Chapter 27
Nato SPS Cluster Workshop on Advanced Technologies: Conclusions

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Abstract The objective of the Science for Peace and Security (SPS) Programme is to promote dialogue and practical cooperation between NATO members and partner nations based on scientific research, technological innovation and knowledge exchange. As a result, understanding and forecasting evolving trends is paramount for SPS to ensure the promotion of activities that reflect both the ambition of the scientific community as well as the real-world security challenges.

27.1 A Multi-domain Workshop

The NATO SPS Cluster Workshop on Advanced Technologies was an opportunity for researchers and co-directors from NATO and partner nations to further strengthen dialogue, to present their activities, to highlight future trends and to provide feedback on how SPS can contribute to the scientific and technical development in the field of security-related advanced technologies.

It was decided to arrange the Workshop in a single open session and to expose the researchers to several topics, in order to promote as much as possible networking, generation of new ideas, cross-domain innovation, etc. Sharing information, experiences and ideas was the main *motif* of the Workshop; recognizing that creativity and innovation require exposure to different ideas and out-of-the-box thinking, the SPS Programme tried to push its researchers in uncharted but innovative waters. Discussions revolved around the projects' achievements and participants could appreciate scientific and technological developments while engaging with other researchers in constructive dialogues and offering observations and suggestions.

In line with the objectives of NATO and the SPS Programme, the projects developed technologies for the security of communication systems, to enhance their resilience and to prevent network intrusion or detect attacks. Cutting-edge

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production and synthetization techniques were explored to exploit advanced materials' properties in a number of fields, from electromagnetic protection to nuclear screening. Innovative sensors and detectors were also developed for border security, situational awareness, monitoring of critical areas and infrastructures, and the detection of hazardous materials. Finally, unmanned and autonomous systems were designed to support a number of security missions in multiple environments. Based on their research efforts and knowledge, participants shared their thoughts on potential future actions and areas of interest in order to advance the scientific and technical state-of-the-art.

27.2 Recommendations for Future Developments

A number of recommendations were collected and will be used to shape upcoming SPS calls for proposals and activities in the field of security-related advanced technologies. Among these recommendations, the most relevant are related to the following topics:

Artificial Intelligence (AI) and Machine Learning AI is becoming an area of strategic importance and a game-changer in future societal dynamics, from economic development to geopolitics and security. Participants in the Workshop highlighted the implications, opportunities and risks of AI, recalling that many of the current SPS projects already make use of AI in a number of areas (target recognition, signal optimization, data mining, object detection and classification, etc.). Looking into the future, the need for the scientific community to provide advice and solutions to make AI secure, fair, ethical, and trustworthy was recognized. The importance of data availability, quality and integrity as critical elements for success was also recalled. As such, participants recommended to enhance further cooperation in this domain, with an emphasis on data and information sharing among the scientific community.

Unmanned Systems and Autonomy Unmanned systems are already on the verge of the commercial and consumer market. In the Gartner Hype Cycle for Emerging Technologies 2019,[1] technologies like autonomous driving, light cargo delivery drones and decentralized autonomous organizations are in the "Innovation trigger" and "Peak of Inflated Expectations" categories, meaning that there is an intense scientific and media interest at this stage, with their potential mainstream market adoption expected within the next decade. On the other hand, the use of autonomous systems, especially in the field of security, raises some questions and doubts, bringing the need for a profound understanding and general awareness on the

[1] 5 Trends Appear on the Gartner Hype Cycle for Emerging Technologies, 2019 – https://www.gartner.com/smarterwithgartner/5-trends-appear-on-the-gartner-hype-cycle-for-emerging-technologies-2019/

full spectrum of opportunities offered and, at the same time, on the risks and implications of the potential misuse by terrorists and adversaries. To this end, it was recommended to analyze and continue gathering the scientific community's perspectives in these technologies and their security implications, with particular focus on policy, ethical and legal aspects.

Quantum Technology Application of quantum computing is leading to the development of powerful machines capable to solve complex problems which are outside the realm of today's computers' capabilities. In the next couple of decades, this could lead to the cracking of current cryptographic algorithms,[2] making obsolete all current IT security systems, and to the need for new encryption schemes and technologies. Accordingly, several SPS projects have tackled the development of new cryptographic algorithms capable to resist against attacks by quantum computers (also known as post-quantum cryptography) and have contributed to international standardization efforts.[3] Other projects have developed Quantum Key Distribution (QKD) systems, i.e. using quantum technology to establish secure links free from the risk of eavesdropping attacks. The experts recognized the need to combine the two efforts as a future priority and to bring the two communities (the quantum physicists and the cryptologists) together in order to promote novel concepts and breakthrough ideas.

Technology Convergence All projects demonstrated and acknowledged the current trends of integrating and combining multiple scientific disciplines to form new and innovative technologies. For example, sensor fusion and communication are enablers for autonomous systems; similarly, innovative materials are the basis for more capable sensors. This trend will become even more radical in the near future, when new opportunities offered by biotechnologies will open unprecedented possibilities. In this scenario, cooperation between different scientific areas should be encouraged through the promotion of large inter-disciplinary projects (i.e. integration of engineering, biotechnologies, physical sciences, data science, computation, life sciences, social sciences, etc.) as novel security applications will necessarily follow this pattern.

27.3 Keeping SPS Abreast of a Developing Scientific and Security Landscape

This book offers a snapshot on how SPS is currently contributing to the international scientific community's efforts in these domains, and a view on how its role may be shaped in the future.

[2]How a quantum computer could break 2048-bit RSA encryption in 8 h https://www.technologyreview.com/s/613596/how-a-quantum-computer-could-break-2048-bit-rsa-encryption-in-8-hours/

[3]SPS projects contribute, for example, to the US National Institute of Standards and Technology (NIST) Post-Quantum Cryptography Standardization Process

The overall objective of SPS is to promote dialogue and practical cooperation between NATO members and partner nations based on scientific research, technological innovation and knowledge exchange. As a result, understanding and forecasting evolving trends is paramount for SPS to ensure the promotion of activities that reflect both the ambition of the scientific community as well as the real-world security challenges posed by new and disruptive technologies. Events like the SPS Cluster Workshop on Advanced Technologies contribute to keeping the Programme's activities abreast of an ever developing scientific and security landscape.

For the Alliance, technological disruption has been the driving force that started NATO's involvement in the scientific domain. With scientific progress and the evolution of security threats, technological disruption is also bound to be part of NATO's future. Its involvement in the scientific domain and support to activities aimed at understanding and preventing emerging security challenges is therefore essential to the Alliance's adaptation and modernization.