and objectives of these technologies, they must put all their efforts into their best use for the benefit of all human beings, their sustainable prosperity and respect for their fundamental rights. NATO must show that it is a useful instrument for these purposes, endorsing them as the forefront of its security and defense efforts for future generations.

STUDENT CHALLENGE PROMPT

Today, NATO members face numerous threats and security challenges that will only multiply with the advent of emerging and disruptive technologies (EDTs). Some of these were laid out in the Madrid Strategic Concept approved in June of 2022. However, EDTs have also proved to provide value and address critical global challenges. NATO must therefore reflect on how it can face these while establishing itself as a leader and maintaining the Alliance's technological edge.

I.   How can NATO establish itself as the leader in responsible use of EDTs?

NATO considers principles of responsible use at the forefront of its strategy and policy work on EDTs. This is endorsed through its "Foster and Protect: NATO's Coherent Implementation Strategy on emerging and disruptive technologies," an overarching plan to guide the Alliance's relationship to nine priority technology areas, including: AI, data, autonomy, quantum, biotechnology, hypersonic, space, novel materials and manufacturing, and energy and propulsion.

II.   What should NATO's role be in the ongoing global technological race?

Emerging and disruptive technologies are increasingly touching all aspects of life. These technologies are also having a profound impact on security. Today, NATO is in a race to maintain its technological edge. Adversaries and competitors are investing in and developing EDTs, which have the potential to have an outsized impact on society and the potential to change the future course of humanity.

III.   How can NATO promote the adoption of green technologies in its climate and innovation policy agenda?

With the alarming acceleration of global warming and weather extremes across the globe, Allied Heads of State have set in motion a new climate agenda to address how this overarching challenge will measurably increase risks to security and defense. In parallel, NATO is operationalizing an ambitious agenda on EDTs, addressing how innovation poses both opportunities and risks in the way NATO operates.

Considering one of the areas of interest in the NATO agenda above, what is one concrete recommendation you suggest to improve security among Allies? Please provide your vision and details as to how your suggestion could be designed and implemented as well as its challenges and benefits.

FINALISTS

BACHELOR'S CATEGORY

MASTER'S CATEGORY

Quynh Dinh

BA in Law & IR
IE University

Giancarlo Da-Ré

MA in Global Affairs
University of Toronto

Noel Ang

BA in War Studies
King's College London

Gustav Christensson

MA in Political Science
Swedish Defence

Kylar Cade

BA in Law & IR
IE University

Viktor Hald Niessen

MA in International
Politics & Governance
Roskilde University

I. How can NATO establish itself as the leader in responsible use of EDTs?

QUYN DINH

Winner in the Bachelor's category

In order to establish itself as the leader in responsible use of AI, NATO should authorize the creation of an AI Planning Group (AIPG) to govern the use of AI in support of the Alliance's three core tasks: collective defense, crisis management, and cooperative security. By centralizing AI policies, introducing standard agreements, and enforcing responsible use principles, an AIPG's would promote interoperability, expedite technological advancements, and foster trust internationally. Moreover, AIPG's engagement with the private tech sector and academia would not only mitigate potential risks associated with AI deployment but also strengthen NATO's collaboration with cutting-edge AI expertise.

GUSTAV CHRISTENSSON

The influence and importance of EDTs extends to both military and normative concerns, as evidenced by the paradigmatic challenges to our rules-based international order. In this context, NATO should use its normative advantage to steer the issue of EDTs towards global agreements and regulations. By establishing a regional platform and an independent international panel of experts, NATO can enhance oversight and transparency in the development and military use of EDTs, address risks, and promote cooperation. This will strengthen global security and uphold the rules-based order.
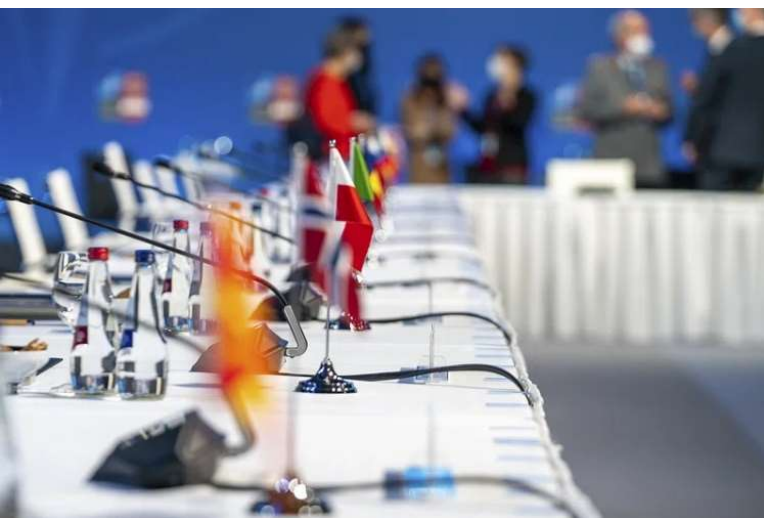
II. What should NATO's role be in the ongoing global technological race?

KYLAR CADE

As part of the ongoing global technological race, NATO must develop a maritime security strategy to address the deep-sea mining (DSM) activities of Allied, Partner, and non-aligned countries. DSM is critical to achieving NATO's 2030 Agenda because it is cross-cutting: it is a source of critical minerals to advance AI, manufacturing, energy, and other emerging and disruptive technologies (EDT). Moreover, China dominates the critical minerals industry and DSM, and there is a need to reduce Western dependence on critical minerals from China or actors that could use their natural endowments or narrow interests to harm Allied interests or affect the global economy. NATO involvement could: (1) enforce international environmental norms related to the extraction of undersea nodules, and (2) ensure that foreign military vessels do not use legitimate business interests to patrol waters where those interests operate. By developing a policy on DSM and addressing such mining in a way that upholds international law, NATO could ensure that the technological race supports free and open societies.

VIKTOR HALD NIELSEN

It is necessary for NATO to take steps to denuclearize the emerging field of hypersonic technology. Without arms control treaties, hypersonic technology may increase the risk of unintended nuclear escalation or unnecessary retaliation. NATO can act responsibly by negotiating arms control treaties and adopting internal policies to reduce this risk. By being vigilant in its use of this emerging technology, NATO can build the architecture necessary to ensure our collective security against the most fundamental threat to society: nuclear annihilation.

III. How can NATO promote the adoption of green technologies in its climate and innovation policy agenda?

NOEL ANG

NATO can advance its climate and innovation agenda through the use of small modular reactors (SMRs) to achieve energy resilience in both the civilian and military sectors, while introducing a host of positive externalities that further benefit each member state. SMRs offer greater energy density, resilience and lower cost than other renewable energy sources at this stage, being a more mature technology. This helps meet the growing energy needs of each NATO member and reduces dependence on imported fossil fuels, the supply and price of which are inherently volatile. It offers important societal and international security benefits as nations become more energy self-sufficient, while providing affordable clean energy that helps stimulate economic growth.

GIANCARLO DA-RÉ

Winner in the Master's Category

NATO should use its procurement power to promote the adoption of unmanned, green technologies for surveillance and early warning systems. These technologies can enhance NATO's ability to gather reliable intelligence and improve response times, particularly in geographically challenging environments. By leveraging these technologies, NATO can enhance stability, address the threats posed by climate change, and fulfill its core tasks of collective defense, crisis management, and cooperative security. The use of sustainable technologies also aligns with the fight against climate change by reducing NATO's own emissions and encouraging supplier sustainability, while benefiting society and international security by improving decision-making and response capabilities during crises.

CLOSING REMARKS

GB JUAN RAMÓN SABATÉ

Head of Studies, CESEDEN

It's truly an honor to be part of the *Safer Tomorrow: Security begins with YOU(TH)* initiative. Witnessing students from around the world coming together to explore the opportunities and challenges posed by new technologies was truly remarkable.

Throughout history, technology has played a pivotal role in shaping the dynamics of warfare. While Western nations have traditionally held a technological advantage in the realm of military capabilities, we are currently experiencing a transformative shift due to the rise of emerging and disruptive technologies.

Recognizing the significance of these advances, NATO has placed them at the forefront of its 2030 Agenda. The objective is to strengthen the Alliance both in terms of defense capabilities and diplomatic influence, taking a comprehensive global approach.

NATO already acknowledged the impact of emerging and disruptive technologies (EDTs) in its Strategic Concept ratified in Madrid last year. To effectively address the challenges posed by these technologies, NATO has taken concrete steps, establishing specific policies and strategies. The Defense Innovation Accelerator for the North Atlantic (DIANA) serves as a platform to encourage innovation and collaboration among member states, industry partners, and academia. Furthermore, NATO has established a fund to support innovative endeavors.

The Alliance places great value on external expertise in navigating the realm of EDTs. The NATO Advisory Group on Emerging and Disruptive Technologies provides valuable insights and publishes annual reports to help inform decision-making. Additionally, forging partnerships with international entities like the European Union and the United Nations is critical to effectively tackling these challenges.

The Center for the Governance of Change is to be commended for spearheading this initiative and for fostering dialogue and creative thinking on the topic of EDTs. By providing a platform for global students to share their perspectives and ideas, the Center has facilitated a comprehensive exploration of critical issues at the intersection of technology and security.

Events such as these act as catalysts for the exchange of knowledge and novel ideas. The concepts and recommendations put forth by participating students have the potential to significantly shape NATO's approach towards these technologies and the future landscape of security.

I extend my heartfelt congratulations to all participants for their valuable contributions and applaud their commitment to building a safer tomorrow. Their views and proposals have the potential to play a pivotal role in NATO's ongoing efforts to navigate the rapidly evolving technological landscape.

In summary, the rapid advancement of emerging and disruptive technologies offers immense benefits to human progress, but it also poses challenges to NATO's technological dominance. **To ensure the Alliance's deterrent and defensive capabilities, it must meet this challenge by effectively integrating EDTs into its defense framework, guided by ethical principles. In addition, NATO must foster a global framework for the governance of EDTs.** This endeavor will require the active involvement of all stakeholders: member states, industry partners, academia, and society.

This is a task to which the younger generation has considerable potential to contribute. Together, we can meet the challenges posed by these technologies and build a secure future that includes us all.

An AI Planning Group, by Quynh Dinh

During the 1950s, insufficient information exchange regarding emerging and disruptive technologies like nuclear weapons prompted the creation of the NATO Nuclear Planning Group [1], which aimed to integrate nuclear power into the organization's military defense strategy. Similarly, just as nuclear power did over 50 years ago, Artificial Intelligence (AI) now stands as one of the most recent advancements in the realm of military technologies, fundamentally altering decision-making processes and enabling autonomous weapon systems. Given the expanding availability of data, AI holds the capacity not only to furnish unmanned surveillance and reconnaissance systems but also to build simulations and proficiently assess potential courses of action.

In order to establish itself as the leader in responsible use of AI, NATO should authorize the creation of an AI Planning Group (AIPG) to govern the use of AI in support of the Alliance's three core tasks: collective defense, crisis management, and cooperative security.

The AI Planning Group would assume responsibility for four pivotal functions, emphasizing technology integration and effective governance for responsible use. Firstly, it would formulate standardization agreements (STANAGs) for each military AI application within NATO [2]. These agreements might foster interoperability and facilitate member nations in sharing a unified set of rules and guidelines, ensuring mutual comprehension and pragmatic functionality concerning AI use.

Secondly, AIPG might consolidate and centralize all existing AI-related NATO policies and strategies, encompassing documents like *NATO's Artificial Intelligence (AI) Strategy* [3] and the *Data and Artificial Intelligence Review Board* [4]. AI policies and strategies, instead of being overseen by various NATO bodies, would be unified under the AI Planning Group's purview.

Thirdly, AIPG might govern the operation of NATO's AI test centers. Beyond AI research, these centers would strive to engage with relevant partners in academia and industry. This engagement is essential as most AI cutting-edge technologies are now in the

How can NATO establish itself as the leader in responsible use of EDTs?

hands of private tech companies rather than defense institutions; NATO cannot integrate AI into military operations without the tech sector's active participation.

Lastly, AIPG would directly enforce NATO's Principles of Responsible Use of AI in Defence. These principles encompass six dimensions: Lawfulness, Responsibility and Accountability, Explainability and Traceability, Reliability, Governability, and Bias Mitigation. Additionally, the AI Planning Group might retain the prerogative to invite third parties such as the UN or relevant international AI standards-setting bodies to inspect its activities. Coupled with adherence to responsible use principles, this inspection serves to communicate NATO's commitment to accountable AI usage for military purposes to the global community.

The AI Planning Group's structure would comprise three levels: the ministerial group, the permanent representative's group, and the staff group. At the apex, the ministerial group could comprise defense ministers from all member states and hold authority over the Group's ultimate decisions. The permanent representative's group might be composed of NATO country's permanent representatives, responsible for assessing the work conducted at the expert level before presenting it to the ministerial level. Lastly, the staff group would represent the expert level, managing the majority of documentation tasks. Proposals and agendas might undergo initial discussion at the staff level before progressing to the permanent representatives and, eventually, the ministerial group.

The establishment of the AI Planning Group would be a major step forward in accelerating the integration of AI into NATO operations. Primarily, instead of dispersing AI agendas across various NATO bodies, the

AIPG would serve as a centralized authority, overseeing all prevailing AI-related policies. Consequently, the advent of the AI Planning Group could avert fragmented leadership in the military utilization of AI. Secondly, AIPG would play a pivotal role in achieving AI interoperability within NATO, driven by its core objective of crafting standardization agreements for each AI military application.

> These agreements form the bedrock for member countries to synchronize AI interoperability, facilitating AI-driven multinational operations. This, in turn, would fulfill NATO's primary task of collectively deterring and, if necessary, defending against armed attacks on any member state.

Thirdly, AIPG might establish a platform for deliberating AI matters and resolve communication challenges stemming from restrictive AI information sharing policies among member states. Lastly, the establishment of the AI Planning Group would fortify NATO's AI leadership, addressing the current fragmented landscape in military AI. This move might inspire defense institutions to follow NATO's lead and establish a similar organ with an adapted mechanism.

In addition, AIPG's impact would extend to shaping a regulatory framework for AI not only within defense contexts but also in the everyday lives of people, serving as a catalyst for the development of a global regulatory framework for AI. Its initiatives in standardizing AI applications, enforcing responsible use principles, and collaborating with external bodies could set a precedent for international AI regulation. This could lead to discussions and collaborations at the global level to create a cohesive and comprehensive framework for AI governance, addressing ethical, legal, and security concerns on a broader scale. As such, AIPG's influence could transcend its

original mandate, fostering positive AI practices that benefit society as a whole.

However, the advancement of the AI Planning Group might encounter specific challenges. The primary hurdle could arise from NATO's consensus decision-making process, where securing unanimous agreement among all member states for the establishment of the AI Planning Group might prove difficult.

Certain NATO members might block this idea by asserting that it introduces additional bureaucracy to the organization; alternatively, they might propose that an existing NATO entity assumes the role. Furthermore, AIPG could confront complexities in devising standardization agreements for the military application of AI. This complexity stems from the versatile, dynamic, and context-sensitive nature of AI applications, in contrast to mechanical

devices which adhere to straightforward protocols and can be standardized to a greater extent.

Much like the emergence of the Nuclear Planning Group in the 1950s, contemporary military AI technology has matured to a point where the establishment of an AIPG is justified. This group would centralize existing AI policies, introduce standardized agreements for military AI usage, and enforce NATO's Principles of Responsible Use of AI in Defence. AIPG would also expedite the operations of AI test centers and alleviate information sharing barriers related to AI agendas among member states. The development of the AI Planning Group could be pivotal in upholding NATO's technological forefront and fostering international trust by conveying the organization's commitment to steering responsible defense innovation endeavors.

Regulating the use and development of EDTs in the security field, by Gustav Christensson

The influence and importance of emerging and disruptive technologies (EDTs) extend to both military and normative concerns, as evidenced by the paradigmatic challenges to our rules-based international order. In this context, this essay will argue that NATO should leverage its normative advantage to direct the issue of EDTs towards global agreements and regulations.

This essay will argue for the need to the topic of EDTs to the br international arena to address the cu lack of global cohesion among cour with the final aim being the implement of comprehensive international agreem To achieve this goal, NATO should wc two fronts. The first front involves t the lead by creating a regional pla

where dialogue with private companies and potential regulations on harmful technologies can be discussed. This approach will increase legitimacy and trust by creating a forum in which relevant actors can discuss and share their insights, concerns, and recommendations. The overarching goal would be to gather insights on how to deal with the issue of EDTs in a way that minimizes their harmful potential while maximizing their dual-use capabilities and maintaining NATO's technological edge.

The second front involves emphasizing the shared global interest in regulating EDTs and proposing the creation of an independent international expert panel, placed under the supervision of United

Nations Office for Disarmament Affairs (UNODA). This proposal draws inspiration from the successful regulation of nuclear weapons through the Nuclear Non-Proliferation Treaty (NPT), the NATO Advisory Group on Emerging and Disruptive Technologies, and the structure of the International Atomic Energy Agency (IAEA) [5].

NPT is used as a successful example of regulation on dangerous technologies by highlighting how regulation is achievable even during tense times, as seen by the Cold War reality present during the NPT negotiations and implementation, as long as there is a shared interest among the involved parties.

However, the specific features of the NPT are not applicable to the matter of EDTs since it is neither desirable nor possible to limit the spreading and development of EDTs to just a few great powers [6].

The responsibility of this expert panel will be to monitor the latest developments of EDTs, examine their dual-use capabilities, and present annual reports. These reports should focus on standardizing the use and development of these technologies, tracking their development and deployment by countries for military purposes, discussing ethical dilemmas with emerging technologies, and exploring the potential need for preventive regulation on certain technologies, similar to the preventive ban on blinding laser weapons [7].

To ensure its depoliticization and a nuanced understanding of the different challenges and dual-use capabilities of EDTs, this expert group should include representatives from the commercial sector, NGOs, civil society, and academia. The panel would promote information exchange between member countries and international experts, address current legal blind spots concerning EDTs, and implement a division responsible for overseeing compliance with

the regulations and tracking the development of EDTs. By placing the panel under the supervision of UNODA and incorporating depoliticization measures, concerns about interference in internal affairs can be addressed.

Three additional measures should be implemented in order to achieve the desired depoliticization. The first measure involves limiting the investigative scope and refraining from interfering in the internal affairs of countries. The second measure involves emphasizing the necessity for cooperation and information exchange considering the destructive potential of these new technologies. The third measure would be to highlight the dual-use capabilities and differentiate between the commercial and military use of technology.

Moreover, the panel would also implement an incentive structure consisting of both positive and negative incentives to encourage international cooperation and responsible use and development of EDTs. This could involve creating depoliticized funds that member countries and their constituents can apply for grants from, while also restricting access to shared platforms and informational expertise for countries that breach agreements

The main challenge with this proposal would be obtaining global support for an independent international expert panel, especially considering the current paradigmatic challenges against the rules-based international order [8]. To address this potential dilemma, the previous suggestions regarding depoliticization are of utmost importance in order to mitigate potential criticism and allegations that it is merely a Western instrument to interfere in the internal affairs of countries.

Moreover, questions may arise as to why NATO should lead this regulation process as opposed to another international body. In this regard, it is important to emphasize that

NATO represents a democratic institution with a normative leadership role, which the organization should actively utilize to influence international cooperation on EDTs. A positive aspect of this proposal is that it enables increased insight and control over the development of EDTs, which, if left uncontrolled, could have severe consequences for the international community as a whole.

The proposal could also be seen as removing domestic agency in favor of supranational decision-making, potentially creating a legitimacy problem. However, the issue of EDTs is too important to be without international transparency and cooperation. Instead, increased international oversight should be considered as a positive and necessary development.

Lastly, there remains a constant dilemma of ensuring that states comply with international agreements (as evidenced by Russia's invasion of Ukraine and reports of the use of chemical weapons in various conflicts) [9]. However, considering the shared interest of the international community, as well as the implementation of an independent division responsible for investigating the development of EDTs and state compliance with international regulations, this issue can be mitigated.

NATO's goal of being a responsible leader in the use and development of EDTs necessitates moving the topic into a broader international arena [10]. Furthermore, this proposal would still enable the alliance to maintain its technological edge by creating international standardization regarding the use and development of EDTs.

NATO represents a democratic institution and should take pride in representing the broader international community. This proposal would achieve this goal by creating a platform where ordinary citizens and NGOs can have their voices heard. The impact on society would be positive and create increased stability in an otherwise unstable contemporary climate.

Moreover, the implementation of this proposal would strengthen the rules-based international order by creating regulations and potential bans on certain EDTs, such as Lethal Autonomous Weapon Systems (LAWS) [11]. This proposal emphasizes the importance of transparency, regulation, and international cooperation to avoid a dangerous arms race with potentially severe consequences.

This text has highlighted how NATO can utilize its normative leadership role to steer the international community toward a strengthened rules-based order regarding EDTs. EDTs present us with possibilities but also challenges that we need to address to avoid a dangerous arms race. In this context, international cooperation and regulation are needed. This paper has shown how a regional platform and an independent and depoliticized expert panel could be implemented to mitigate and control this development

How can NATO establish itself as the leader in responsible use of EDTs?

A maritime security strategy to address deep sea mining (DSM) activities, by Kylar Cade

As part of the ongoing global technological race, NATO must develop a Pacific Ocean Maritime Security Strategy (POMSS). One of its objectives would be to protect the Exclusive Economic Zones (EEZs) of allied, partner, and non-aligned countries from encroachments related to resource exploitation, such as deep-sea mining (DSM).

POMSS would be crucial for achieving the NATO 2030 agenda because it would encompass multiple aspects of the 2022 Strategic Concept and have cross-cutting implications. The strategy would strengthen allied security within member state EEZs in the Pacific Ocean, which Russia and the People's Republic of China (PRC) border. Furthermore, it would provide tangible recognition by NATO of the Indo-Pacific region's significance to North Atlantic stability. Moreover, it would create opportunities to cultivate relationships with and provide requested support to Pacific Island countries, considering both the Chinese presence in the region and the climate and environmental concerns of Pacific islanders. Lastly, the strategy would serve as a demonstration of NATO's commitment to upholding an international rules-based order.

"Deep-sea mining (DSM) refers to the extraction of minerals from the deep sea, which encompasses the ocean area below 200 meters in depth" [12]. DSM can be conducted both within the bounds of an EEZ and beyond, as designated by international law.

> DSM represents a largely untapped source of critical minerals with the potential to advance emerging and disruptive technologies (EDTs) such as AI, manufacturing, and energy.

Additionally, the PRC holds dominance in the critical minerals industry and a strong interest in DSM, as evidenced by recent participation at the International Seabed Authority (ISA) [13], which oversees resource exploration and exploitation in the Area. NATO must acknowledge the Chinese precedent of overexploitation in the Pacific, which could extend to ocean mining activities given the significant size of the PRC marine merchant fleet and the potential repurposing of even a few vessels. Nevertheless, DSM remains a topic of controversy, with NATO allies and partners

holding diverse positions and policies regarding the practice [14].

Given the divergent DSM policies within the alliance, the POMSS would not, at this point, defend allies' specific DSM practices, if any exist. Instead, it would establish an additional Standing NATO Maritime Group (SNMG3) tasked with preventing encroachments into Pacific Ocean waters by foreign vessels engaged in DSM and accompanying foreign warships. Notably, mineral deposits have been confirmed or are suspected to exist within the EEZs of countries and territories that the US and France are legally obligated to protect, as well as other Pacific Island nations [15].

Policy discussions regarding DSM, as part of a broader effort to outline the POMSS, would also provide an avenue to formulate a unified NATO stance on appropriate military actions in the Area. This could draw from President Clinton's observation: "Only mining activities are subject to regulation by the International Seabed Authority […]. Other activities on the deep seabed, including military activities, telecommunications, and marine scientific research, may be conducted freely in accordance with principles of the Convention pertaining to the high seas…" [16].

NATO's recognition of the growing importance of the Indo-Pacific region is evidenced by engagements with nations such as Australia, the Republic of Korea, New Zealand, and Japan. The 2022 Strategic Concept establishes a connection between North Atlantic security and the Indo-Pacific region.

> SNMG3 would enhance interoperability and, in alignment with the third priority of the NATO 2030 initiative, contribute to strengthening the capabilities of the forces of Pacific partners, particularly in the context of DSM-related patrols.

For non-aligned Pacific Island states, POMSS would furnish a means to stay informed about any unlawful Chinese endeavors to exploit their resources through the establishment of information sharing mechanisms. Additionally, the presence of SNMG3 would enable allies and partners to participate in counter-trafficking and disaster relief efforts, the latter of which may rise in prominence within the next decades, thereby solidifying relationships with Pacific islanders for mutual gain.

Considering that the ISA has yet to authorize commercial DSM operations due to member concerns over their environmental impact, POMSS would reinforce NATO's influence on the rules-based order by monitoring and potentially deterring such activities. The organization has previously emphasized: "'Based on a broad definition of security that recognizes the importance of political, economic, social, and environmental factors, NATO is addressing security challenges emanating from the environment. This includes…depletion of natural resources, pollution and so on…" [17].

Potential adverse effects stemming from NATO POMSS development and DSM-related security missions encompass an escalation in the militarization of deep-sea activities and an increased presence of Chinese and Russian military vessels in the Pacific region. As a result, the strategy would serve to provide clear messaging to all states about NATO's intentions.

NATO possesses an opportunity to cultivate an area of constructive competition with the PRC that adheres to international law. In parallel, this strategy would deepen alliance readiness in the Pacific Ocean, foster partnerships, and amplify the effectiveness of relationships with Pacific Island states. In doing so, NATO could ensure that the technological race advances democracy, human rights, and free and open societies.

Denuclearization of Hypersonic Technology, by Vicktor Hald Nelson

What should NATO's role be in the ongoing global technological race?

This paper tries to answer how NATO can act as a leader in the EDT area of hypersonic technology, specifically as it relates to nuclear de-escalation. The recent advent of hypersonic technology has led to the development of hypersonic delivery systems, by Russia [18] and China [19]. These missiles and glide vehicles could potentially deliver a nuclear warhead with greater speed and maneuverability than ballistic and cruise missiles [20]. This development in nuclear weapons increases the risk of nuclear war to a degree similar to the Cold War, and NATO must respond by denuclearizing this emerging technology.

This proposal should be seen in the context of the increased nuclear tension between NATO and Russia seen in 2022 [21], and the potential future conflict with China in the Strait of Taiwan and the South China Sea [22]. Potential military conflict between nuclear powers always increases the risk of nuclear warfare. The tension speaks to the importance of nuclear de-escalation, like the tensions of the Cold War that were eased by successful negotiations.

The proposal is split into two separate recommendations. The first recommendation is the most ambitious while the second is more feasible. First, it is proposed that NATO takes steps to negotiate an arms control treaty with the other nuclear powers. This treaty would ban the application of nuclear warheads on hypersonic missile systems. All participants should guarantee that their hypersonic missile development will be incompatible with their nuclear warheads and that hypersonic missiles will play no part in their deterrence doctrine.

This arms control treaty is inspired by the long history of international regulation of CBRN weapons, and the history of successful nuclear arms reduction negotiations in which NATO members have participated [23]. It can be argued that NATO must be unceasing in its commitment to limit the nuclear applications of emerging technologies.

The second recommendation is that NATO adopts an internal policy, that nuclear weapons will not be applied to hypersonic technology and hypersonic missiles will never be part of its nuclear deterrence. This not only demonstrates how NATO is a responsible actor in global security, but also lessens the risk of nuclear escalation in response to the alliance's development, testing and deployment of the emerging conventional hypersonic weapons. Even if the remaining nuclear powers do not follow the same standards, this will send a strong signal of goodwill by NATO, while not compromising the alliance's security as laid out in the 2022 Strategic Concept [24].

This step will not affect the traditional nuclear deterrence of NATO member states [25]. The nuclear capabilities of NATO are already enough to deter a nuclear attack, especially when considering the second-strike capabilities of SSBNs that cannot be degraded by a first strike by an adversary [26]. NATO's deterrence will therefore be unaffected by both an internal policy of denuclearization and a broader arms control treaty.

> The risk associated with hypersonic missiles is a question of 'nuclear ambiguity;' if an enemy detects a hypersonic missile, it is unclear if it carries a nuclear or conventional warhead [27]. This means that a conventional strike may be misinterpreted as a nuclear attack, therefore risking an unintended nuclear response.

This threat is made even more severe by the speed of these systems which limits the time for decision-making regarding a response, and the maneuverability that may circumvent countermeasures. These factors create a dangerous combination, where an already stressful decision to launch nuclear retaliation is based on unclear information regarding the nature of an attack, taken under time strain, with no defensive alternative option. If nuclear hypersonic missiles can be banned globally, this nuclear ambiguity can be lessened, and more certainty introduced to the decision-making process [28].

The most significant challenge of this recommendation is the feasibility of making other nuclear powers agree to denuclearize their hypersonic technology, as they may see this as weakening their deterrence and technological advantage. However, previous examples show that the Soviet Union and Russia were willing to agree to the mutual de-escalating of nuclear arsenals, the 1972 ABM [29], 2002 SORT [30] and 2010 New Start [31] being examples. This paper therefore proposes that modern nuclear arms control treaties should be modelled on the mechanisms and negotiations of those past treaties.

It can be argued that the other nuclear states will look favorably to the potential tactical advantage of removing nuclear ambiguity if they deploy conventional hypersonic technology in a conflict. The responsible action for NATO is to at least attempt an arms control treaty, even if convincing China and Russia may prove impossible.

A ban on nuclear hypersonic missiles will have great benefits for society, as it would decrease the risk of unintended nuclear escalation. There is no more devastating threat to society or humankind than nuclear annihilation, and consequently decreasing this risk is paramount [32]. Throwing the world into a new nuclear arms race by deploying nuclear hypersonic missiles will lead to heightened tension and push society closer to the ultimate human mistake, the destruction of our species. There may be a psychological effect in society by successful nuclear arms control treaties, as the fear of nuclear war may lessen through cooperation with adversaries in this field.

> NATO policies that lower the societal fear of nuclear war will increase the public's trust in the alliance and demonstrate its continued relevance for global security and peace moving forward.

In conclusion, it is necessary for NATO to fight against the proliferation of nuclear weapons to emerging technologies, as it increases the risk of nuclear war. In the past, arms control treaties have worked, and they continue to be necessary as EDTs become available to alliance members, adversaries, and peers. The alliance must reaffirm its commitment to nuclear de-escalation by proposing a treaty banning nuclear hypersonic missiles and thereby, leading the world a step further away from Armageddon.

What should NATO's role be in the ongoing global technological race?

Small Modular Reactors (SMR), by Noel Ang

NATO can foster the adoption of green technologies as a strategy for enhancing energy resilience. This entails strengthening a nation's self-sufficiency and safeguarding it against energy supply disruptions and sudden market price shocks, which reverberate across the spectrum of human security. Recent occurrences, like the Texas Grid failure in February 2021 [33] and the Californian Wildfires' strain on the power grid [34], have underscored the perils linked to extreme weather events. Furthermore, the Natural Gas Crisis in Europe in 2022 has emphasized the hazards of excessive reliance on foreign energy sources.

To address these challenges, this proposal suggests that NATO promotes the integration of Small Modular Reactors (SMRs) for both military and civilian applications. SMRs offer a way to diversify power generation, mitigating the vulnerability associated with a single point of failure and creating a more robust energy grid. They also serve as a valuable interim solution during the transition to net-zero emissions, providing higher power density and reliability compared to pure renewables [35]. Additionally, SMRs boast lower initial and overall costs, even when considering the levelized cost of electricity (LCOE) [36], rendering them economically feasible options for less populated or developing regions where establishing a large-scale nuclear plant might be impracticable. Their modular nature also allows for scalability to match shifts in population or energy demand, assisting member states such as Germany in reducing dependence on external natural gas supplies.

> By being early adopters of SMR technology, NATO can establish itself as a technological leader and exert considerable influence over the trajectory of SMRs.

The proposal encompasses three primary areas where NATO could expedite SMR adoption. Firstly, the establishment of a collaborative nuclear consortium among member states, leveraging the nuclear engineering expertise of the US, UK, and France—countries actively pursuing SMRs—would promote economic activity, job creation [37], enhanced cooperation, and reduced development and deployment costs.

Secondly, a Public Relations Campaign led by each member state's government would educate citizens about the role of nuclear energy in tackling climate change, dispelling misinformation, and alleviating concerns about nuclear energy. This campaign could extend to NATO military bases transitioning to SMRs, serving as exemplars for safety and reliability.

Lastly, NATO could offer economic incentives such as construction subsidies or development loans to accelerate SMR adoption, particularly in rural or underdeveloped areas. This approach would shield these regions from abrupt energy price fluctuations in the volatile market, promoting economic growth [38], and consequently improving human security and equality.

While the proposal presents several advantages and disadvantages, the standout benefit of SMRs lies in their potential to bridge the gap towards achieving the objectives of the 2015 Paris Climate Agreement and 2050 Net Zero. Their energy density and reliability provide a valuable transitional solution as advancements in energy storage technology are awaited. It also enables countries to become more self-sufficient when meeting their own energy needs, protecting them from security risks such as energy blackmail seen in Russia's Natural Gas threats or OPEC+ Oil Production Cuts. A decentralized power grid built around multiple SMRs, as opposed to a single large plant, bolsters resilience by minimizing single points of failure and averting large-scale blackouts [39]. Moreover, affordable energy fuels economic development, generating positive spillover effects like increased tax revenue, infrastructure improvements, and foreign investment, all of which enhance human security. These benefits extend beyond individual member states to NATO as a whole, rendering it better equipped to provide resources during crises.

However, nothing comes without a cost, and the main drawback is nuclear waste; an increase in the use of nuclear energy will inevitably result in a greater amount of nuclear fuel waste, especially without the economies of scale that larger plants benefit from [40][41]. NATO will also have to shoulder the initial economic burden of promoting SMRs through educational campaigns and economic incentives.

In addition to the direct impact on air quality and the climate, citizens will be protected from economic shocks to the energy sector, will have reliable access to affordable clean energy, which will stimulate economic growth, and jobs will be created to meet the demand of the expanded nuclear sector [42]. All of this translates directly into happier and more productive citizens, leading to greater political and economic stability, which in turn enhances human security. This cycle of self-improvement will strengthen each NATO member state, making it a more valuable ally in NATO.

In conclusion, SMRs emerge as the most promising avenue for NATO's support in fulfilling global climate objectives and countering the imminent threat of Climate Change.

> Beyond their climate implications, SMRs yield additional advantages including economic growth, energy resilience, and human security, ultimately enhancing the security of NATO member states.

While there are challenges associated with this proposition, they are outweighed by the urgency of Climate Change, necessitating immediate action rather than waiting for a hypothetical technological breakthrough. Today's challenges must be shouldered to secure the future for generations to come, as Voltaire wisely noted: "Don't let perfect be the enemy of the good."

Procuring Unmanned Green Technologies for Interoperable Surveillance and Early Warning Systems, by Giancarlo Da-Ré

NATO faces mounting complex threats exacerbated by climate change. Severe environmental events can escalate instability and inflame conflicts, jeopardizing NATO's core responsibilities of collective defense, crisis management, and collaborative security. NATO stands in a unique position to bolster stability by utilizing early warning systems to assess climate-related risks and resilience intelligence. The proposal suggests NATO harness its procurement influence to promote the adoption of unmanned, eco-friendly technologies for surveillance and early warning systems, enhancing response times and extending NATO's presence in challenging geographical settings.

Reliable and timely intelligence stands as a vital facet of NATO's decision-making and consultation procedures. While early warning systems prove valuable during crises, they also yield benefits in terms of conflict prevention and risk evaluation. This involves continuous analyses of climate change's effects on NATO's strategic landscape and assets, alongside incorporating climate considerations into security risk and resilience assessments for regions of interest. Intelligence reports carry particular weight considering NATO's limited human resources. While establishing a presence in relevant areas remains important, the assumption of an endless supply of human resources for this purpose isn't realistic. NATO's resource allocation will be further strained due to the role of climate change as a threat multiplier.

Unmanned technologies present a pathway for gathering intelligence to inform well-considered and prompt decisions.

> Deploying unmanned technologies enables monitoring of situations or environmental conditions through data collection, which, when coupled with AI algorithms, can identify risks that might evade human detection. These risks can then be directly integrated into surveillance and early warning intelligence reports.

As NATO continues to enhance interoperability among internal and allied systems, intelligence gathering becomes exceedingly efficient. An example involves data collection in the Arctic using interoperable systems accessible to NATO and allies like NORAD. NATO's present use of autonomous systems to examine climate change effects in the Arctic already establishes a clear link between NATO's Autonomy Implementation Plan and its Climate Change and Security Action Plan (CCSAP) [44][45]. This connection is expected to strengthen further, particularly in light of Northrop Grumman's recent 5-year contract to supply NATO with a fleet of UAVs [46]. Northrop Grumman has publicly shared their progress in developing more energy-efficient UAVs, aligning with an industrial shift towards sustainability [47].

The proposal aims to leverage the connection between NATO's Autonomy Implementation Plan and CCSAP to accelerate the adoption of eco-friendly technologies. Collaborating with the NATO Science & Technology Organization and private industry partners like Northrop

Grumman, NATO's Support and Procurement Agency can continue updating its RFP requirements to include considerations for renewable, unmanned technologies suitable for surveillance and early warning systems intelligence.

The need for heightened surveillance and early warning systems has grown due to the opening of the Arctic resulting from melting sea ice.

The dual functions of surveillance technologies enable simultaneous improvement in scientific, security, and military capacities in the Arctic. Financially, these dual purposes promote burden-sharing and cost-effectiveness for NATO.

By employing autonomous technologies, data collection capacity for informed, timely decisions expands, and the use of interoperable systems to feed AI-generated data into shared intelligence reports strengthens trust between allies. Furthermore, by utilizing NATO's procurement power to drive demand for sustainable technologies, NATO can reduce its emissions and encourage suppliers to adopt sustainability. This shift towards sustainable technologies will also reduce NATO's dependence on a volatile energy market, enhancing energy security and fiscal predictability for the Alliance.

Nevertheless, risks are present. The foremost concern is that technologies perceived as defensive can incite escalation through military spirals [48]. Additionally, if state or non-state actors intercept data-gathering technologies, information extraction is a possibility. Even without physical interception, these systems could be vulnerable to cybersecurity attacks. Hence, stringent cybersecurity measures would be imperative for these devices and any interoperable systems that might expose NATO or its allies to vulnerability.

The growing adoption of eco-friendly technologies is pivotal in the battle against climate change. The repercussions of climate change on political, financial, supply chain, food system, health, energy, and migration systems signify that collective defense, crisis management, and cooperative security face mounting challenges. These implications disproportionately affect women, girls, and vulnerable populations already susceptible to exploitation by state and non-state entities.

It's crucial for NATO to seize opportunities to reduce greenhouse gas emissions and leverage its influence to steer industries toward sustainability. Moreover, the use of surveillance and early warning systems will aid decision-makers in staying informed and mobilizing appropriate resources during crises, whether triggered by climate events or other factors. Countries with limited early warning coverage experience disaster mortality rates eight times higher than those with better coverage [49]. Integrating AI-generated data into risk reports via interoperable systems will further enhance preparedness and response. This holds particular significance for Arctic security when considering China's plans for the Polar Silk Road and the projected rise in LNG shipments [50].

On the whole, increased utilization of unmanned, eco-friendly surveillance technologies by NATO and its allies will aid NATO in fulfilling its core responsibilities and advancing its climate and innovation policy agenda. While not a comprehensive solution, it represents a significant stride toward a safer, more sustainable future.

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