The Emerging Security Challenges Division

ANNUAL REPORT 2020

THE NATO SCIENCE FOR PEACE AND SECURITY SPS PROGRAMME

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AND SECURITY
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Preface by David van Weel

In a year dramatically marked by the disruption caused by the coronavirus pandemic and its toll on societies, it is important not to lose sight of what we have still been able to accomplish. In 2020, challenges to our security did not stop for COVID-19 – nor did the Science for Peace and Security (SPS) Programme.

The COVID-19 outbreak has made clear once again that many of the emerging challenges we face are too great for any single nation to face alone. In the spirit of cooperative security, the SPS Programme has demonstrated NATO's commitment to tackling these challenges with its partners. In doing this, it has also confirmed its ability to adapt and continue enhancing security-relevant practical cooperation – by sharing knowledge, building networks, and giving visibility to its results – despite the restrictions resulting from the ongoing pandemic.

Engaging partners from all NATO partnership frameworks, in 2020 the Programme has carried out activities in line with NATO's strategic objectives and partnership priorities. As you will notice in this Report, the list of this year's highlights is not short. To name just a few: as NATO welcomed its newest Ally, the Republic of North Macedonia, SPS contributed to strengthening its capacity to deal with cyber threats by delivering cyber defence training courses to government institutions in Skopje; In the framework of the Defence and Related Security Capacity Building (DCB) Initiative, the Programme continued developing capabilities to tackle cyber challenges in the Republic of Moldova, as well as chemical and biological threats in Tunisia; In cooperation with the NATO-ICI Regional Centre, SPS delivered a second package of tailored training courses for Istanbul Cooperation Initiative (ICI) partners – and for the first time online. Moreover, SPS continued to benefit from the involvement of partners across the globe in its projects, especially through initiatives dealing with challenges at the crossroads of advanced technologies and counter-terrorism, such as the DEXTER consortium.

Using online tools, SPS has also succeeded in engaging high-level stakeholders and in giving visibility to the launch of new and innovative activities. These included the kick off of the key flagship project "PROMEDEUS", which aims to integrate telemedicine elements into Mauritania's crisis management system, building also on two previous SPS projects. The participation in the event of NATO Deputy Secretary General Mircea Geoană and of Mauritanian state ministers stands to show the importance of this SPS project for Mauritania and the wider Sahel region, in the framework of NATO's package on the South.

Any reflection on 2020 would be incomplete without acknowledging the challenges brought about by COVID-19 and the measures taken to address them. Indeed, the SPS Programme has

been an integral part of NATO's efforts aiming to build resilience and promote recovery from the coronavirus pandemic.

SPS is helping to do this from different angles. In the field of crisis management, SPS projects have provided tools to facilitate coordination and information-sharing among 'first responders' in the Western Balkans and are developing telemedicine capabilities that may be useful in the fight against the virus in Mauritania. In the field of defence against biological threats, the Programme also enhanced diagnostics capabilities in the Republic of Moldova, Tunisia and Morocco, through mobile laboratories capable of identifying i.a. coronavirus pathogens. Moreover, SPS harnessed scientific expertise from both NATO and partner nations to launch a dedicated project working towards rapid and large-scale diagnostics of COVID-19.

There is, however, no room for complacency, especially as we are not out of the woods yet and our efforts may need to be intensified also in this domain. COVID-19 is also reshaping the world we live and operate in, and further reflection and research will be essential to better grasp and address its consequences. In what the Programme and the researchers involved in it have achieved there are signs of hope and possibility, but also indications of the resulting challenges – well beyond the sphere of public health and into the strategic realm. SPS has already its work cut out for 2021.

I wish you a pleasant read through this Annual Report.

David van Weel
Assistant Secretary General
NATO Emerging Security Challenges Division

Foreword by Dr. Deniz Beten

This year has been an unprecedented and challenging year also for the Science for Peace and Security Programme.

The coronavirus pandemic affected populations all over the world, including the representatives of governments, academia and civil society from NATO and partner nations who over the years have been cooperating in the framework of SPS. However, tapping into its network of scientists and experts, the Programme was well-positioned to help tackling the threat posed by the coronavirus by promoting new initiatives and adapting ongoing projects, contributing to NATO's efforts to support Allies and partners.

In addition to coronavirus response, the year was marked by the review and launch of many new SPS activities, particularly in the areas of explosives detection and advanced technology (quantum, artificial intelligence, and autonomy), which were the focus of two Special Calls for Proposals launched in late 2019. Moreover, following growing interest in the nexus between the environment and security, SPS looked back at its broad range of activities on the topic since its origins. In 2020, the Programme's key priorities of Environmental and Energy Security already attracted innovative proposals tackling themes such as environmental hazards mapping and smart energy, and may support a greater number of activities on the topic in the future, in line with the Alliance's priorities.

The execution of the Programme was challenged take place in person due to coronavirus-related restrictions, several of them were successfully adapted and implemented online. For instance, this allowed SPS to continue delivering Advanced Training Courses in cyber defence to civil servants in North Macedonia, as well as at the NATO-ICI Regional Centre in Kuwait. Moreover, a number of Advanced Research Workshops were organized in new, 'hybrid' formats, which took into account the need for social distancing among participants, while still engaging large audiences online. In these formats, the fifth edition of the Zagreb Security Forum, and the NATO Defence College Foundations' event "Game Changers 2020" could safely take place, and bring forward timely discussions on hybrid threats in the 21st century, artificial intelligence, climate change, and the impact of the coronavirus pandemic on transatlantic relations.

Due to their longer execution timeframe, SPS Multi-Year Projects were least affected by the onset of the coronavirus pandemic. Using online tools, the Programme organized 10 virtual kick-off meetings involving NATO senior leadership, as well as dignitaries from NATO and partner nations, to mark the launch of new flagship initiatives, such as the PROMEDEUS project with Mauritania in the fields

of crisis management and telemedicine. Moreover, other key initiatives, such as two cyber defence capacity building projects that established Cyber Incident Response Capabilities (CIRC) in the Republic of Moldova and in Mongolia, could be successfully completed by providing software, hardware and specialized training.

Despite the new challenges that 2020 has brought, there is a clear silver lining in the effort and commitment of all the nations, experts and scientists that continued to refer to the Programme as an opportunity for cooperation. The steady execution pace of the Programme's initiatives and the approval of 70 new activities – more than in the previous three years – are a positive sign that our network is able to look beyond the coronavirus pandemic, and ready to continue cooperating on innovative solutions to a broad range of shared security challenges.

With this Report, we are especially glad to be able to share with you not only the challenges, but also the achievements that marked this year for the SPS Programme.

I hope that you will enjoy reading this Annual Report.

Dr. Deniz Yüksel-Beten
Senior SPS and Partnership Cooperation Advisor
NATO Emerging Security Challenges Division

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List of Abbreviations

ACSRT	African Centre for the Study and Research on Terrorism
AP4	Asia-Pacific partners (Australia, Japan, Republic of Korea, New Zealand)
ARW	Advanced Research Workshop
ASI	Advanced Studies Institute
ATC	Advanced Training Course
CBRN	Chemical, Biological, Radiological, and Nuclear
C-IED	Counter-Improvised Explosive Devices
CIRC	Cyber Incident Response Capability
CoE	Centre of Excellence
CT	Counter-Terrorism
CVE	Countering Violent Extremism
DCB	Defence Capacity Building
DEXTER	Detection of EXplosives and firearms to counter TERrorism
DIMLAB	Deployable Biological and Chemical Analytical Laboratory
EADRCC	Euro-Atlantic Disaster Response Coordination Centre
EAPC	Euro-Atlantic Partnership Council
ESCD	Emerging Security Challenges Division
EU	European Union
ICI	Istanbul Cooperation Initiative
IO	International Organisation
IPAP	Individual Partnership Action Plan
IPCP	Individual Partnership Cooperation Programme
ISEG	Independent Scientific Evaluation Group
MD	Mediterranean Dialogue
MENA	Middle East and North Africa
MYP	Multi-Year Project
NAC	North Atlantic Council

NATO	North Atlantic Treaty Organisation
NCIA	NATO Communications and Information Agency
NICS	Next-Generation Incident Command System
NPS	Naval Postgraduate School
NSO	NATO School Oberammergau
NSPA	NATO Support and Procurement Agency
NUC	NATO-Ukraine Commission
OSCE	Organization for Security and Co-operation in Europe
PaG	Partners across the Globe
PCSC	Partnerships and Cooperative Security Committee
SEE	South-East Europe
SPS	Science for Peace and Security
STO	NATO Science and Technology Organisation
UAV	Unmanned Aerial Vehicles
UAS	Unmanned Aircraft Systems
UN	United Nations
USA	United States of America
UNSCR	United Nations Security Council Resolution
UXO	Unexploded Ordnance
WPS	Women, Peace and Security

Executive Summary

The NATO SPS Programme promotes practical cooperation between NATO and partner countries in the area of civil science, technology, innovation, and capacity building. It provides expertise and financial support for tailor-made, security-related activities in the form of established grant mechanisms, including Multi-Year Projects (MYP), Advanced Research Workshops (ARW), Advanced Training Courses (ATC) and Advanced Study Institutes (ASI).

The Programme supports both 'top-down' and 'bottom-up' activities. While the first are initiated by NATO International Staff (IS) in cooperation with Allies and/or partner delegations, the latter are submitted directly to the SPS Programme by independent scientists and experts themselves. The Programme is guided by a set of key priorities that address emerging security challenges of mutual concern, such as counter-terrorism, energy and environmental security, cyber defence, hybrid threats, and defence against CBRN agents; they support the development of security-related advanced technologies; and they deal with human and social aspects of security.

Based on the 2013 North Atlantic Council's (NAC) SPS Programme Overarching Guidelines, SPS supports NATO's efforts to strengthen international and regional security by projecting stability and building capacity in partner countries. All SPS activities contribute to the Alliance's Strategic Objectives - as defined

in the 2010 Strategic Concept, and set out in the 2011 NATO Partnership Policy - and arising from high-level political meetings, including Ministerials and Summits. Through a balanced 360 degrees approach, SPS promotes practical cooperation based on four core dimensions: science, partnership, security, and unconventional issues. In the past year, these defining features allowed SPS to contribute to NATO's pandemic response through cooperative activities involving Allies and partner nations

In light of COVID-19 pandemic, restrictions imposed on all types of meetings and travel pushed the SPS Programme to explore alternative options to ensure its business continuity throughout 2020. As meetings of the Partnerships and Cooperative Security Committee (PCSC) in SPS format did not take place in person, key documents such as the 2021 SPS Work Programme, the nomination of new members of the Independent Scientific Evaluation Group (ISEG), and 70 new Award Recommendations were approved electronically. Moreover, in order to keep nations informed about progress and achievements of the SPS Programme regular updates were shared in electronic format. In a similar fashion, the Programme proposed viable solutions to carry out SPS-supported events (workshops and training courses) that were postponed due to COVID-19 outbreak. The easing of restrictions during the summer of 2020, combined with a quick event planning reconversion, allowed a number of SPS workshops and training courses to take place in an online/on-site hybrid format. In this regard, ARWs like the '2020 Zagreb Security Forum' and 'Game Changers 2020' proved to be excellent examples of meetings combining physical and virtual participation, held successfully and in line with local health and safety rules and restrictions. In addition, the availability of various online platforms provided SPS with the necessary tools to implement Advanced Cyber Training Courses in North Macedonia and at the NATO-ICI Regional Centre in Kuwait, which trained 99 cyber experts altogether.

In 2020, as the world turned to science to find solutions to prevent the spread of and protect populations from the coronavirus outbreak, the SPS Programme joined NATO efforts to respond to COVID-19 pandemic. SPS activities developed or adapted solutions and tools to improve the diagnosis of the virus, as well as emergency response capacities related to the pandemic.

In particular, the SPS flagship project 'New and validated tools for the diagnosis and follow-up of SARS-CoV-2 infected individuals (NOCOVID)' was kicked-off in May 2020 with the aim of contributing to limit the SARS-CoV-2 diffusion by providing new tools for rapid diagnosis that can be used in large-scale settings. Furthermore, the mobile biological and chemical analytical laboratories currently supported by SPS in Morocco and Tunisia have been adapted to include SARS-COV-2 agent in their library of detectable pathogens. In the crisis management area, the Next Incident Command System (NICS) has been used by first responders from North Macedonia to exchange information rapidly and efficiently in order to provide the public with real-time data on the status of the pandemic and give useful points of contact for assistance.

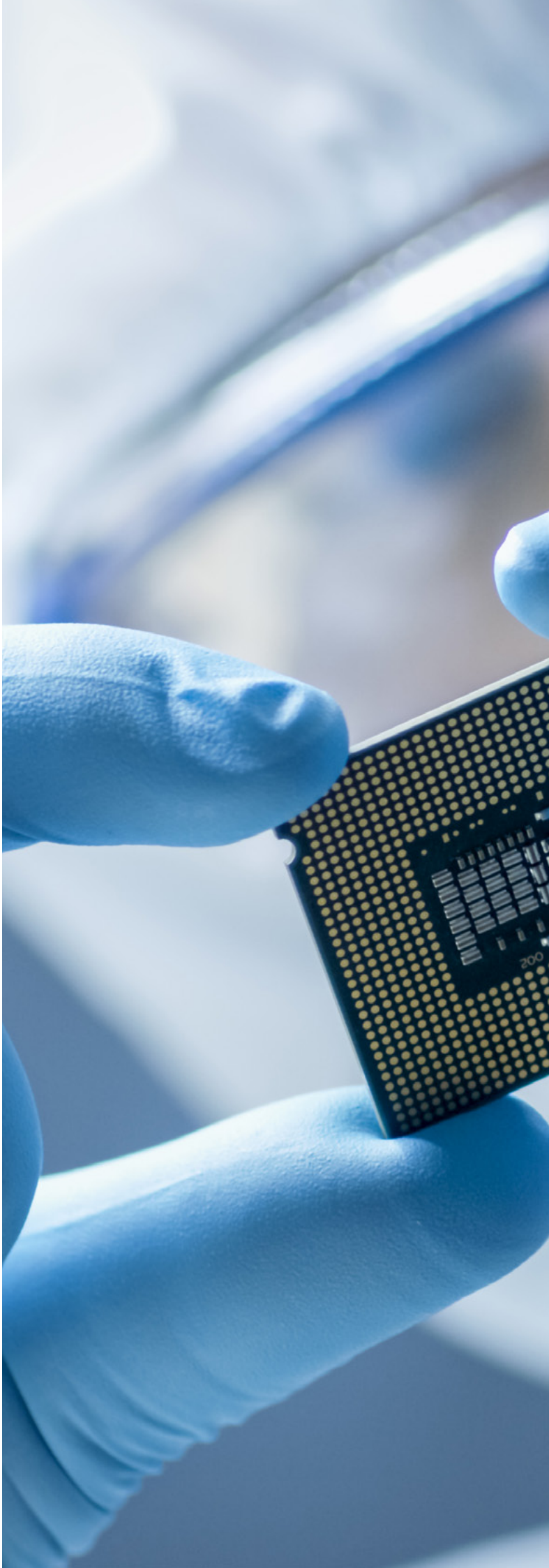
Selected SPS Key Achievements

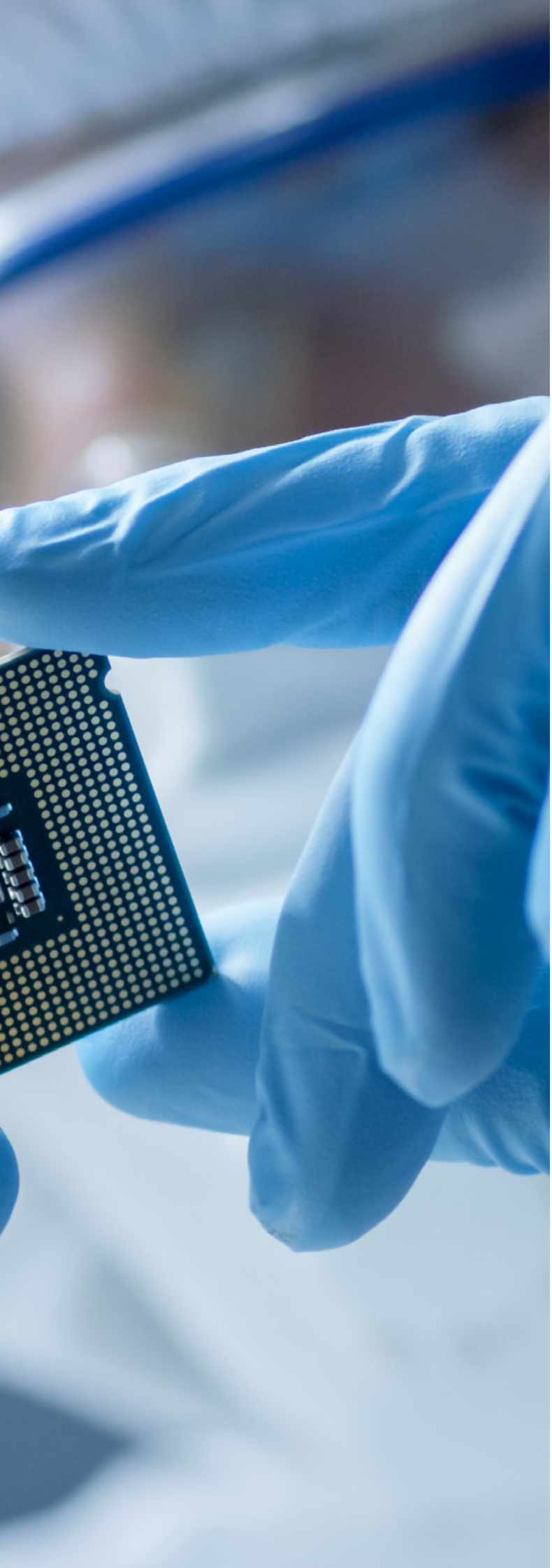
Despite the COVID-19 pandemic, the SPS Programme managed to pursue its 360 degrees approach towards NATO partners, which resulted in the development of an impressive number of joint collaborative activities across all partnership frameworks of the Alliance.

Among the SPS top-down initiatives, the key flagship DEXTER Programme continued making progress towards the development of an integrated and affordable sensor-fusion system able to detect explosives and firearms in public places, remotely and in real time, without disrupting the flow of pedestrians. DEXTER brings together a multinational consortium of 11 laboratories and research institutes in 8 NATO nations and partner countries.

In the East, Ukraine has remained the Programme's largest beneficiary with 17 new activities approved by Allies in 2020. Among them, the new Multi-Year Project "Demining Robots", building on the successful results of a previous SPS project, kicked-off with the aim of changing the approach to detecting landmines in post-war zones. Equally important, Ukrainian scientists continued to be involved in numerous SPS activities addressing primarily the key priority of Security-related Advanced Technology.

In cooperation with the NATO Communications and Information (NCI) Agency, this project established a Moldovan Armed Forces Cyber Incident Response Capability (CIRC) within the Ministry of Defence of the Republic of Moldova. SPS is also providing a mobile biological laboratory and related





tailored training to enhance this Nation's capacity to respond to threats from biological agents like anthrax.

In the Western Balkans, the development and deployment of the Next-generation Incident Command System (NICS) has marked practical cooperation among the countries of this region for the past four years. NICS has proved on various occasions to be a resourceful asset capable to adjust to unpredictable crises, including the coronavirus pandemic.

SPS activities initiated in the Western Balkans have significantly increased. Scientists from Serbia and Croatia continued working on a project focusing on the development of a multispectral surveillance camera. During North Macedonia's accession process to NATO, two tailor-made Advanced Cyber Training Courses were delivered to support this country to meet Allied cyber security standards. Moreover, the '2020 Zagreb Security Forum' facilitated the development of a regional network of experts in Eastern and South Eastern Europe to increase resilience against hybrid threats.

SPS engagement with the South promoted regional cooperation across Mediterranean Dialogue (MD) and Istanbul Cooperation Initiative (ICI) countries. In the framework of the DCB package for Tunisia, SPS completed two tailor-made cyber defence Advanced Training Course for governmental agencies. In addition, SPS is providing a dual use (civil-military) mobile chemical laboratory. In Egypt, SPS completed a project to improve the safety and speedy clearance of UXO by the Egyptian Corps of Engineers in the Western Sahara desert. In Jordan, experts joined efforts with scientists from Italy, Ukraine, and the USA to launch the new initiative "Demining Robots".

In Mauritania, the key flagship project 'PROMEDEUS' will support the crisis management centres and medical emergency response to enhance civil protection and public health. In Morocco, SPS will deliver a dual use mobile biological laboratory focusing on the application of nanobiotechnology. The first scientific cooperation initiative - 'Implementation of a Terahertz Imaging and Detection System' - with Algeria reached its final stages of implementation. In Israel, scientists continued to collaborate on a range of Advanced Technology activities on topics such as autonomy, advanced sensors and detectors.

At the NATO-ICI Regional Centre in Kuwait, SPS activities have provided added value to the SPS cooperation with ICI countries. In this regard, a new package of three tailor-made training courses in the Cyber Defence and Energy Security fields was delivered to nearly 60 participants from ICI and Gulf Cooperation Council (GCC) nations. In Qatar, the past year has seen the kick-off of a Multi-Year Project focusing on the security of Internet of Things networks.

Over the past year, SPS cooperation with Partners across the Globe has gravitated around the four Asia Pacific (AP4) countries, in particular Australia, Japan, and the Republic of Korea. SPS activities led by these countries are developing, for instance, nanostructures for highly efficient infrared detection, terahertz sensors for detection of gas and molecules, as well as sensors for nerve agent detection, and a nanotechnology based biosensor. In the field of Advanced Technology, scientists in Canada and the Republic of Korea are working on passive bio-inspired atmospheric floating vehicles (used in swarms), which will contribute to more effective forecasting of the spread of CBRN agents or emissions from man-made or natural catastrophes. Likewise, in the field of Energy Security, Australian experts are developing universal energy monitoring kits and a simulation model for military camps. Finally, Japan's participation in SPS activities has intensified in 2020 following the kick-off of two flagship initiatives contributing to advancing procedures and technologies for the detection of landmines and of CBRN threats at border crossings and ports.

In Mongolia, another capacity-building project was successfully completed in cooperation with the NCI Agency, resulting in the establishment of a Cyber Security Centre and Cyber Incident Response Capability at the Ministry of Defence and General Staff of the Mongolian Armed Forces, and the provision of specialized training and equipment.

To ensure coordination and benefit from specialized expertise in its activities, SPS regularly worked with other NATO Divisions, Agencies and Centres of Excellence. Although mainly in an online format, the Programme also continued to engage with international organizations. For instance, the Vice-President of the European Commission participated remotely in the '2020 Zagreb Security Forum', while consultations at staff level with the Organization for Security and Cooperation in Europe (OSCE) and the African Union/African Centre for the Study and Research of Terrorism (ACSRT) advanced with a view to develop new joint activities.

SPS Programme Implementation 2020: Fact and Figures

The SPS Programme received a total of 173 applications in response to two application deadlines throughout this year. Of these, 134 passed the eligibility screening and were peer-reviewed electronically by the ISEG. 59 of them were recommended. The PCSC reviewed and approved electronically 70 SPS Award Recommendations, including 13 proposals carried forward from the 2019 application review cycle. The remaining two applications recommended by the ISEG in late 2020, will be considered by Allies in 2021.

24 SPS Multi-Year Projects were completed[1]. In several of these projects, scientists and experts from both NATO and partner countries worked together to build capacity through the provision of modern equipment and specialized training. Furthermore, young

scientists received support to develop their careers in science and technology.

The prototypes developed in these activities were scaled up by the end users. In addition, seven events (Advanced Training Courses and Advanced Research Workshops) were carried out in hybrid format or online because of the coronavirus-related restrictions[2].

The SPS Programme fully executed its budget of EUR 11.8 M in 2020, maintaining a linear spending curve. A substantial part of the budget remained allocated for new and ongoing large-scale MYPs.

Public Diplomacy

In a year defined by new challenges posed by the coronavirus pandemic, the SPS Programme adapted its public diplomacy efforts to find new ways of engaging with its audiences online. Making use of virtual tools, the Programme continued raising awareness among key stakeholders about its contribution to NATO's strategic objectives and priorities, and showing the achievements and impact of its activities. Kick-off meetings of key flagship projects in an online format succeeded in involving NATO leadership, renowned scientists and experts as well as high-level officials from capitals in NATO nations and partner countries. With support from NATO's Public Diplomacy Division, the Programme's accomplishments gained substantial visibility via the NATO website and mainstream media. SPS was also featured in the NATO Secretary General's Annual Report 2020.

To engage new and young audiences, SPS participated in the NATO Science initiative, which was launched as a platform to highlight innovative research projects supported by NATO. In this context, four NATO Science videos promoted SPS Multi-Year Projects showcasing technologies for rapid skin wound healing, explosives detection, collaboration among first responders in emergencies, and high altitude radars. SPS also continued to make effective use of its Twitter account and official website to disseminate information about the Programme and its achievements. While the SPS Twitter account exceeded the threshold of 4000 followers in 2020, the SPS website was revamped to make more information available and easily accessible. Eight informative brochures about SPS activities were published online last year, as well as nine SPS-related webstories, some of which were featured on the main NATO homepage.

Moreover, a disclaimer encouraging diversity among applicants for SPS activities was added to the website and calls for proposals advertised throughout the year. Finally, proceedings from 13 SPS-supported activities were published in the NATO Science Series books, on topics such as space infrastructure, cybersecurity and resilience in the Arctic[3].

[1] A full list of SPS Multi-Year Projects completed in 2020 can be found in Annex 3.

[2] An overview of SPS events organized in 2020 can be found in Annex 2.

[3] A list of Science Series volumes published in 2020 is available in Annex 4.

CHAPTER 1
SPS Impact in 2020

Adaptation and Response to the COVID-19 Pandemic

The severity of the spread of the COVID-19 has taken the world by surprise, imposing historic shocks on the international system, and affecting NATO nations and partner countries. COVID-19 posed an unprecedented challenge to NATO, which took action to help its Allies and partners in need, and assist them by boosting their resilience, sending equipment, and taking measures to protect populations and infrastructure.

The SPS Programme reacted to the new challenges created by the COVID-19 pandemic by adapting its way of working to the current circumstances, and taking responsibility for the promotion of safe behaviors in the context of its activities. Its workshops and training courses scheduled in 2020 were particularly affected, and had to be carried out remotely or be postponed to comply with restrictions on international travel and gatherings. Above all, this led SPS to make greater use of online tools to manage its activities, as well as to draw attention to new flagship initiatives launched in the course of the year, some of which were of direct relevance for the fight against COVID-19.

SPS response to COVID-19 in a nutshell:

- Adaptation of suitable ongoing projects addressing biological threats to tackle COVID-19;
- Launch of new flagship initiatives to enhance coronavirus diagnosis and boost telemedicine;
- Postponement of in-person events;
- Delivery of training courses online.

Since the start of the pandemic, SPS has been an integral component of NATO's response to the coronavirus. Its key priorities and broad network of experts, scientists and research institutions lent themselves to tackling the security implications of COVID-19 from different perspectives. This resulted in the adaptation of ongoing activities to include elements relevant to the fight against the virus. It also sparked the development of new initiatives to address this multifaceted challenge through practical cooperation, scientific innovation and capacity building. As a result, SPS activities relevant to the fight against the virus have been featured on pages of the NATO website devoted to the topic (*www.nato.int/covid19*), and in dedicated NATO factsheets that summarize actions taken by the Alliance in response to COVID-19. Below is an overview of key initiatives supported by the Programme in 2020 that are contributing to the fight against the virus.

Strengthening diagnosis capacity

Enhanced diagnosis capacity is critical to assess and monitor rates of infection, which can inform policy and operational responses to COVID-19. This is why, soon after the onset of the coronavirus pandemic, SPS took action to launch and adapt projects with a potential to boost this capacity. SPS succeeded in fast tracking the approval of a new scientific project aiming to develop tools for the rapid and large-scale diagnosis of COVID-19. Research laboratories in Italian and Swiss universities, as well as the Italian National Institute of Health (ISS) are leading this initiative, combining expertise from the fields of immunology, virology and molecular biology to develop a new generation of rapid, accurate and sensitive immuno-diagnostic methods. This new two-year project, named "NOCOVID", is expected to deliver results that could to have a long-term impact on the international response to the spread of viruses on a large scale.

The official launch of NOCOVID took place on 5 May 2020, and was one of the first high-visibility online events hosted by SPS in the course of the pandemic. At the event, H.E. Francesco M. Talò, Italian Permanent Representative to NATO, H.E. Philippe Brandt, Ambassador of Switzerland to the Kingdom of Belgium and Head of the Swiss Mission to NATO, and Dr Antonio Missiroli, NATO Assistant Secretary General for Emerging Security Challenges, stressed the importance of the project to identify ways to limit the spread of COVID-19. They also singled out the initiative as a meaningful example of cooperation at NATO outside the military sphere. Connecting remotely, the President of ISS, Professor Silvio Brusaferro, project stakeholders, as well as selected media representatives joined the conversation to discuss details and potential impact of the project, which will be significant. Indeed, its results will not only contribute to the improvement of risk management and public health measures, but will also represent a model for quick procedures to counteract potential future epidemics.

Figure 1 - Work in the laboratory.

"This project is very important, especially in the context of new indispensable tools that we will have to deal with the second phase of the health emergency" – Silvio Brusaferro, President of the National Health Institute and Professor of General and Applied Hygiene at the University of Udine (Italy).

Two ongoing projects in the field of CBRN defence were also well suited to contribute to greater diagnostics needs. These types of projects, which focus on establishing mobile analytical laboratories, have proven to be very efficient for the diagnosis of highly dangerous pathogens as well as for training purposes. In recent years, SPS has been working on such mobile laboratories in the Republic of Moldova, Morocco and Tunisia. More specifically, through the project "DIMLAB", the Programme has been developing mobile laboratories for the detection of biological and chemical agents in Morocco and Tunisia since 2019. In the context of the COVID-19 pandemic, these analytical laboratories have been adapted to include the SARS-COV-2 agent in their library of detectable pathogens. Similarly, in the Republic of Moldova, a mobile biological laboratory that SPS started developing in 2016 will boost surveillance capability, early detection and rapid response to infectious biological agents, and may prove useful in the fight against the pandemic.

Enhancing crisis management through telemedicine

The SPS Programme has also contributed to NATO's response to COVID-19 by strengthening the public health and civil protection capacity of Mauritania. With two projects, implemented between 2012-2017, the Programme already established a crisis management centre in Nouakchott and four regional coordination centres. With support from SPS, the centres have been supplied with training and modern communication equipment for crisis monitoring, alert and management, and are currently operational.

Figure 2 - Mobile biological laboratory in the Republic of Moldova.

July 2020 marked the start of a new phase of SPS cooperation with Mauritania in the field of crisis management, with the launch of the new SPS project 'PROMEDEUS'. Building on the results of the two previous projects, this top-down flagship initiative aims to support the development of Mauritania's operational capabilities and emergency management. The project will achieve this goal by improving coordination between Mauritanian Civil Protection, health emergency systems, and participating authorities, notably though the creation of a telemedicine system for medical emergencies. This capability will initially be established in an area of a 100-km radius surrounding the capital, Nouakchott, but will eventually be extended to nearly all Mauritanian territory.

SPS commemorated the kick-off of PROMEDEUS on 10 July 2020 with a high visibility online event engaging project stakeholders from NATO, Mauritania and Romania. From NATO HQ, the Deputy Secretary General Mircea Geoana and Deputy Assistant Secretary General for Emerging Security Challenges, Robert Weaver, stressed how this project will address security challenges of mutual concern to NATO and Mauritania, and its potential impact on the broader Sahel region. They were joined online by the Mauritanian Minister of Interior and Decentralisation, Dr. Mohamed Salem Ould Merzoug; the Minister of Health, Mr. Mohamed Nadhirou Ould Hamed; the Romanian State Secretary, Dr. Raed Arafat; and the Mauritanian Ambassador to NATO, Abdellahi Bah Nagi

Kebd, who highlighted the relevance of this and previous SPS projects to the fight against the coronavirus pandemic in Mauritania. Indeed, the previously established crisis management centre, as well as the telemedicine capabilities to be delivered with PROMEDEUS, will help Mauritania to combat COVID-19 and similar emergencies in the future, and ensure better preparedness and effective response.

"The PROMEDEUS project matches perfectly the needs and expectations of the Government of the Islamic Republic of Mauritania, as we are making significant efforts to deal with the COVID-19 pandemic," – Dr Mohamed Salem Ould Merzoug, Minister of Interior and Decentralisation of Mauritania.

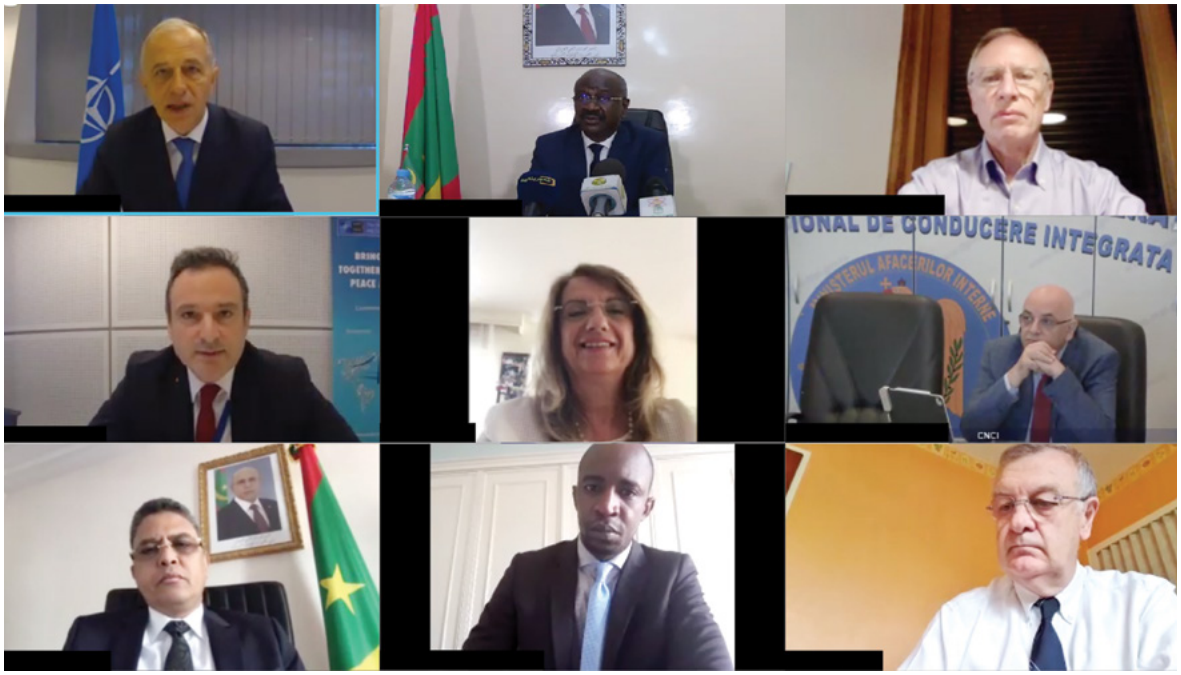


Figure 3 - Virtual kick-off meeting of the SPS MYP 'PROMEDEUS' held on 10 July 2020.

Facilitating coordination in emergencies

Since 2016, SPS has been implementing the multi-year project "Advanced Regional Civil Emergency Coordination Pilot", which has been supporting the adoption of the Next-generation Incident Command System (NICS) across the Western Balkans. This flagship collaborative initiative aims to facilitate collaboration across all levels of preparedness, planning, response and recovery during natural disasters and other incidents.

The NICS tool has the capacity of enabling the exchange of information about an event, including GPS locations or images, rapidly and efficiently via mobile

devices. First responders from across the region had the opportunity to use the NICS web-based command and control software in the context of numerous field exercises over the past years. These exercises tested the tool in simulated scenarios likely to occur in the Western Balkans, such as forest fires, but never in the context of a global pandemic.

However, NICS has become one of the assets used in North Macedonia's response to the coronavirus. In 2019, its administration adopted NICS as the national crisis response collaboration system to coordinate all parts of government in the event of an emergency. Following the coronavirus outbreak, North Macedonia used the tool to facilitate coordination, communication and cooperation among institutions involved in COVID-19 response across the nation. Moreover, participants in this SPS project created a website (http://nicspublic.cuk.gov.mk) to rapidly share updated information with the public and provide citizens with data on the status of the infection at national and municipal level, as well as useful points of contact for assistance in crisis areas.

#DYK - Did you know that many other SPS scientific projects are working on technologies that could be of use in the fight against COVID-19? For instance:

- The completed project "Ultra-sensitive opto-electrochemical detection of liquid explosives fabrication" developed technology for the detection of explosives and compounds used for their fabrication in waste water and suspected sites. After the conclusion of this SPS project, the project team started developing a system that can detect the SARS-COV-2 virus in effluents by using similar sensing principles.
- The new project "Nano-technology inspired biosensor with photo-responsive Liquid Crystals – NANO-LC" will develop a sensor for the detection of harmful bacteria intentionally or unintentionally dispersed in potable water. This sensor could potentially also be used to monitor the presence of COVID-19 in potable water, as well as to develop a color-based indicator to mark whether face masks have come into contact with the virus.

Read more about how North Macedonia is using NICS in the fight against the coronavirus here.

Cooperation with Partners

The Programme's initiatives in support to NATO's response to COVID-19 represented only a fraction of its activities in 2020. Indeed, SPS continued to pursue a balanced 360 degrees approach towards NATO partners, which resulted in the implementation of over 120 activities throughout the year, and the approval by Allies of 70 new Award Recommendations, a significantly greater number compared to previous years. Despite the ongoing pandemic and the impossibility to maintain a "business as usual" approach, the SPS Programme remained a trusted platform for cooperation between scientific communities, and enabled the implementation of scientific projects, training courses, workshops, and capacity-building activities involving partner countries from all of NATO's partnership frameworks.

Tailored cooperation and dialogue between the Alliance and Ukraine gained greater momentum in 2020, as the country became one of NATO's six Enhanced Opportunities Partners, alongside Australia, Finland, Georgia, Jordan and Sweden. During her visit to NATO in July, Ukraine's Deputy Prime Minister, Olha Stefanishyna, highlighted the importance of SPS as a valuable platform for Ukraine-NATO practical engagement. Against this background, Ukraine remained the Programme's largest beneficiary for the sixth year in a row, with 17 newly approved activities in the fields of Energy Security, Cyber Defence, Hybrid Challenges, CBRN Defence, Advanced Technology, UXO clearance, and Women, Peace and Security (WPS). Ukrainian scientists led and participated in a broad portfolio of activities, several of which focused on the priority areas for cooperation identified at the 2019 meeting of the NATO-Ukraine Joint Working Group on Scientific and Environmental Cooperation, which oversees cooperation between NATO and Ukraine in the field of security-related civil science and technology. Ukrainian scientists continued to make significant contributions to SPS top-down flagship initiatives, particularly in the framework of two research and development projects – Micro-

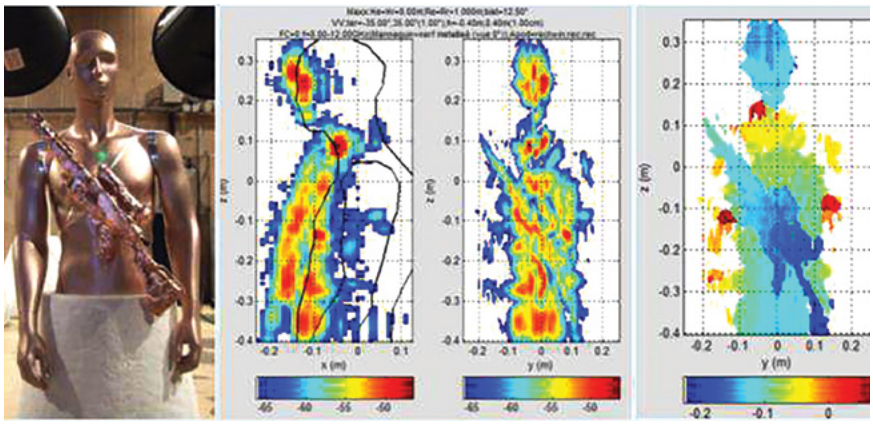


Figure 4 – Firearms detection through microwave imaging.

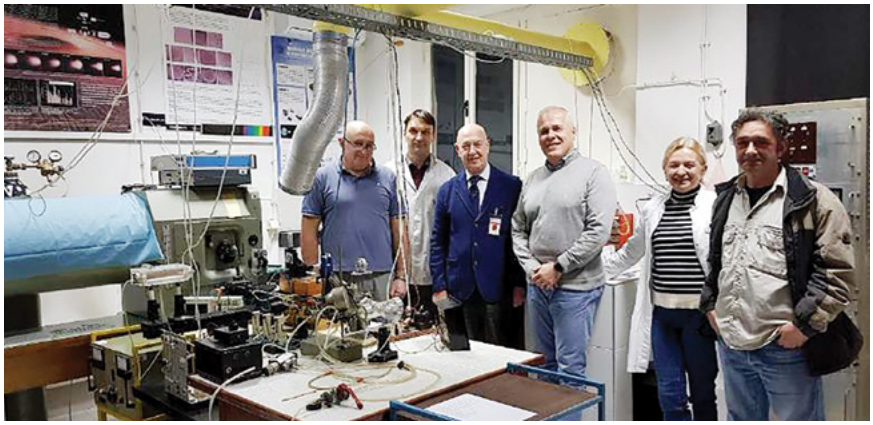


Figure 5 – Scientists from Italy and Serbia working together in the framework of the SPS MYP 'EXTRAS'.

wave Imaging Curtain (MIC) and EXplosive TRAce detection Sensor (EXTRAS) – included in the DEXTER Programme. DEXTER was launched in 2019, and brings together a multinational consortium of 11 laboratories and research institutes from four NATO nations and four partner countries to develop an integrated and affordable sensor-fusion system able to detect explosives and firearms in public places, remotely and in real time, without disrupting the flow of pedestrians. Newly launched activities also allowed to build on the successes of previous cooperation and strengthen existing relations among researchers and institutions. For instance, 2020 saw the launch of the multi-year project "Demining Robots", involving scientists from Ukraine, Italy, Jordan and the USA. The research team leading this initiative will expand on the technology and prototype developed in the framework of the completed project "U-GO 1st", by introducing a set of cooperative robots that will help ensuring safer procedures for the detection and identification of explosive hazards.

The Republic of Moldova remained a very active partner, participating in scientific cooperation projects in the field of Defence against CBRN Agents and Human and Social Aspects of Security, while also benefiting from two flagship top-down SPS capacity building projects. In the framework of the DCB package for the Republic of Moldova, SPS completed the delivery of a multi-year project that developed the cyber defence capabilities of the Moldovan Armed Forces, by establishing the Moldovan Armed Forces Cyber Incident Response Capability (MAFCIRC). Between 2018-2020, in cooperation with the NCI Agency, this

Figure 6 - NATO Deputy Secretary General, Mircea Geoana, and the Minister of Defense of the Republic of Moldova, Victor Gaiciuc, virtually inaugurate the Moldovan Armed Forces Cyber Incident Response Capability.

project delivered cyber defence infrastructure, specialized training and technical advice, with the goal of building capacity to control and minimize any damage from cyber incidents, provide quick and efficient recovery and prevent similar future events. Moreover, a second top-down initiative in the field of Defence against CBRN Agents continued developing a mobile biological laboratory. Combined with specialized and tailored training for its operators, this project will contribute to enhancing the country's surveillance capacity against biological threats, and in particular the ability to detect and respond to contamination from biological hazards such as anthrax.

Activities with partners in the Caucasus continued with a particular emphasis on scientific cooperation in the fields of Counter-Terrorism and Advanced Technologies. In particular, this year saw the launch of the top-down Multi-Year Project "Network for alerting and managing public safety and resilience (REACT)", involving researchers from Georgia, Italy and the USA. This initiative aims to develop an innovative platform for the rapid and effective management of crises following a terrorist attack with chemical and biological agents, and will have a significant impact on events targeting urban areas with high population density. The start of the project "Development of Optical Magnetic Sensing System for Security Checkpoints" marked the start of the first SPS activity co-led by Armenia since 2017. This new initiative, developed in response to the SPS Special Call for Proposals on Advanced Technologies, will engage Armenian, French and Latvian scientists, who will develop a more sensitive and reliable optical magnetometric system for security screening at border checkpoints. Cooperation with Azerbaijan was also further strengthened with the approval of a top-down cyber defence Advanced Training Course, which will provide Azerbaijani civil servants who hold key roles in cyber security with an advanced training on operational cyber security and cyber security technology contents. This course, which will be implemented in 2021 in cooperation with Turkish experts, will contribute to the exchange of best practices and the exploration of innovative technologies to enhance cyber defence, thus enhancing cyber resilience in Azerbaijan.

In the Western Balkans, 2020 served as yet another demonstration of NATO's Open Door policy, as North Macedonia became the 30th member of the Alliance. Against this background, SPS contributed to improving the capacity of NATO's newest member to respond to cyber threats, by

Figure 7 - Minister of Defence of North Macedonia, Radmila Shekerinska, delivering opening remarks at the SPS Cyber Defence Advanced Training Course on 'Network Security' in April 2020.

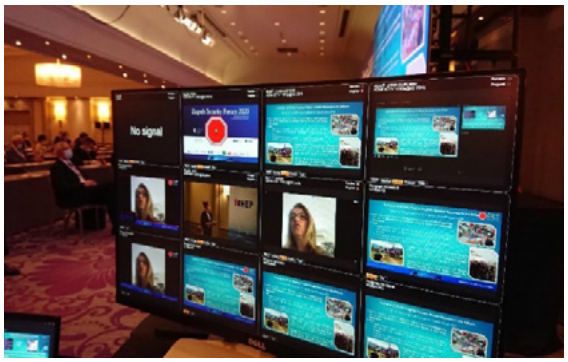


Figure 8 – NATO Senior SPS and Partnership Cooperation Advisor, Dr. Deniz Beten, delivering opening remarks at the Zagreb Security Forum 2020 on 7 September 2020.

Figure 9 - Inauguration of the NICS Laboratory at the Military Academy in Skopje, North Macedonia, on 26 November 2020.

delivering two Cyber Defence Advanced Training Courses to 64 civilian and military participants from seven government institutions in Skopje. These courses, implemented between January and August, were adapted to an online format due to COVID-19-related restrictions, like many other SPS-supported events this year. Among them, the '2020 Zagreb Security Forum', which took place in September, demonstrated creativity in adapting to the challenging circumstances of the coronavirus pandemic. By carrying out the event in a hybrid format, its organizers succeeded in safely engaging participants in Zagreb as well as online, enabling discussions on hybrid and cyber security challenges, their impact, and opportunities to increase resilience in our societies. Three new SPS events led by experts from Bosnia and Herzegovina and North Macedonia were approved by the PCSC in 2020, and will further explore these topics by focusing on the Western Balkans' challenges relating to the practical application of advanced technologies to enhance security and defense capabilities; on enhancing cyber defences against hybrid threats; and on raising awareness on the role of women in tackling radicalization and violent extremism in the region.

Many SPS-supported activities in the Western Balkans showed the benefits of cooperation particularly by facilitating engagement among NATO members and partners countries in the region. With a truly regional approach, the multi-year project "Advanced Regional Civil Emergency Coordination Pilot" has been engaging experts and institutions in Bosnia and Herzegovina, Croatia, Montenegro, and North Macedonia, as well as the USA, since 2016. By enabling the adoption across the region of a Next-Generation Incident Command System (NICS) to enhance communication and coordination among first responders to disasters, this top-down flagship initiative continued making progress in 2020. This year's milestones include the inauguration of a NICS Laboratory at the Military Academy in Skopje for training and operational purposes. NICS was also used during the most recent earthquake recovery efforts in Croatia in December 2020, where the National Civil Protection Units adopted the tool to coordinate with other relevant organizations. Moreover, in the realm of scientific cooperation, Serbian and Croatian scientists continued to work together in the framework of the SPS project "Biological and Bioinspired Structures for MultiSpectral Surveillance", focusing

on the development of a multispectral surveillance camera, which covers ultraviolet, visible and infrared radiation.

Regional cooperation was also central to the Programme's engagements with Mediterranean Dialogue (MD) and Istanbul Cooperation Initiative (ICI) partners. Against the backdrop of unfolding discussions on NATO's additional engagement in the Middle East and North Africa, SPS activities continued to deliver on Allied priorities, by building capacity among MD partners, particularly in Egypt, Mauritania and Tunisia. In Egypt, SPS completed a multi-year project that contributed to enhancing mine detection and clearance in the Egyptian Western Desert. With this initiative, implemented through cooperation between the Netherlands and Egypt, the Programme provided two Explosive Remnants of War (ERW) clearance groups of the Egyptian Corps of Engineers with a minimum enhanced operational detection and clearance capability. In Tunisia, SPS delivered two DCB activities in the fields of Cyber Defence and Defence against CBRN Agents. The first consisted in a Network Security Advanced Training Course for Tunisian governmental agencies, including the Ministry of Defence, Ministry of Interior, National Security Agency and Ministry of Public Administration. This 10-week course started in 2019 and was completed in February, providing 25 participants with an understanding of the bits-in transit aspects of information and cyber security, and preparing them to defend their national networks, to increase the country's cyber resilience and to work together with their peers from other partner and NATO countries. Moreover, in the field of CBRN Defence,

Figure 10 – Demonstration of usage of shoring box panels during C-IED training for the Egyptian Corps of Engineers.

SPS continued the implementation of the DCB multi-year project "DIMLAB". Bringing together experts from Tunisia, Morocco and Spain, this project will deliver two dual-use (civil and military) deployable biological and chemical laboratories in Morocco and Tunisia. With the launch of the new top-down flagship initiative "PROMEDEUS" in July, SPS started a new phase of its efforts to enhance Mauritania's crisis management system. After the successful completion of two previous projects that established a crisis management centre in Nouakchott and four regional operational coordination centres across the country, PROMEDEUS will support the creation of a telemedicine system, which will further enhance the country's ability to manage emergencies.

Figure 11 – Foresight exercise in the framework of the SPS MYP 'Responding to Emerging Security Challenges in NATO's Southern Neighborhood'.

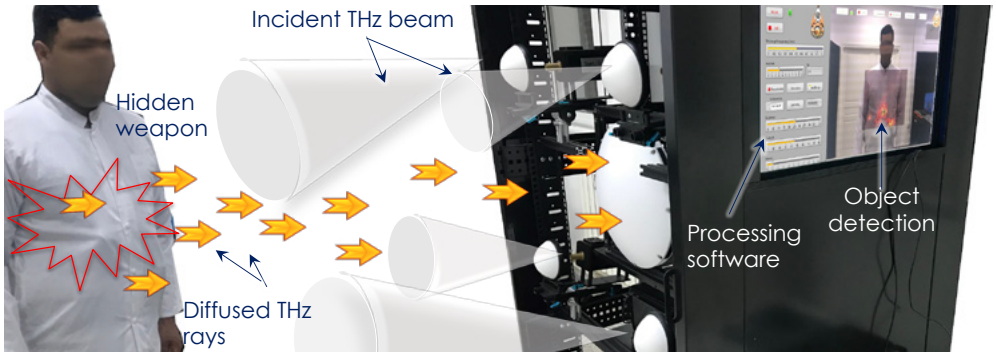


Figure 12 – Demonstration of terahertz body scanner.

MD countries maintained a high level of engagement with the Programme also through scientific research and development projects. Scientists and experts from Israel were involved in a large number of bottom-up multi-year projects addressing primarily the SKS Key Priorities of Security-related Advanced Technologies and Counter-Terrorism. Cooperation with Israeli scientists continued also in the framework of a top-down initiative in the CBRN field, which is improving and providing a basis for the development of novel anthrax counter measures by identifying small molecules that block anthrax virulence. Implemented in cooperation with scientists in Turkey, this project builds on a completed project that was awarded the SPS Partnership Prize for excellence in 2018. Moroccan experts continued working with counterparts in Belgium, Jordan, Spain and the United Kingdom through the multi-year project "Responding to Emerging Security Challenges in NATO's Southern Neighborhood", which will be completed in 2021. Through this initiative, researchers are developing in-depth analyses of sources of change and instability in NATO's southern neighborhood, to discuss potential future scenarios and their implications on the Alliance. In addition to this activity, Jordanian scientists are contributing to a newly launched project aiming to develop physical systems to enhance the security of Internet of Things networks. This project, implemented with Portuguese and Qatari researchers, is one of the initiatives resulting from the SPS Special Call for Proposals on Advanced Technologies issued in 2019. Algeria is also contributing to the SPS Programme's extensive portfolio of activities in the field of Advanced Technologies, particularly through the project "Implementation of a Terahertz Imaging and Detection System" - the first scientific cooperation initiative between NATO and Algeria. Experts from Algeria, France and Sweden involved in this project are developing an innovative technology capable of identifying dangerous materials and of securing vulnerable locations from terrorist threats.

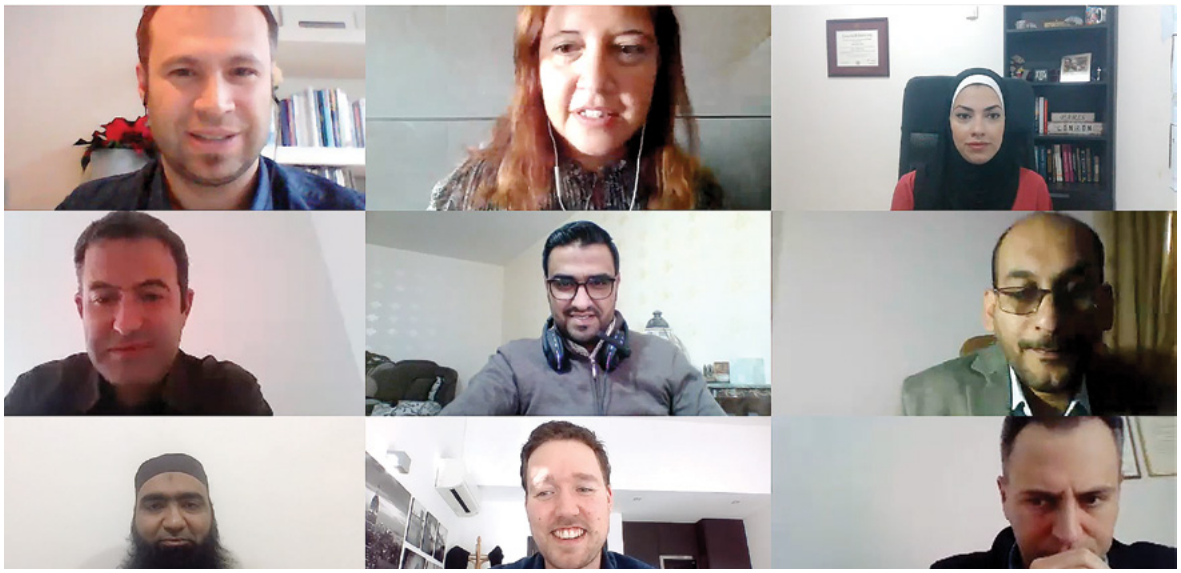


Figure 13 - Virtual kick-off meeting of the SPS MYP 'Developing Physical-Layer Security Schemes for Internet of Things Networks' held on 20 November 2020.

In cooperation with the NATO-ICI Regional Centre in Kuwait, SPS continued engaging Istanbul Cooperation Initiative (ICI) partners in its activities. After the success of the first package of SPS Advanced Training Courses implemented at the Centre between 2017-2019, the second Annual Review of the NATO-ICI Regional Centre in November 2019 highlighted greater interest in SPS ATCs in Cyber Defence and Critical Energy Infrastructure Protection. Meeting this request, a new package of tailor-made courses on these topics was approved by PCSC at the end of March 2020 and implemented between September-December. The three courses included in the package were developed in cooperation with the Centre, NATO School Oberammergau (NSO) and the Naval Postgraduate School (NPS) in Monterey. Although these activities were designed for in-person teaching, they were swiftly and successfully converted into online courses to adapt to the circumstances of the coronavirus pandemic, and enabled the participation of more than 50 attendees from ICI and Gulf Cooperation Council (GCC) countries. Activities involving ICI partners however did not include only training courses, but also scientific cooperation projects. In particular, the engagement of Qatari researchers in SPS activities on advanced technologies increased from previous years, following the approval by PCSC of two new multi-year projects co-led by Qatar. One of these activities was already launched in 2020, while the second, which aims to enhance situational awareness at sea through cooperative and quickly deployable Unmanned Aircraft Systems (UAS), will be kicked off in 2021.

Advanced technologies were also central to the Programme's cooperation with NATO's Western European Partners (Austria, Finland, Ireland, Sweden and Switzerland). For instance, the VTT Technical Research Centre of Finland continued playing a pivotal role in the MYP "INtegrated System for Threats Early Detection (INSTEAD)", which is a key component of the flagship DEXTER Programme. Also in the area of sensors and detectors, Switzerland is co-leading the newly launched project THESEUs, which aims at developing compact, high-efficiency Terahertz laser sources that will be integrated with high-performance cameras to implement a portable imaging/scanning system for border controls. Moreover, Swiss involvement in the top-down project "Mobile Adaptive/Reactive Counter Unmanned Aerial System (MARCUS)", jointly supported by SPS and the United States Department for Homeland Security, was essential to bring forward the development of a technology to counter UAS and to deal with the risk posed to national security by low, slow and small (LSS) threats. In cooperation with Italy, both Switzerland and Austria are participating in two new initiatives tackling challenges related to the coronavirus pandemic. While Switzerland is already co-leading the "NOCOVID" project dealing with large-scale diagnostics, a new activity involving scientists from Graz University of Technology in Austria will be launched in 2021 to develop rapid and innovative nanotechnology-based biosensors to detect and monitor the presence of the SARS-CoV-2 virus and other toxic bio-agents in workplaces. Addressing the SPS key priority of Counter-Terrorism, Swedish

Figure 14 - Young scientist works on MARCUS.

experts continued leading the MYP "Evaluation Support for Countering Violent Extremism at the Local Level", in cooperation with the Harvard T.H. Chan School of Public Health in the USA. This project, started in 2018, has the goal of facilitating the integration of scientifically derived knowledge from evaluation data into CVE policies.

SPS activities in 2020 continued to involve NATO's Partners across the Globe, expanding in particular the Programme's engagement with Asia-Pacific partners, or AP4 (Australia, Japan, Republic of Korea and New Zealand). "NANO-LC", a new project in the field of CBRN Defence involving the Republic of Korea, was launched in August 2020, with the goal of developing a breakthrough technology to detect pathogens dispersed in potable water. Moreover, Japan is co-leading two newly launched multi-year projects contributing to advancing procedures and technologies for the detection of landmines as well as of CBRN threats at border crossings and ports. The latter of these activities, named "E-SiCure2", builds on the results of a previously concluded activity and will further strengthen collaboration among scientists from participating nations (Croatia, Japan, Portugal and Slovenia). 2020 also saw the approval by Allies of two new initiatives in the field of Advanced Technologies co-led by Australia, which will aim at enhancing protection against laser sources and at employing terahertz techniques for the rapid detection of toxic substances. In addition to working with AP4 partners, SPS reached an important milestone in its cooperation with Mongolia with the completion of a cyber defence capacity building project. This initiative, implemented in cooperation with the NCI Agency between 2017-2020, aimed to develop and enhance the country's cyber defence capabilities through the creation of a Cyber Security Centre and Cyber Incident Response Capability for the Ministry of Defence and General Staff of the Mongolian Armed Forces. Through the provision of equipment, specialised training, and expert advice to the staff of the newly established Cyber Security Centre, this project contributed to enhancing the resilience and security of Mongolia's information technology systems. Another significant milestone reached in November 2020 was the approval by Allies of the first SPS multi-year project involving Colombia. This activity will address the SPS Key Priority of Security-related Advanced Technologies, and follows NATO's first-ever scientific activity with Colombia, implemented in 2019 in the framework of SPS.

Figure 15 – Members of the research team of the SPS MYP 'NANO-LC' working on the project.
Source: Twitter @NanoLc

SPS regularly engages with NATO Divisions, agencies and entities, with a view to coordinate, share knowledge and expertise and avoid duplication of efforts. In 2020, this entailed frequent interaction with NATO stakeholders in the context of ongoing discussions on Emerging and Disruptive Technologies, as well as potential developments concerning partnerships at NATO. Moreover, in the framework of top-down capacity building projects in the Republic of Moldova and Mongolia, the Programme continued enjoying the support of the NCI Agency and of the NATO Support and Procurement Agency (NSPA). SPS also benefits from cooperation with NATO-accredited Centers of Excellence (CoEs), such as the C-IED CoE in Madrid, which contributed to the implementation of the recently concluded SPS initiative aiming to enhance Egypt's capacity to deal with the threat from explosive hazards. SPS also contributes to NATO's cooperation with other International Organizations, such as the United Nations (UN), the Organization for Security and Cooperation in Europe (OSCE), the European Union (EU) and the African Union (AU). For instance, the Vice-President of the European Commission and European Commissioner for Democracy and Demography, Mrs. Dubravka Šuica, addressed current and future hybrid threats in Eastern and South-Eastern Europe at an SPS workshop. Brussels-based representatives from the EU and UN were also slated to participate in the SPS Cluster Workshop on Women, Peace and Security, which was scheduled to take place in March and had to be postponed

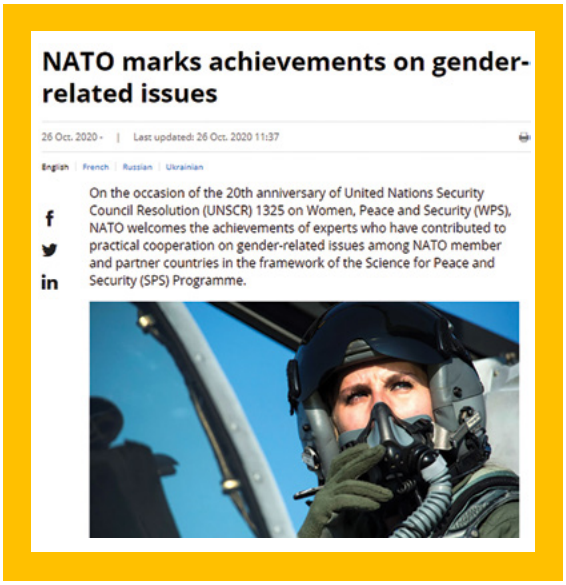
Figure 16 - Two possible scenarios of application of the proposed CLARIFIER integrated radar-lidar system. Up: Detection of (intentional or unintentional) obstacles in sensible infrastructures, e.g. airport runways. Down: Early oil spill detection in docks.

last minute due to the onset of the coronavirus pandemic. Staff from NATO and the OSCE continued consulting on the findings of the 2019 SPS Border Security Best Practices Workshop, hosted in Amman, and seeking potential avenues for further cooperation. Counter-Terrorism and Border Security, including military aspects and non-permissive environments, were areas where NATO and OSCE agreed to pursue potential joint projects. During 2020, SPS has continued interacting with the AU/African Centre for the Study and Research of Terrorism (ACSRT), with a view to developing a second iteration of the 2019 pilot NATO-AU Counter-Terrorism course, hosted in Algiers in cooperation with the NATO Defence against Terrorism CoE. These consultations built on the NATO-AU Counter-Terrorism dialogue in December 2019, and on the briefing by AU ACSRT to NATO Allies in July 2020, and contributed to highlighting new topics for future NATO-AU counter-terrorism cooperation in the framework of SPS.

Public Diplomacy Impact

SPS activities hold a high public diplomacy value that builds on over 60 years of science at NATO. Through its public diplomacy efforts, the Programme gives visibility to NATO's commitment to cooperative security, and to the importance of partnerships. Its activities demonstrate the benefits of cooperation not only for the experts and scientists involved, but also for NATO and its partner nations. Thanks to its focus, SPS also helps to move beyond the perception of NATO as a purely military alliance, bringing attention to the achievements of practical cooperation along the lines of civil science, technology and innovation.

In 2020, the Programme continued to give visibility to its activities and achievements, in alignment with NATO's priorities and lines of effort, coordinating many of its outreach initiatives with NATO's Public Diplomacy Division. Although restrictions resulting from the coronavirus pandemic hampered the possibility of organizing physical events to raise awareness about the Programme, SPS took concrete steps to engage experts, government representatives and the public through the public diplomacy tools at its disposal. In particular, through online events, it succeeded in giving visibility to key initiatives launched or completed in the course of the year, and in connecting remotely with stakeholders from governments and the scientific community.



Read the webstories here:

- NATO celebrates leading women in science – 11 Feb 2020
- NATO marks achievements on gender-related issues – 26 Oct 2020

This year's achievements have also been recognized and highlighted across the Alliance. In particular, the NATO Secretary General's Annual Report 2020 reflected not only the Programme's accomplishments, but also its contributions to initiatives such as DCB and NATO's response to the COVID-19 pandemic.

An important theme for the Programme's public diplomacy activities in 2020 was the 20th anniversary of United Nations Security Council Resolution (UNSCR) 1325, which provided an opportunity for NATO and the international community to reflect on the progress achieved in the Women, Peace and Security (WPS) agenda. SPS took part in this reflection by highlighting the significant participation of women in its security-related scientific activities, as well as its work with partners countries on WPS-related topics. In particular, on the International Day of Women and Girls in Science, which falls on 11 February every year, SPS published a webstory dedicated to celebrating the outstanding contribution of women to SPS scientific projects. The story highlighted the stories of three scientists from Belgium, Italy and Turkey, who shared their personal successes and challenges as women in science.

Their experiences and achievements specifically stressed the importance of mentoring and role models to encourage the participation of women in science, as well as greater awareness of what working in this field entails. In October 2020, on the anniversary of UNSCR 1325, the Programme also gave visibility to SPS activities that have made significant strides towards the advancement of the WPS agenda over the past years. Seeking the perspectives of those who contributed to their success, the Programme published a webstory highlighting three of the 14 activities completed by SPS in this field. This story stressed the achievements and impact of key SPS multi-year projects from the perspective of experts from Canada, the Republic of Moldova, and the United Kingdom. The interviewees shared insights on their experiences working on SPS projects on WPS that led to the adoption of the first National Action Plan on UNSCR 1325 in the Republic of Moldova, the first organizational climate assessment in the Georgian Armed Forces, and evidence-based research on how to incorporate gender analysis in NATO's policy and operational planning.

NATO SPS Website

The SPS website (*www.nato.int/science*) is the main online source of information on the Programme. It contains useful and up-to-date information for public use on SPS and its activities, as well as guidance for scientists and experts who may be interested in developing new SPS applications. The website also hosts highlights from SPS activities and their participants in the form of webstories, as well as previous annual reports. Examples of SPS activities involving each of NATO's partner nations may also be found in dedicated country flyers, which are updated twice a year.

#DYK – Did you know that the three webstories most read by visitors of the SPS website were:

- The announcement of the launch of a new SPS Multi-Year Project aiming to enhance COVID-19 diagnosis – 5 May 2020
- An overview of SPS cooperation with Ukraine, published following the visit of Ukraine's Deputy Prime Minister, Olha Stefanishyna, to NATO HQ. – 7 Aug 2020
- An interview with Prof. Vantsevich, one of the scientists working with SPS to develop new technologies to improve the mobility of autonomous vehicles on severe terrain conditions. – 21 Feb 2020

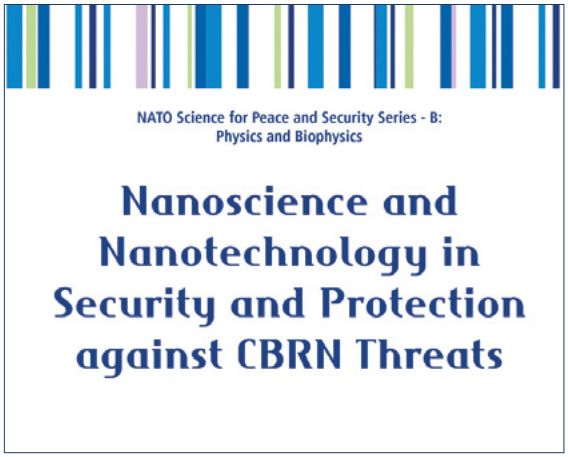
As the main repository of knowledge on current and past SPS activities for the public, the content of the website also requires frequent updates and new content. In 2020, the SPS website underwent an important overhaul, which included the reorganization of many of its pages for greater ease of access to information. This helped in particular to clarify application and grant management processes, and to increase the visibility of the calls for proposals announced in the course of the year.

Moreover, in cooperation with the Public Diplomacy Division, the website was enriched with nine new webstories, several of which were also featured on the NATO homepage.

Flyers and Publications

While updating its website, SPS also increased significantly the amount of information available on its flagship activities, by producing eight dedicated informative brochures. These brochures provide snippets of information on goals and deliverables of projects across the whole range of the Programme's Key Priorities, and give insights into how multinational project teams can collaborate in the framework of SPS.

SPS-supported Events offer co-directors the possibility of publishing proceedings and results of their activities in the Science Series. While the content of the volumes published does not necessarily represent the perspective of NATO, these books contribute to developing and enriching the body of knowledge on subjects of relevance to the Alliance. In 2020, SPS supported the publication of 13 new Science Series books on topics such as space infrastructure, cybersecurity and resilience in the Arctic, and advanced technologies for security applications. In addition, numerous scientific publications have been published in peer-reviewed journals and specialized magazines by SPS grantees.



#DYK – Did you know that flyers and publications supported by SPS are available on the SPS website?

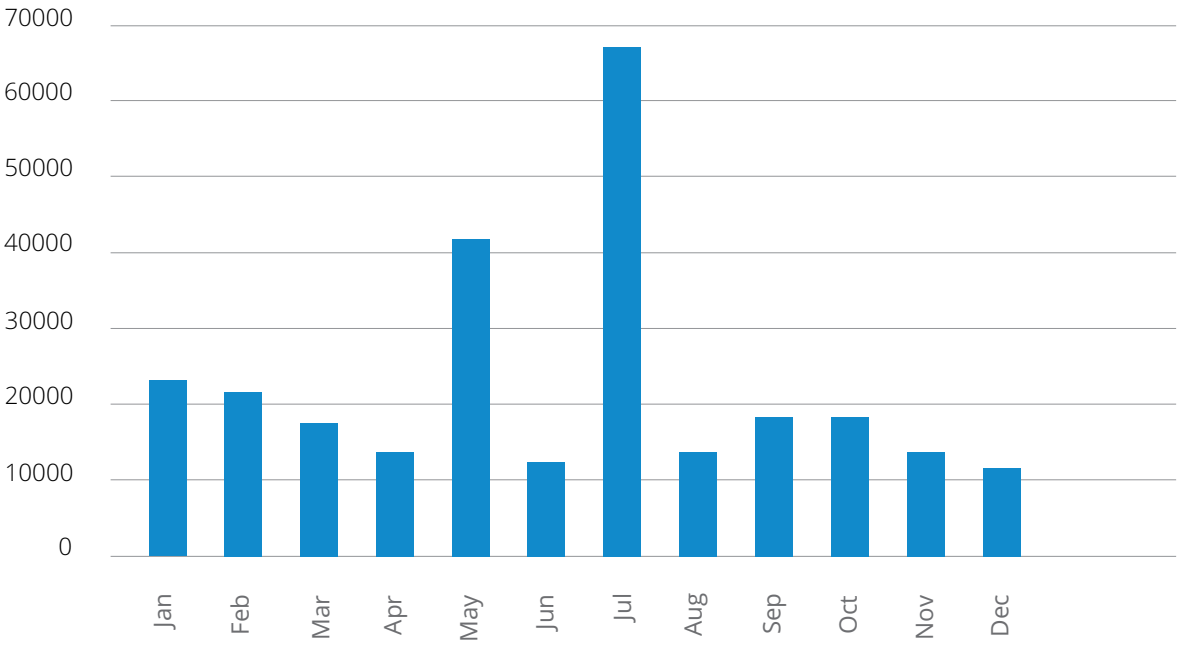
- A list of NATO Science Series publications since 2015 is available here.
- A list of flyers and brochures on recent SPS projects is available here.

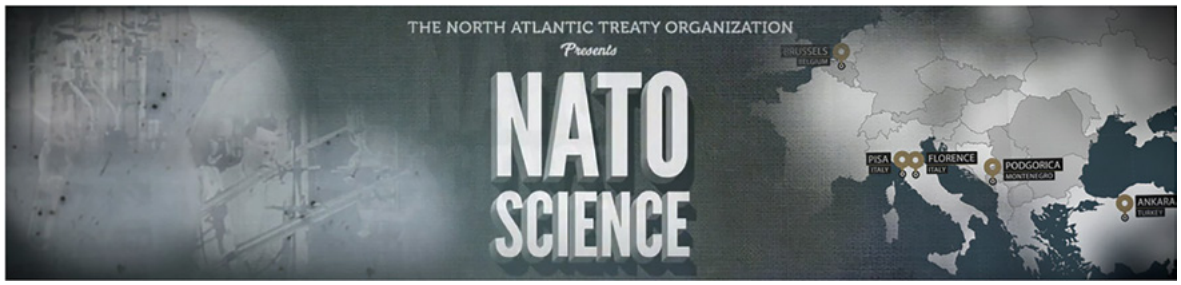
SPS on Social Media

In 2020, the SPS Programme maintained a lively social media presence on Twitter. Its account (*@NATO_SPS*) continued to register an increase in the number of followers, which for the first time exceeded the threshold of 4000. Through this informal channel, the SPS Programme has provided updates to an interested audience about its achievements and milestones, as well as on the launch of new activities. To further amplify the reach of its tweets, SPS directly engaged with NATO stakeholders, NATO Delegations and Missions, as well as SPS-supported scientists and their respective institutions. Moreover, tweets were also used to attract attention to new content posted on the SPS website, expanding the reach of webstories and new calls for proposals.

SPS also made efforts to align its social media presence with key NATO events, such as the accession of the Republic of North Macedonia, as well as topics of interest of the public like the fight against the coronavirus pandemic and the development of new technologies. Tweets focusing on the launch of the two multi-year projects NOCOVID and PROMEDEUS, respectively in May and July 2020, had the highest number of impressions, demonstrating the keen interest of the SPS audience in these events.

@NATO_SPS Twitter impressions in 2020





NATO Science

The NATO Science initiative was launched in 2020 to attract the public's attention towards examples of new and innovative research projects that NATO has supported. This series is part of NATO's efforts to engage younger audiences, and increase their awareness of a strand of work generally not linked to NATO's image in mainstream media. A dedicated NATO Science website was launched in November 2020 to host the content generated in this series, which was also promoted via social media.

The NATO Science website aggregated information and interactive content provided by SPS as well as the Science and Technology Organization. In particular, in the framework of this initiative, five videos were produced, four of which featured SPS Multi-Year Projects showcasing technologies for rapid skin wound healing, explosives detection, collaboration among first responders in emergencies and high-altitude radars. Each video featured also an interview with the scientists who contributed to making these activities a success.

NATO Science videos and interviews are available here:

- Rapid skin wound healing (RAWINTS)
- High-altitude balloon-borne radar (BALSAR)
- The Next-Generation Incident Command System (NICS)
- The robot that goes first (U-GO 1st)

Third-party Coverage on Mainstream and Social Media

SPS activities regularly attract the interest of local and international media outlets, who contribute to amplifying the reach of the Programme's public diplomacy efforts among their audiences. Given the predominance of the coronavirus pandemic in the 2020 news cycle, the launch of an SPS multi-year project working to develop rapid and large-scale diagnostics of COVID-19 received extensive media attention. Particularly in Italy, which is co-leading this promising project with Switzerland, the launch of the project was widely featured in mainstream national newspapers, as well as in scientific television programmes. Of note is also the local media coverage in Ukraine of an SPS webstory dedicated to the country's extensive involvement in the SPS Programme. The story was published following the visit of Ukraine's Deputy Prime Minister, Olha Stefanishyna, to NATO HQ in July 2020.

Several beneficiaries of SPS grants proactively reached out to mainstream media in the context of their activities. Among them, the Advanced Research Workshop "Game Changers 2020", jointly organized by Italy and Morocco in December, was a prominent example among this year's "hybrid" events. With a dedicated media strategy, event organizers succeeded in engaging with their audience before, during and after the workshop via social media, as well as with selected newspapers, online magazines and press agencies, resulting in over 17 articles on the event in local and international media.

SPS actively encourages the beneficiaries of SPS grants to give visibility to their projects online. This resulted in the development of a number of project-specific websites, as well as of dedicated Twitter accounts, through which project teams can share regular updates and engage with the SPS Programme. Over the years, these initiatives of SPS-supported scientists created numerous opportunities to showcase their achievements, directly engage with the media, and consequently attract greater interest in the SPS Programme. Selected examples of such activities include the website of the "Demining Robots" project, (*http://www.natospsdeminingrobots.com*), as well as that of "VECTOR" (*https://projectvector.net*), a research initiative aiming to enable remote analysis of Unexploded Ordnance (UXO) and communication between off-site experts and units on the ground. The new project NANO-LC (*@NanoLc*) is one of the most visible SPS activities on Twitter. Since the launch of this activity in August 2020, its project teams in Italy and the Republic of Korea have been sharing their progress in the development of a smart bio-sensor for the detection of harmful pathogens in water, attracting considerable local and nation media coverage.

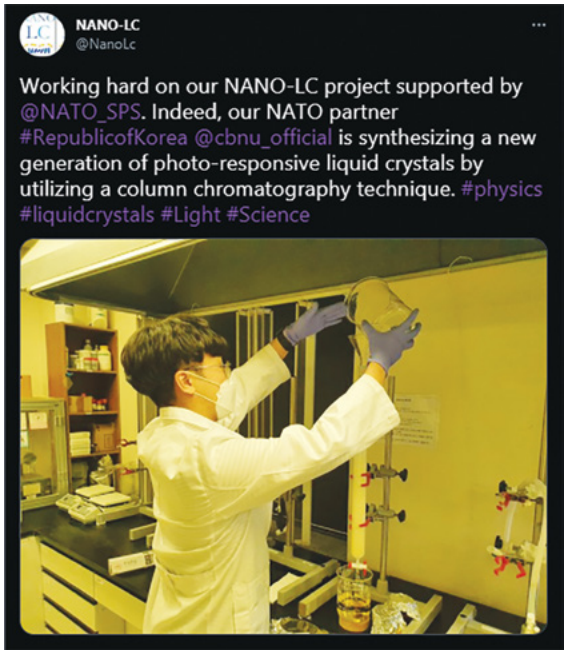


Figure 17 - Source: Twitter @NanoLc

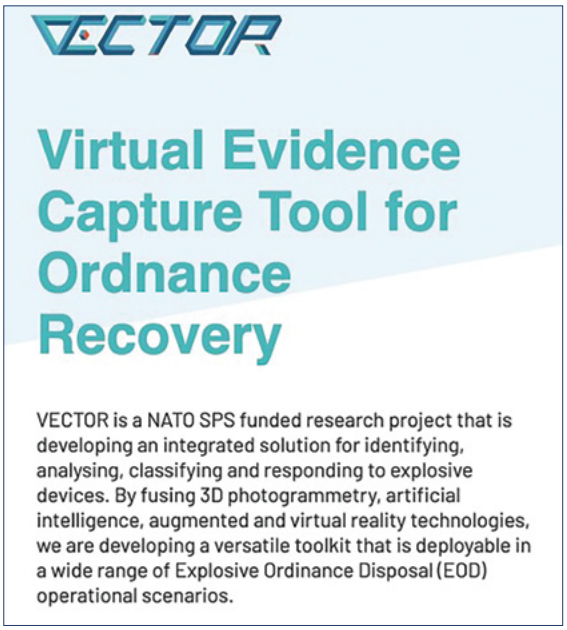


Figure 18 - Source: VECTOR project website: https://projectvector.net

CHAPTER 2 Selected Key Achievements

Counter-Terrorism

The SPS Programme supports all three key areas set out in the NATO Policy Guidelines on Counter-Terrorism (CT): awareness, capabilities and engagement. SPS training courses and workshops bring together experts from NATO and partner nations to improve awareness and understanding of terrorist threats, and to share best practices on CT and Countering Violent Extremism (CVE). SPS Multi-Year Projects develop capabilities by providing technological solutions, such as detectors, to assist in the fight against terrorism. Partnerships are inherent in all SPS activities, supporting the engagement pillar and ensuring that NATO remains connected with partners and other international actors in the fight against terrorism. SPS also supports key efforts in the updated ""Action Plan on Enhancing NATO's Role in the International Community's Fight against Terrorism", including through capacity building. The activities launched as a result of the 2018 Special Call for Proposals in the field of Counter-Terrorism have contributed to developing new capabilities and technologies to tackle terrorist threats and to manage the consequences of terrorist attacks.

Over the course of 2020, two SPS activities under the Key Priority of CT were completed. These MYPs were overseen by co-directors from four different NATO and partner countries and involved 17 young scientists. They developed a multimodal detection system for explosives, and a hybrid-monitoring network, using static sensing devices as well as mobile drones, for situation assessment in inaccessible or hostile environments, specifically suitable for CT missions.

Key flagship top-down *DEXTER Programme*

ONGOING

Participating countries: *France, Germany, Italy, Netherlands, Finland, Serbia, Republic of Korea, Ukraine*

DEXTER (Detection of Explosives and firearms to counter TERrorism) is an SPS key flagship top-down initiative, which aims at developing an integrated system that can detect explosives and firearms in public places, remotely and in real time, without disrupting the flow of pedestrians. As an alternative to random searches on moving passengers or crowd management through multiple checkpoints, DEXTER's final product will allow the identification of carriers of firearms and explosives without affecting the passengers' traffic. The system will be applicable to mass transit scenarios, such as subway stations, train stations and airports, and to critical infrastructures and mass gathering venues. The real-life impact of DEXTER is truly remarkable and of direct benefit to the populations of NATO and Partner countries. The programme contributes directly to NATO's CT efforts and is specifically mentioned in the "Action Plan on Enhancing NATO's Role in the International Community's Fight against Terrorism", last updated in November 2019.

DEXTER includes three research and development projects, launched in 2018 and 2019, and engages 11 research institutions from 8 NATO and Partner countries, and involves an incredible amount of research and coordination. The establishment of a dedicated Consortium, officially signed by all stakeholders and endorsed by NATO in July 2019 has successfully provided an integration framework for the three projects, while ensuring close engagement of all stakeholders involved. Moreover, the Consortium enables joint research and development, delivers better situational awareness, and brings the research and technological developments under the same framework.

- **MIC (Microwave Imaging Curtain)** involves researchers from France, Republic of Korea and Ukraine, and aims at designing a radar system capable of generating 2D and 3D images in real time, addressing non-checkpoint detection of explosives and firearms.

- **EXTRAS (EXplosive TRAce detection Sensor)** aims at developing a proximal trace detection of explosives and their precursors on surfaces, through the implementation of spectroscopy techniques that investigate, in real time, a wide range of surfaces of a potential bomber that might be contaminated with energetic materials. Scientists from Germany, Italy, the Netherlands and Ukraine are working on this project.

- **INSTEAD (INtegrated System for Threats EArly Detection)** is implemented by Finnish and Italian scientists and aims at delivering a system for the centralized management of a plurality of sensors in order to improve the detection capabilities of person-borne explosives in moving crowds.

Figure 19 –Tracking of potential carriers of energetic materials in the framework of the SPS MYP 'EXTRAS'.

All three projects continued progressing in 2020 thanks to the resilience of all project collaborators and notwithstanding the difficulties brought about by the COVID-19 pandemic. Tests, simulations and projects' integration are ongoing and will continue in 2021, together with the preparations for a Big City Trial (live demonstration in a genuine environment), which will take place in Rome, Italy, and is currently scheduled in spring 2022.

G4968 - MYP *Advanced Regional Civil Emergency Coordination Pilot (ARCECP)*

ONGOING

Participating countries: ***USA, Croatia, Bosnia and Herzegovina, Montenegro, Republic of North Macedonia***

Launched in 2016, this SPS flagship top-down project outlines a four-year plan to pilot a Civil Emergency Protection situational awareness and collaboration platform in the Western Balkans. In this regard, ARCECP is enabling participating nations to acquire, deploy and customize the Next-generation Incident Command System (NICS), thus supporting capacity-building of emergency response and management in the region.

NICS is a web-based command and control software that facilitates collaboration across all level of preparedness, planning, response and recovery during natural disasters and other incidents. It enables first responders to exchange information about an event, including GPS locations and images, rapidly and efficiently via mobile devices. To this end, NICS was successfully tested during the NATO field exercises 'Bosnia 2017', 'Serbia 2018', and 'Montenegro 2019'. The system was foreseen to be tested again at the Euro-Atlantic Disaster Response Coordination Centre (EADRCC) exercise 'North Macedonia 2020', which was postponed to 2021 due to the COVID-19 pandemic.

Over the past year, NICS has enabled first responders from North Macedonia to exchange information rapidly and efficiently via mobile devices; it has provided the public with real-time data on the status of the pandemic in their area, and given useful points of contact for assistance. Moreover, in November 2020 a NICS Laboratory was inaugurated at the Military Academy in Skopje, in presence of the Minister of Defence, Ms. Radmila Shekerinska, the Director of the Crisis Management Center and the Dean of the Military Academy. The laboratory will be used for training and operational purposes. More than 1000 users representing the Ministry of Interior, Army, Fire Brigade, Police, Medical Services and the Red Cross of North Macedonia have been trained or exposed to the use of NICS since the start of ARCECP project.

With the establishment of its national instance, Croatia has been testing and adjusting NICS locally with users from the Ministry of Interior, Croatian Mountain Rescue Service (CRO) and the Varaždin County and fire brigade. For instance, CRO used NICS for educational and training purposes as well as for promoting the implementation efforts. The system was also used during the most recent earthquake recovery efforts in Croatia in December 2020, where the National Civil Protection Units adopted the tool for certain tasks in concertation with other relevant organizations. Finally, Croatia is currently exploring the option to add extra modules in NICS for national purposes, including warehouse management, population census, and regional specifics.

In a similar manner, Bosnia and Herzegovina used NICS intensively in different real life situations, such as search and rescue operations, responding to large forest fires, landslides, as well as in demining activities. Following the adoption at the nation level, the Ministry of Security is using the system for communication and coordination at local, regional and national level.

Due to growing usage and adoption of the NICS system in Bosnia and Herzegovina, its Ministry of Defense and Red Cross Society recently joined forces with the local NICS implementation team. Bosnia and Herzegovina is organizing a local field exercise where the national Armed Forces will assist civilians in responding to natural or other disasters, and will test existing procedures and

Figure 20 - Minister of Defence of North Macedonia, Radmila Shekerinska, at the inauguration of the NICS Laboratory at the Skopje Military Academy in November 2020.

usage of the NICS system during joint operations in the field. Finally, the country started preparations for an operations center for training and real-time operational use of NICS.

In spite of the pandemic's impact on operational continuity, multiple institutions in Montenegro continued to be involved in the implementation of NICS at national level: training activities and tabletop exercises as well as testing of NICS features continued in 2020. Montenegro is a regular participant in all (virtual) project meetings and workshops and they continue to provide input and feedback to the development and implementation efforts. To this end, they have developed a 112 mobile application, which offers a range of very useful services such as weather forecast, road conditions, electrical grid maintenance, seismological data, and 112 SOS call. Each of these functions integrates with external services in order to provide up-to-date information.

NEW

G5732 - MYP *Development of Operational Capabilities and of Health Emergency Management in the Fields of Public Health and Civil Protection in Mauritania (PROMEDEUS)*

Participating countries: *Romania, Mauritania, France*

This Multi-Year Project is a flagship initiative building on the achievements of two previous SPS projects that established a crisis management centre in Nouakchott, and four regional operational coordination centres in Mauritania.PROMEDEUS aims to further enhance Mauritania's crisis management system by supporting the development of its operational and emergencies management capabilities in the fields of public health and civil protection, notably through the creation of a telemedicine system for medical emergencies. PROMEDEUS will address security challenges of mutual concern to NATO and Mauritania and will have an impact on the broader Sahel region. The results foreseen from this project are significant for protecting people, goods and the environment, and in ensuring better and faster responses to threats, including widespread diseases such as the COVID-19 pandemic. Eventually, the capabilities developed through this project will be extended to the vast majority of the Mauritanian territory.

The project is in line with the NATO 2010 Strategic Concept that identifies crisis management as one of the three essential core tasks of collective defence and cooperative security. Mauritania, the host of the G5 Sahel headquarters, is a key partner for the Alliance, cooperating through mechanisms such as the SPS Programme to enhance security and stability, and build resilience in the Sahel region.

Figure 21 – Detail of the Crisis Management Centre in Nouakchott established with support from the SPS Programme.

For more information on this Multi-Year Project:

- **Project brochure:** Développement des capacités opérationnelles et de la gestion des urgences dans les domaines de la santé publique et de la protection civile en Mauritanie
- **Webstory:** NATO's Science for Peace and Security Programme supports Mauritania to deal with crisis management

G5674 - MYP *Enhancing Security at Borders and Ports (ESiCure2)*

NEW

Participating countries: *Croatia, Japan, Slovenia, Portugal*

'ESiCure2' is a follow-on to a previously completed project (ESiCure), which designed and fabricated a state-of-the-art radiation detector. ESiCure2 aims to develop a semiconductor-based sensing device capable of delivering a space-resolved signal of a source emitting both neutrons and X-rays, enabling the identification of explosive CBRN materials or special nuclear materials.

This system will provide a solution to address the major challenge of illicit materials trafficking at maritime ports or terrestrial borders. The novel sensing device will be scalable, affordable, robust and versatile enough to detect dissimulated threats at ports of entry and along unattended borders. It will be suitable for in-transit monitoring of cargo and crowds, for mounted mobile surveillance tools, as well as for personal and distributed detector networks. Such technology would largely outperform existing screening capabilities, like synchronous neutron and X-rays detection, decreasing inspection times and false-positives.

The results of this project will contribute to ensure the development of a full range of capabilities for the safety and security of populations and the defence against CBRN threats, in line with the 2010 NATO Strategic Concept. It will address security issues of mutual concern included in the priority areas of cooperation identified in the IPCP between NATO and Japan. In particular, the project will offer an innovative solution in the fields of arms control and non-proliferation, as well as for public events security, and nuclear fuel and waste safety. This project will highlight the contribution of SPS to scientific advancements for the safety of populations in NATO and partner countries.

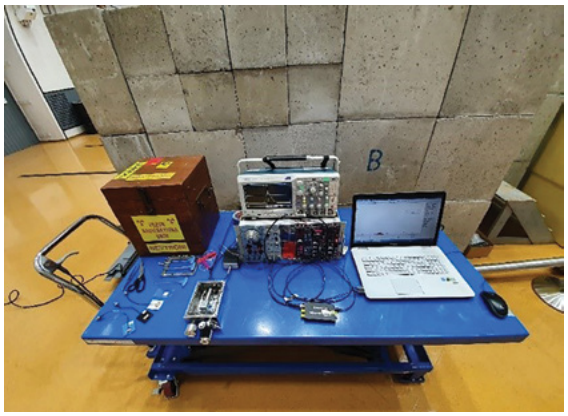
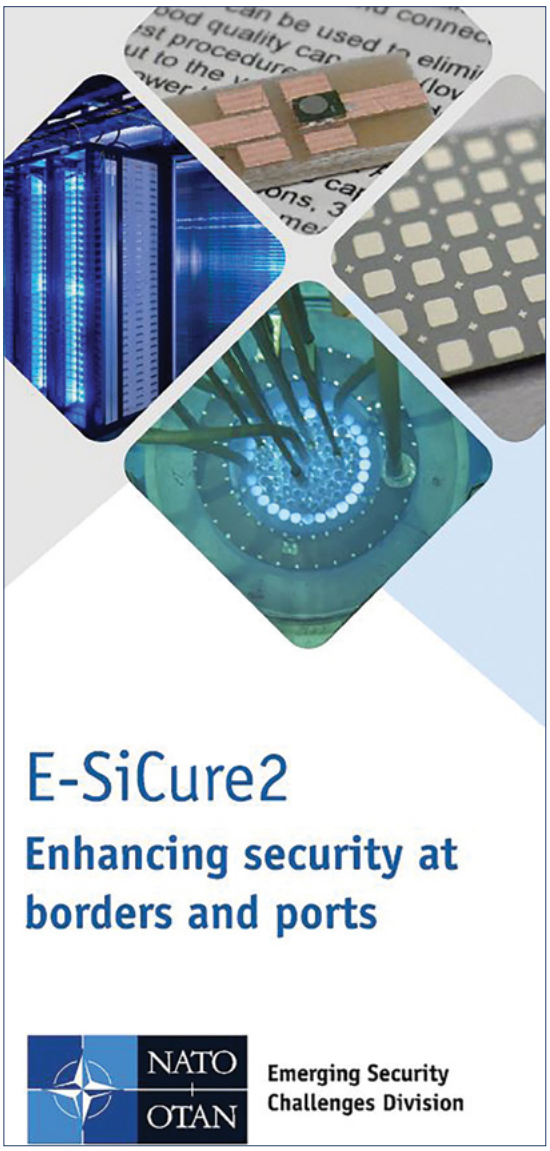


Figure 22 – Full experimental setup for preliminary testing in the SPS MYP 'ESiCure2'.

Find out more about this Multi-Year Project:

Project brochure: E-SiCure2: Enhancing security at borders and ports
Twitter: @e_sicure



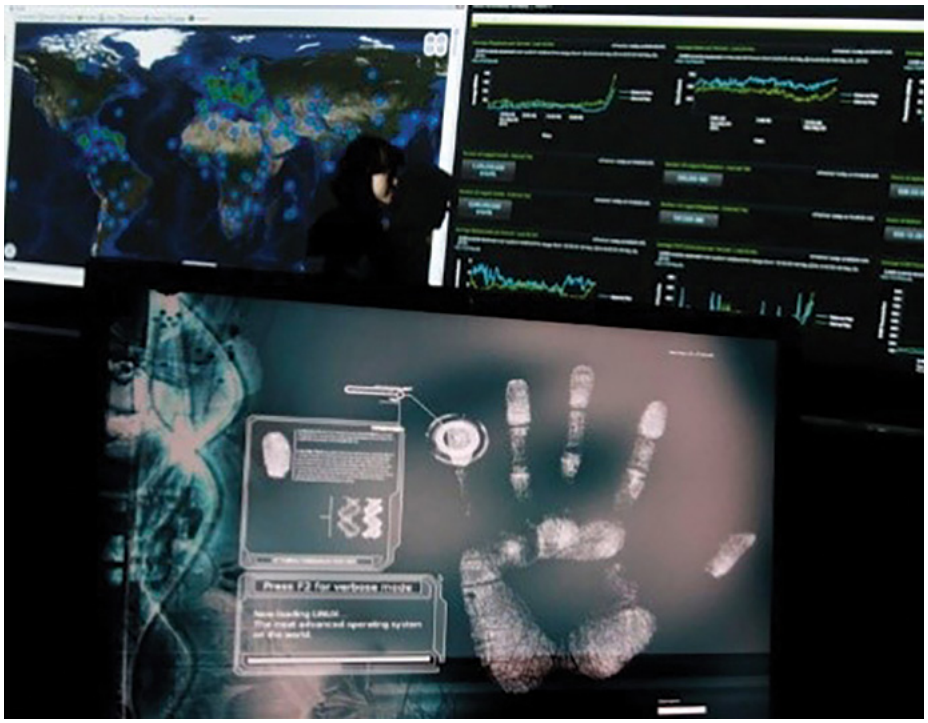
G5812 - MYP *Network for Alerting and Managing Public Safety and Resilience (REACT)*

NEW

Participating countries: *Italy, Georgia, USA*

This Multi-Year Project is a key initiative to enhance interoperability and increase security between NATO and its partners, and to enable early, rapid and effective management of chemical and biological (CB) attacks and incidents. REACT directly contributes to NATO's Strategic Objective to "further develop NATO's capacity to defend against the threat of chemical, biological, radiological and nuclear weapons" as laid out in the 2010 Strategic Concept.

REACT aims to develop an innovative platform for the rapid and effective management of crises following a terrorist attack with CB agents, and to control the diffusion of contamination over space and time in the short to long-term. This project will provide both NATO and partner nations with all necessary tools to implement and maintain a permanent, low-cost and intelligent alarm system for CB attacks and incidents. This technological achievement will significantly improve the security management and protection of citizens and first responders in targeted urban areas of high population density. Through REACT, several young scientists will also be provided with an opportunity to research, collaborate and expand their networks.



For more information on this Multi-Year Project:

Project brochure: netwoRk for alErting And managing publiC safeTy and resilience – REACT

ONGOING

G5556 – MYP *Evaluation Support for Countering Violent Extremism (CVE) at the Local Level*

Participating countries: *USA, Sweden*

The Harvard T.H. Chan School of Public Health in partnership with the Swedish Contingencies Agency (MSB) leads this SPS project, which is co-sponsored by the U.S. Department of Homeland Security Science and Technology Directorate (DHS S&T). The project brings together experts in the areas of program evaluation, training and CVE, with the primary objective of building capacity in CVE programmes evaluation at the local organizational level. It responds to an SPS focus on counter-terrorism initiatives following the endorsement by NATO nations of the "Action Plan on Enhancing NATO's Role in the International Community's Fight against Terrorism". The project aims to facilitate the integration of scientifically derived knowledge into security policies, by demonstrating that evaluation data from sound evaluation methods and tailored to the local context and needs can be used by practitioners and policy makers to share lessons learned and further disseminate CVE solutions and best practices.

Within the scope of this project, a virtual workshop for the Global Safety Evaluation (GSE) Network took place on 1 July 2020. The GSE Network was conceived to bring scientists and policy-makers together in an academic research environment, to work on evaluation of CVE programmes at the local level, and to provide support for CVE actors. The event engaged 91 experts, scientists, and government officials in implementing evaluation methods to assess the performance of CVE programmes. It gathered participants from NATO member and partner countries in the Middle East and North Africa and the Western Balkans in order to expand the geopolitical influence on CVE collaborative efforts.

Figure 23 - Virtual workshop for the Global Safety Evaluation (GSE) Network, July 2020.

Energy and Environmental Security

Since the 1970s, NATO has been developing and adapting an overarching environmental policy in a military context – reinforced by political and standardization agreements – including topics such as waste management, environmentally friendly management practices, and responses to natural and man-made disasters. In the field of environmental security, the SPS Programme aims to reduce the environmental effects of military activities, and to respond to security challenges arising from the environment such as the impact of climate change, which was recognized in NATO's 2010 Strategic Concept as a security risk, while also preventing the disruption of energy supplies.

Alongside environmental security considerations, energy security has been highlighted in all Summit Statements since 2008 as well as in the NATO Strategic Concept. SPS activities in energy security facilitate cooperation amongst experts and scientists, and develop high-quality scientific research and solutions. This includes development and exploitation of cutting-edge technologies and capacities that strengthen the resilience of critical energy infrastructure, and reduce the military's reliance on fossil fuel while maintaining capability to the required levels of effectiveness. Examples can range from the development of the next generation of batteries and portable chargers, to smart energy systems with high impact in the military domain.

In 2020, three SPS Multi-Year Projects were completed under the Key Priority of Energy Security, involving six co-directors and 11 young scientists from NATO and partner countries such as Australia, Italy, Serbia, Spain, Ukraine, United Kingdom, and USA. They worked together to provide effective methods for the monitoring and structural assessment of the operating pipelines; demonstrate the technical feasibility of incorporating hybrid power systems in existing unmanned vehicles; and produced algae-derived biofuel as a way to improve energy security.

In addition, a five-day Critical Energy Infrastructure Protection and Resilience Course was delivered at the NATO-ICI Regional Centre to 27 trainees from various ICI and GCC countries.

Furthermore, under the Key Priority of Environmental Security, a Multi-Year Project was completed by experts from Slovakia, Ukraine, Czech Republic and Spain, who developed a small lithium-sulfur battery (Li-S). This activity benefited from the contribution of nine young researchers, and led to two patent applications.

NEW

G5772 – MYP *Portable Chargers for Soldiers*

Participating countries: *Italy, Ukraine, Republic of North Macedonia*

The main goal of this Multi-Year Project is the development of a lightweight, efficient and wearable self-charging system. The proposed system will be composed of two independent units: an energy-harvesting unit and an energy storage unit. The first one will work by converting mechanical energy into electrical energy, and will use advanced piezoelectric multi-level ceramic-polymeric nanocomposites to achieve lightweight and flexible units with improved piezoelectric properties. The second – the energy storage unit – will be constituted by new, lightweight and flexible devices that can store a large amount of energy (also known as Supercapacitors).

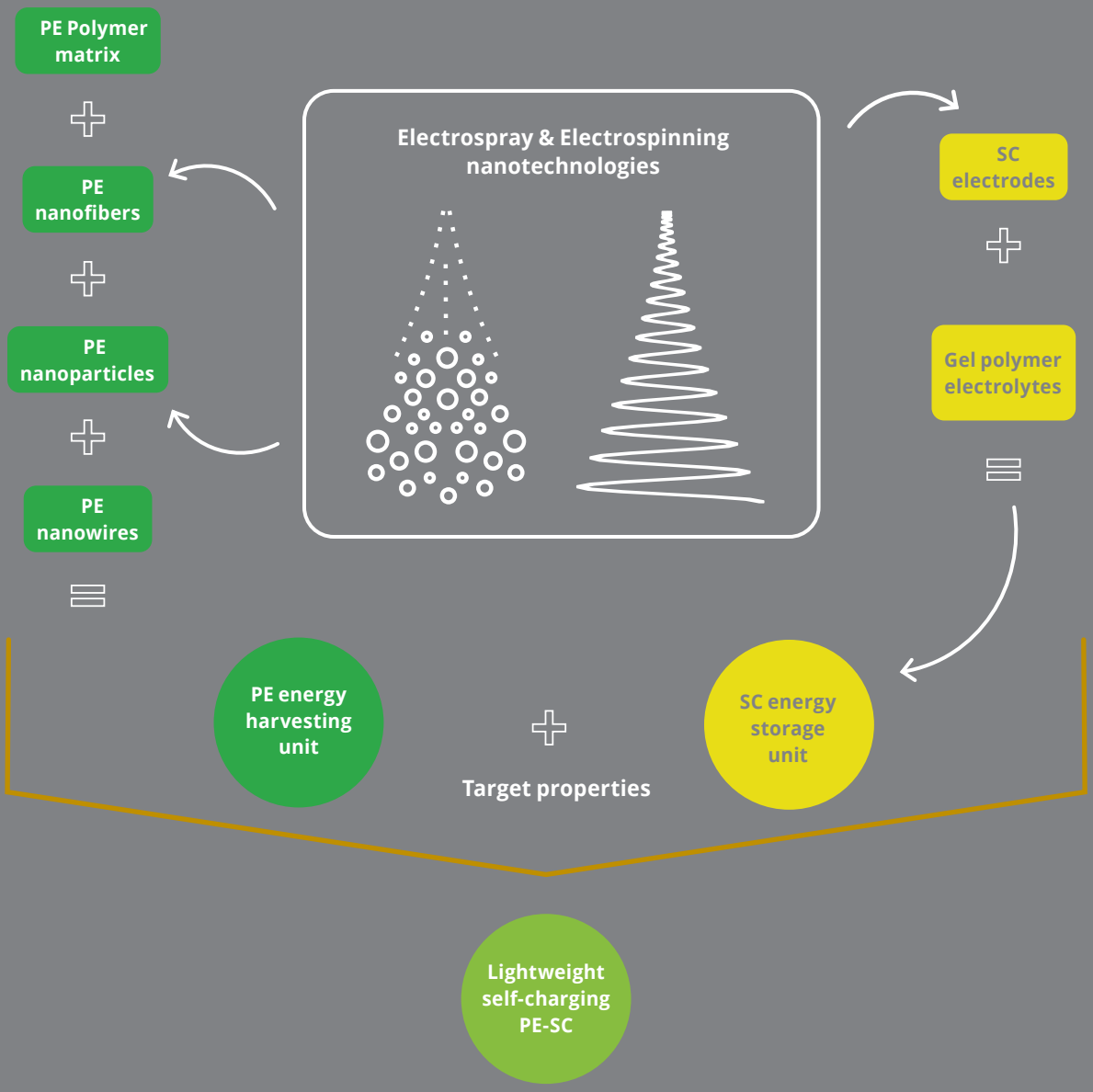


Figure 24 – Proposed concept of the SPS MYP 'Portable Chargers for Soldiers'. Innovative piezoelectric (PE) energy harvesting unit and supercapacitor (SC) energy storage units will be independently developed by making extensive use of electrospray and electrospinning nanotechnologies.

NEW

G5690 – MYP *Earthquake Hazard and Environmental Security in Kazakhstan and Kyrgyzstan*

Participating countries: *United Kingdom, Kyrgyz Republic, France, Germany, Kazakhstan, USA*

Kicked-off in June 2020, this Multi-Year Project aims to produce a standard active fault map and gather paleo-seismic information across the Tien Shan region of Kazakhstan and the Kyrgyz Republic. Earthquakes are a major threat to the environmental security of the Kazakh and Kyrgyz Republics, creating risks to population centres and to critical infrastructure such as canals, dams, roads and pipelines. For effective hazard assessment, and to build critical local capacity, the research team proposes to create up-to-date active fault maps through forensic field- and satellite-based geological investigations, including the analysis of past seismic events. The project will help to promote transcontinental cooperation between Central Asia, Europe and the USA.

ONGOING

G5525 – MYP *Harmonized Energy Monitoring and Camp Simulation Tools for Energy Efficiency*

Participating countries: *Canada, Australia, France, Germany, Netherlands, USA*

Over the course of 2020, this top-down project continued to advance its goal to increase energy efficiency in deployable camps and reduce reliance on fossil fuels. The project is developing and deploying universal energy monitoring equipment and a camp simulation model, which will facilitate the assessment and forecasting of energy demand management in military camps while supporting interoperability. The equipment comprises flexible, portable, and non-intrusive kits.

In the 2016 Warsaw Declaration, Heads of State and Government committed to improving the energy efficiency of military and forces through establishing common standards, reducing dependence on fossil fuels, and demonstrating energy-efficient solutions for the military. This project contributes to that goal in a very practical sense. Deliverables will include the tools and procedures required to enable informed decisions to be made on the optimization of running military camp equipment through the efficient production and consumption of energy, energy storage, and demand management.

G5148 – MYP *Development of New Cathodes for Stable and Safer Lithium-Sulfur Batteries*

COMPLETED Participating countries: *Slovakia, Ukraine*

Completed in March 2020, this Multi-Year Project developed and prepared a small lithium-sulfur battery. The novel aspects of the project were the combination of different chemical and physical procedures of preparation and characterization of all battery components, especially the cathodes. The project investigated new materials to enable the production of components for Li-ion batteries with significantly improved reliability, including greater stability, power density and efficiency. The project also focused on the development of new sulfur-based composite cathode materials suitable for high-energy lithium-ion batteries, and took into account safety, environmental compatibility, price and efficiency considerations. Based on research results, the project team concluded that pouch cell prototypes offered improved safety and energy density and that this advantage could also be used in military applications.

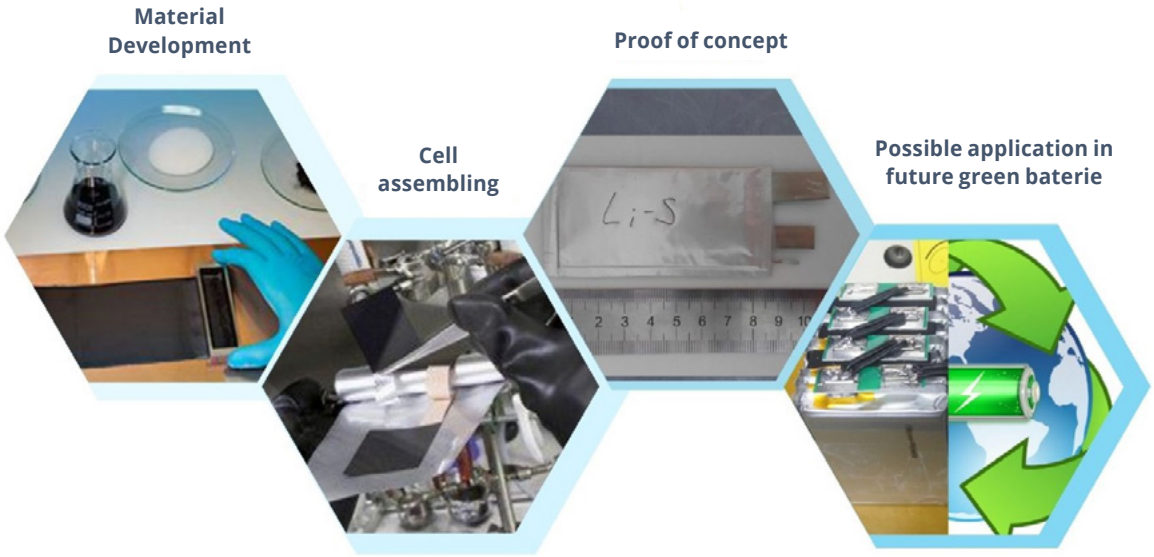


Figure 25 – Visual overview of the implementation process of this MYP.

G5079 – MYP *Improving Efficiency and Operational Range in Unmanned Vehicles using Fuel Cells*

COMPLETED Participating countries: *Spain, Australia*

This three year Multi-Year Project was completed in February 2020. It aimed to demonstrate and evaluate the technical feasibility of hybrid power systems, based on batteries and proton exchange membrane (PEM) fuel cells, in existing unmanned vehicles. The hybrid power systems were designed and developed according to the specifications of three existing unmanned platforms: an Autonomous Underwater Vehicle (AUV) and two Unmanned Ground Vehicles (UGVs). These power systems were integrated and evaluated in real operating conditions.

Regarding the AUV, the expected requirements were not completely fulfilled during drag and resistance tests at the initial system integration stage. The project team plan to conduct further evaluations in underwater conditions and to develop a new underwater platform that can deliver the full potential of the hybrid power system developed in this project.

The power systems for the two UGVs were successfully integrated and tested in different scenarios and missions. The systems developed in this project provided an increased operational range over more than seven hours of use in challenging environmental conditions, thereby demonstrating the utility of retro-fitting existing platforms with innovative energy systems.

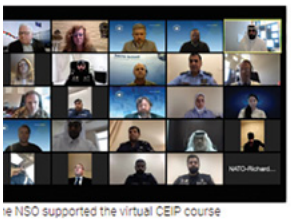
Figure 26 – UGV with hydrogen storage system developed in the framework of SPS MYP 'Improving Efficiency and Operational Range in Unmanned Vehicles using Fuel Cells'.

G5737 – ATC *Critical Energy Infrastructure Protection and Resilience Course (22-26 November 2020)*

COMPLETED

Participating entities: *NATO School Oberammergau, NATO-ICI Regional Centre in Kuwait*

This Advanced Training Course in the area of critical energy infrastructure protection and resilience, has been developed by authorities from the National Security Bureau of Kuwait, the NATO School Oberammergau and the Naval Postgraduate School. The course addressed the challenges associated with protecting national critical energy infrastructure from threats, including cyber, terrorist attacks, or natural disasters, and how to maintain the energy supply chain and operational resilience in the energy domain. The course was delivered online over the course of five working days, to a group of 27 civilian and military personnel working in governmental institutions in Kuwait, Qatar, United Arab Emirates and Saudi Arabia.



e NSO supported the virtual CEIP course

The NSO conducted CEIP Course online

By Liliana Serban, ROU-CIV, Naval Postgraduate School Course Director and Col Michael A. Davis, USA-A, Commandant of the NSO

27 participants completed the NATO Science for Peace and Security Advanced Training Course "Critical Energy Infrastructure Protection(CEIP) and Resilience".

The NATO School Oberammergau (NSO) in conjunction with the Naval Postgraduate School in Monterey, California, and the NATO-Istanbul Cooperation Initiative Regional Centre in Kuwait conducted the course. This annual event brought together students from across the inter-governmental spectrum in Kuwait, Qatar, United Arab Emirates, and Saudi Arabia.

This course was conducted exclusively online due to the COVID-19 pandemic. The many practitioners and scholars joined the students virtually from locations and organizations such as NATO's Hybrid Threats & Energy Security Section and the Defence Policy and Planning Division at NATO HQ in Brussels, Belgium.

Figure 27 – Article published upon completion of the SPS ATC 'Critical Energy Infrastructure Protection and Resilience Course'. Source: NATO School Oberammergau

Cyber Defence

The Cyber Defence activities supported by the SPS Programme cover a wide range of topics, from quantum computing to analysis of threats, artificial intelligence, cryptology, security of networks and hybrid threats in the information domain, cyber-physical systems protection and control, cyber defence in supply chains and logistics. They are developed in line with the 2010 Strategic Concept, which identifies the enhancement of cyber defence capabilities as a key objective, and respond to Allied guidance received at the latest NATO Summits. Moreover, they implement the provisions of the revised 2014 NATO Policy on Cyber Defence regarding the need for the Alliance's co-operation with partner countries. Therefore, the activities resulting from the 2017 Special Call for Proposals on Cyber Defence have greatly contributed to enhancing the technological research and development in the cyber security area and built cyber capacity in NATO partner countries.

Four Multi-Year Projects were completed throughout 2020 under this SPS Key Priority area. Among them, one SPS initiative led by Canada and North Macedonia focused on the virtualization of wireless networks resources capabilities in order to reach a highly flexible and adaptable wireless network able of providing reliable communication in flash crowds. In the framework of another project, experts from France, Morocco and USA developed machine-learning algorithms with the aim of analyzing different cyber-attack types days in advance. Both projects involved the participation of 11 young scientists. In addition, two major capacity building projects were successfully implemented with the support of the NCI Agency and the Ministries of Defence of the Republic of Moldova and Mongolia respectively. These two distinct projects contributed to the creation of Cyber Incident Response Capabilities through the provision of equipment, training and technical advice.

Despite the COVID-19 pandemic, five courses were implemented online and/or in presence over the past year, including: a Network Security course delivered in Tunisia at the end of 2019 and finalized in early 2020; a package of Network Security and Network Vulnerability Assessment and Risk Mitigation courses delivered in North Macedonia; and a package of Introduction to Network Security and Introduction to Network Vulnerability courses conducted at the NATO-ICI Regional Center in Kuwait.

G5448 – MYP *Quantum-safe Authenticated Group Key Establishment*

ONGOING

Participating countries: *Slovakia, Malta, Spain, USA.*

Figure 28 – Meeting of project teams working on SPS-supported MYPs on quantum technology in Smolenice Castle, Slovakia.

With computers getting faster every day, internet security is increasingly coming under threat. Even worse, in a few years quantum computers will make all traditional communication systems insecure. In fact, currently popular cryptographic algorithms are based on mathematical problems that cannot be solved even by traditional super computers; however, they could be easily solved on a sufficiently powerful quantum computer. This project aims at exploring cryptographic theory to establish structural guarantees for secure communication protocols that cannot be broken, even by quantum computers. The project has currently established and physically implemented, through hardware and software means, post-quantum cryptographic solutions and protocols.

G5340 - MYP *Development of the Moldovan Armed Forces Cyber Defence Capabilities*

COMPLETED

Participating entities: *NCI Agency, Republic of Moldova*

This top-down Multi-Year Project constituted the latest contribution of the SPS Programme to the DCB Package for the Republic of Moldova, and responded to a request by the country's government.

The goal of the project was to develop the cyber defence capabilities in the Moldovan Armed Forces. This was achieved by establishing the Moldovan Armed Forces Cyber Incident Response Capability (MAFCIRC) with a supporting cyber defence infrastructure.

This capability will allow to control and minimize any damage, provide quick and efficient recovery and prevent similar future events.

The main deliverables of the project were:

- Building defence capacities of the Republic of Moldova through the establishment of the MAFCIRC with its supporting infrastructure at the Moldovan Ministry of Defence (MoD). The MAFCIRC will contribute to the protection of critical military IT infrastructure, prevention, detection and reaction to cyber attacks in the first stages, followed by sharing of information and lessons learned with relevant Moldovan defence and security institutions;

- Delivery of specialised cyber defence, Cyber Security Incident Response and ISO 27001 trainings to the personnel of MoD (15 persons were trained);

- Provision of technical advice to design the cyber laboratory;
- Provision of necessary IT equipment and refurbishment of the physical infrastructure of the cyber laboratory
- Supporting the Moldovan Armed Forces in expanding cooperation with specialized institutions from NATO in the area of cyber defence so as to develop and ensure their information security.

For more information on this Multi-Year Project:

Project brochure: Inauguration of the Moldovan Armed Forces Cyber Incident Response Capability

Webstory: Cyber Incident Response Capability established in the Republic of Moldova with NATO support

In January 2021, a virtual inauguration ceremony followed the successful conclusion of this project, which was implemented between February 2018 and November 2020 in cooperation with the NCI Agency. NATO Deputy Secretary General Mircea Geoană, Assistant Secretary General for Emerging Security Challenges David van Weel and Dr Deniz Beten, Senior SPS and Partnership Coordination Advisor took part in the ceremony from the NATO TV Studio. The Minister of Defence of the Republic of Moldova, Victor Gaiciuc, the Chief of National Army General Staff and Commander of the National Army, Brig. Gen. Igor Gorgan, as well as the NCI Agency Chief of Staff, Major General Göksel Sevindik, participated in the event remotely.

The event gained broad visibility through articles published via NATO channels, as well as via local media coverage in the Republic of Moldova.

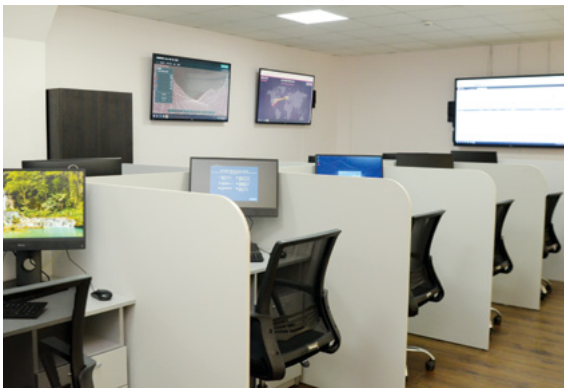


Figure 29 – Detail of the cyber laboratory established with support from the SPS Programme within the Moldovan Ministry of Defence.

G5281 – MYP *Creation of Cyber Security Center*

COMPLETED

Participating entities: *NCI Agency, Mongolia*

The goal of this top-down project was to develop the cyber defence capabilities in the Mongolian Armed Forces. This was addressed by creating a Cyber Security Centre incorporating a Cyber Incident Response Capability (CIRC) for the Ministry of Defence and General Staff of the Mongolian Armed Forces and the training of network administrators/ cyber security staff to man the Cyber Security Centre and CIRC.

The main deliverables of the project were:

- Building defence capacities of Mongolia through the establishment of the Cyber Security Center with supporting infrastructure at the Mongolian Ministry of Defence (MoD).
- Delivery of specialised cyber defence training in network technology skills and CIRC-specific skills, as well as English language skills, to MoD personnel;
- Provision of technical advice for the design and integration of the cyber laboratory;

Figure 30 - NATO Deputy Secretary General, Mircea Geoana, and the Minister of Defense of Mongolia, Saikhanbayar Gursed, at the virtual ribbon-cutting ceremony for the inauguration of the Mongolian Cyber Security Centre.

For more information on this Multi-Year Project:

Project brochure: Virtual Inauguration Ceremony of the Cyber Security Centre in Mongolia

Webstory: NATO helps to strengthen Mongolia's cyber defence capacity

- Supplying necessary IT equipment for the cyber laboratory;
- Supporting the Mongolian Armed Forces in expanding cooperation with specialised institutions from NATO in the area of cyber defence so as to develop and ensure their information security.

This project was implemented between July 2017 and November 2020 in cooperation with the NCI Agency and the Ministry of Defence of Mongolia. To mark its successful conclusion, SPS hosted a virtual ribbon-cutting ceremony in January 2021. NATO Deputy Secretary General Mircea Geoană and Assistant Secretary General for Emerging Security Challenges David van Weel participated in the ceremony from NATO HQ. Mongolia's Minister of Defence, Saikhanbayar Gursed, and the NCI Agency Chief of Staff, Major General Göksel Sevindik, joined the event remotely and highlighted the importance of the new cyber defence capability established through this SPS initiative.

COMPLETED

G5675 - ATC *Network Security Course and Network Vulnerability Assessment and Risk Mitigation Courses*

Participating entities: *NATO School Oberammergau, Republic of North Macedonia*

In light of its NATO accession process, the development of cyber security capabilities was considered a top priority for North Macedonia. Following an assessment conducted in Skopje by the NATO Cyber Defence Section, the Assistant Secretary General for Emerging Security Challenges highlighted the importance of providing cyber defence training to this Nation through the framework of SPS. This encouraged the development and approval of two top-down SPS Advanced Training Courses tailored to North Macedonia's needs, and conducted jointly by the NATO School Oberammergau and the Naval Postgraduate School.

01. Network Security Course provided an understanding of the bits-in transit aspect of information/cyber security, by including three major topic areas:

A. An understanding of how computer networks function

B. The detection and filtering of malicious network traffic via authentication mechanisms, attack signature recognition, and filter mechanisms and strategies, and

C. The protection of friendly network traffic via cryptologic mechanisms.

02. Network Vulnerability Assessment and Risk Mitigation Course trained students in the methodologies and techniques used for vulnerability assessments and follow on mitigation. These methodologies were reviewed in-depth as they were applied from the vantage point of a hacker. Common vulnerabilities were also studied.

In total, 64 military and civilian personnel from North Macedonia representing seven governmental institutions took part in the two courses. Security managers benefited from technical insights that facilitate informed decision-making and better communications with technicians and engineers. Security technicians and engineers benefited from the big picture that provided grounding and context for what is often narrowly focused and task-oriented work. Also, they understood potential vulnerabilities and their mitigation in networked systems as they studied (1) methods to obtain information about a remote network, (2) how to possibly exploit or subvert systems residing on that network, as and (3) techniques to mitigate risks to networked systems.

For more information on these Advanced Training Courses:

Webstory: North Macedonia strengthens its cyber defences

COMPLETED

G5742 - ATC *Advanced Cyber Defence Training Courses at the NATO-ICI Regional Centre in Kuwait*

Participating entities: *NATO School Oberammergau, NATO-ICI Regional Centre in Kuwait*

Taking into account the lessons learned from the SPS Advanced Training Courses delivered between 2017-2019, and after a joint NATO-ICI Regional Center assessment of future training needs in the region, a new package of courses was developed and implemented in 2020. The primary goal of the SPS Advanced Training Courses (ATC) in cyber defence and critical energy infrastructure protection included in the package was to strengthen the Istanbul Cooperation Initiative (ICI) by fostering cooperation between NATO and ICI countries. This was in accordance with the NATO-Kuwait bilateral agreement, signed by the NATO Secretary General and the Ministry of Foreign Affairs of Kuwait on 24 January 2017, and with the mandate of the NATO-ICI Regional Centre.

In addition to a training course in critical energy infrastructure protection, two Cyber Defence Advanced Training Courses were delivered at the NATO-ICI Regional Centre in Kuwait in 2020:

01 **Introduction to Network Security Course (27 September-8 October 2020)**

The aim of this basic cyber defence course for system and network administrators was to provide participants with an understanding of the functioning of computer networks, the detection and filtering of malicious network traffic as well as the protection of friendly network traffic. Delivered in cooperation with the Naval Postgraduate School (NPS) in Monterey and the NATO School Oberammergau (NSO), this two-week course aimed at providing each student with a thorough conversational knowledge of all the dominant terminology and principles involved in the bits-in-transit aspect of network security. At the end of the course, students were be able to describe the patterns and protocols of "normal" network traffic, and of many cues that can be used to recognize malicious/attack traffic and also to demonstrate the rudiments of firewall deployment and rule-writing.

02 **Introduction to Network Vulnerability Assessment and Risk Mitigation Course (29 November – 10 December 2020)**

The aim of this advanced-level SPS cyber defence training course for system and network administrators was to involve participants directly with the methodologies and techniques used for network security, vulnerability assessments and risk mitigation. This two-week training course was also delivered in cooperation with the NPS and NSO. The course aimed at providing an understanding of the methods and operations used to exploit cyber networks. At the end of the course, students were be able to describe the methodology used to assess the vulnerability of an organization connected to the Internet and also the current types of vulnerabilities. The course covered the main areas of network vulnerability assessment: Ethical Hacking, Use of Metasploit (Penetration testing software), Physical Security, Footprinting and Reconnaissance, Scanning and Enumeration.

35 participants from Bahrain, Kuwait, Oman, Qatar and the Secretariat General of the Gulf Cooperation Council attended the two courses, and would now be prepared to participate in more advanced cyber defence training as part of the process of building regional cyber defence expertise.

NATO-ICI Regional Centre Kuwait

Online Cyber METT delivered to the NATO-ICI Regional Centre Kuwait

By Liliana Serban, ROU-CIV
Naval Postgraduate School Course Director

On 24 Sep 20, the NATO School Oberammergau (NSO), in partnership with the Naval Postgraduate School (NPS) and the NATO-Istanbul Cooperation Initiative (ICI) Regional Centre, Kuwait, concluded the Introduction to Network Security Course under the auspices of the NATO Science for Peace and Security (SPS) Programme.

The two-week Mobile Education and Training Team (METT) course was conducted exclusively online in order to mitigate the effects of the COVID-19 pandemic, and attracted 19 students from Kuwait, Qatar, Oman and the Gulf Cooperation Council (GCC) General Secretariat.

The course addressed three major topics: networking, basic principles (INFOSEC, Filtering and Cryptology) and recognizing/blocking the "bad" bits (Traffic Analysis and Filtering); it will be followed by the Introduction to Network Vulnerability Assessment Course 29 Nov -10 Dec 20.

Figure 31 - Article published upon completion of the SPS ATC 'Introduction to Network Security'.
Source: NATO School Oberammergau

CBRN Defence

In line with NATO's objective to improve the ability of the Alliance and its partners to protect their populations and forces from CBRN threats, the SPS Programme supports activities under the Key Priority of Defence against CBRN agents. The ambition to continuously improve NATO's capabilities and technologies to counter CBRN threats was reiterated at the 2018 Brussels Summit by the Alliance's Heads of State and Government.

SPS activities in this domain aim to deliver high-quality scientific research, develop technologies, build capacity, and train young researchers and experts, strengthening the overall resilience and capabilities of participating countries. They include research activities, conferences, workshops and training courses across the field of CBRN defence. This way, SPS supports situational awareness on safety and security developments, and enhances CBRN response capabilities, technical competences, and skills in NATO and partner nations. Cooperation among experts and scientists from NATO and partner nations, as well as the development of capabilities within these integrated teams, are critical factors in the implementation of capabilities and practices to meet CBRN threats. Projects in this area provide an excellent demonstration of broad multi-disciplinary and multi-national participation.

Under this Key Priority, three MYPs were completed in 2020. They involved co-directors from seven countries and supported 10 young scientists. They developed technologies to reliably identify nuclear materials using spectrometry data, detect genotoxicity from CBRN and explosive devices in the field, and to improve security through safer cementation of hazardous wastes.

NEW

G5817 – MYP *New and Validated Tools for the Diagnosis and Follow-up of SARS-CoV-2 Infected Individuals (NOCOVID)*

Participating countries: *Italy, Switzerland*

In May 2020, the SPS Programme launched a Multi-Year Project contributing to Allied efforts to combat the COVID-19 pandemic. This 24-month initiative aims to enhance the speed and efficiency of COVID-19 diagnosis through a multidisciplinary approach, by bringing together experts in the field of immunology, virology and molecular biology. The aim of this project is not only to produce immunodiagnostic tools specific for SARS-CoV-2 antigens in sera of patients or contacts, but also to detect viral particles or viral-released proteins in biologic fluids of infected individuals for a rapid diagnosis based on the detection of antigens. This type of detection, as a measure of individuals' infectivity, has already been applied to the diagnosis of active tuberculosis, for which the differential diagnosis is crucial in order to plan therapies and restriction measures.

The results foreseen from the project are extremely relevant to the COVID-19 pandemic, and support NATO's efforts to enhance resilience and civil preparedness in Allied and partner nations. The immunization procedure used in this project to generate monoclonal antibodies will also provide an immunogenicity preclinical model of a COVID-19 preventing vaccine. The identification of virus-neutralizing antibodies can represent a first step in the development of immuno therapeutics based on the administration of antibodies to treat infected patients. The results are expected to have a long-term impact on the international response to the spread of viruses on a large scale, and will contribute to the improvement of risk management and public health measures in the future.

For more information on this Multi-Year Project:

Project brochure: New and validated tools for the diagnosis and follow-up of SARS-CoV-2 infected individuals

Webstory: Coronavirus response: NATO supports practical scientific cooperation with Allies and partners to enhance COVID-19 diagnosis

NEW

G5759 – MYP *Nanotechnology-based Biosensor with Photo-Responsive Liquid Crystals – NANO-LC*

Participating countries: *Italy, Republic of Korea*

The contamination of drinkable water by pathogens could affect large portions of the population, endangering their health and lives. Furthermore, in a water terrorism scenario, early detection is critical in order to minimize the impact on the population. Kicked-off in August 2020, the "NANO-LC" project aims to pioneer a new breakthrough technology to address this threat on public health and security. This project will develop a miniaturized device capable of detecting a selection of specific pathogens in potable water in real time. More precisely, this project proposes a compact, low-cost, real-time (≈300-400 milliseconds), highly sensitive biosensor offering a quantitative and chemical recognition evaluation of the bio-associated risks.

Figure 32 – Virtual kick-off of SPS MYP 'Nanotechnology-based Biosensor with Photo-Responsive Liquid Crystals – NANO-LC' in August 2020.

The device will generate an alarm upon the detection of dangerous pathogens, to ensure a rapid response to the contamination and prevent casualties. The results will contribute to improve defence capabilities against biological weapons of mass destruction and the contamination of water intended for human consumption by dangerous pathogens in line with the NATO 2010 Strategic Concept.

Furthermore, this project will enhance the Alliance's collaboration with the Republic of Korea through a joint cooperative project in the field of civil science and security as stated in the IPCP between the country and NATO.

ONGOING

G5571 - MYP *DIMLAB-Deployable CB Analytical Laboratory. Application of Nano-Bio- Technology*

Participating countries: *Spain, Morocco, Tunisia*

Deployable field laboratories have formed the backbone of the fight against CB threats. Usually comprising chemical and biological modules, these labs need to meet operational requirements for the rapid detection and identification of the main hazardous CB warfare agents. The challenge is therefore to design and build a lightweight, easily transportable and storable laboratory that offers accurate identification of biological pathogens and chemical products, while being cost effective, user-friendly and easy to maintain.

This top-down Multi-Year Project (MYP) was launched in November 2019, and aims at building two dual-use (civil and military) deployable laboratories, one chemical and one biological, for Tunisia and Morocco respectively. The project will focus on the application of nanobiotechnology to develop a fully operational, chemical-biological analytical turnkey solution for the use of academia and national institutions. It goes beyond the state of the

Figure 33 – Live demonstration of CBRN incident response.

art in seeking to create a framework of cooperation in which scientists and engineers work together analysing technologies and instruments to be used in CBRN response. In 2020, the project has been adapted to include the SARS-COV-2 agent in the library of detectable pathogens.

The impact of COVID-19 on travel and face to face in-country meetings has been significant, but video conferencing has allowed good progress to be made. In this regard, the specifications for the deployable laboratories and equipment were agreed and procurement is continuing. Moreover, a series of monthly seminars covering CB threats and operational doctrine took place in preparation for the final training and activation of the capability.

This project is a key component of the SPS contribution to the DCB package for Tunisia, which listed CBRN defence as a priority area of cooperation with NATO in its most recent IPCP.

COMPLETED

G5402 – MYP *Improved Security through Safe Cementation of Hazardous Wastes*

Participating Countries: *United Kingdom, Serbia*

Figure 34 - Young researcher from the Institute of multidisciplinary research, while using ICP-OES equipment to investigate the leaching of hazardous elements from alkali-activated matrices.

This Multi-Year Project enhanced public security by developing an innovative solution to remove chemical and radioactive hazards associated with waste materials. Specifically, the project used alkali-activated materials (AAMs) for improved solidification/stabilization (S/S) of hazardous wastes (toxic and/or radioactive). The S/S process decreases the potential environmental impact of hazardous wastes by reducing their leachability.

The main expected outcome of the project was the safe and secure storage and eventual disposal of wastes, removing them from the biosphere. CBRN waste located in Serbia still awaits detailed characterization and treatment. The developed technology will be applied by the Waste Processing Facility within the Public Company "Nuclear Facilities of Serbia", enabling the conditioning of radioactive waste into standard waste packages for final disposal. The proposed project resonates with the commitment made by NATO Heads of State and Government at the Warsaw Summit to "ensure that NATO continues to be both strategically and operationally" prepared to counter CBRN threats. The removal of hazardous contaminants from the biosphere is essential to ensuring the long-term security and sustainability of future societies.

Advanced Technologies

In October 2019, Defence Ministers approved an Emerging and Disruptive Technologies (EDT) roadmap to help structure NATO's work across key technology areas, and enable Allies to consider these technologies' implications for deterrence and defence, capability development, legal and ethical norms, and arms control aspects. At the London Meeting of December 2019, Heads of State and Government confirmed the need to address "the breadth and scale of new technologies to maintain our technological edge, while preserving our values and norms". Advanced technologies represent a unique opportunity for the SPS Programme to support cutting-edge security-related research and development, and to sustain the Alliance and its Partners in their modernization and innovation efforts. Advanced technologies are disruptive in nature, contributing to the evolution of the security environment; they bring a tremendous added value in addressing a variety of security challenges in the fields of counter-terrorism, hybrid challenges, cyber defence, and crisis management. As such, this SPS Key Priority area responds directly to NATO's Strategic Objective of ensuring that the Alliance has the full range of capabilities necessary to deter and defend against any threat to the safety and security of its populations.

The Programme supports activities that develop emerging and disruptive technologies, including nanotechnology, artificial intelligence, big data, quantum technology, new materials, sensors and detectors, and unmanned and autonomous systems. SPS activities under this Key Priority support scientific advancements, development of technologies for civil-military applications, and the creation of a vibrant scientific community - including young scientists - to share common interests and significant know-how.

In 2020, eight SPS Multi-Year Projects in the area of Advanced Technologies were completed by co-directors from 15 countries. They involved 31 young scientists under the age of 40. These MYPs developed high-efficiency sensors and graphene/polymer based devices; autonomous platforms for monitoring and securing harbor infrastructures; and a new command and control system allowing the coordination of teams of drones. Furthermore, they focused on the development of a compact LIDAR source; an indoor collaborative navigation system for the protection of personnel engaged in operations; a data fusion system integrating different sources; and a new agile mobility control system for unmanned ground vehicles.

Overview of the 2020 SPS Special Call for Proposals in the field of Advanced Technologies

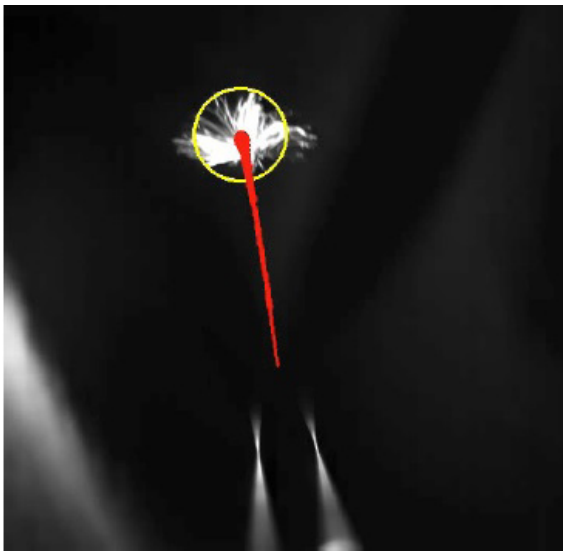
In late 2019, SPS issued a Special Call for Proposals in the field of Advanced Technologies, to trigger applications in a number of fields: data science and artificial intelligence, communication systems, material science, sensors and detectors, autonomy, counter-autonomy and technological convergence. This calls for proposals attracted more than 50 applications, which resulted in 22 activities awarded in the course of 2020, focusing on areas such as photonics, quantum mechanics, drones, autonomy, Internet of Things, and sensor fusion.

G5638 – MYP *Development of Micro-Scale, Bio-Inspired Passive Drone System*

NEW

Participating countries: *Canada, Republic of Korea*

This project aims at the development of passive atmospheric floating vehicles, to be used in swarms, to allow the characterization of atmospheric flows in areas of interest. This will allow to better forecast the spread of potential chemical agents or emissions from man-made or natural catastrophes. The floating sensor vehicles will be designed according to bio-inspired structures, i.e. wind-dispersed seeds, such as dandelion, thistle and milkweed, in order to exploit flows for maximal dispersal. The vehicle will also incorporate an inertial measurement unit (accelerometer, gyroscope, and magnetometer), a GPS for dead-reckoning, and the necessary communication equipment for data transmission.



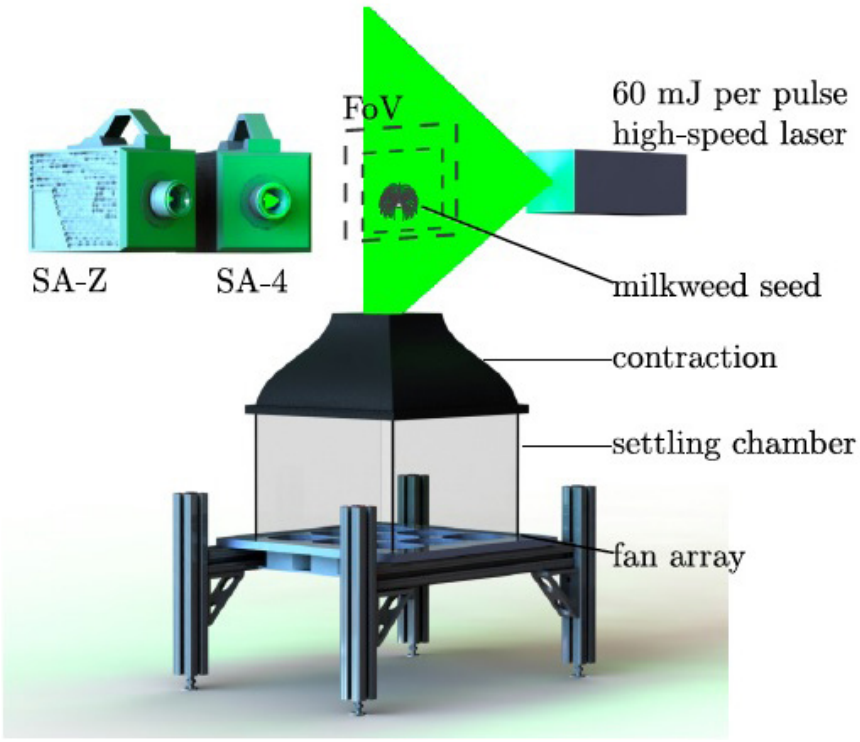


Figure 35 – Modelling of the bio-inspired passive drone system.

NEW

G5721 - MYP *Miniaturized Terahertz sources for Humans and Environmental SEcURity (THESEUs)*

Participating countries: *Italy, Israel, Switzerland*

THESEUs is one of the MYPs launched in 2020 in the fields of advanced technologies and explosives detection. The project involves Universita' di Pisa, ETH Zurich, Technion, Consiglio Nazionale delle Ricerche, and Universita' di Siena, and is focused on both explosives detection and quantum technology. Quantum Cascade Lasers (QCLs) are semiconductor lasers that emit in the infrared spectrum and in particular in the terahertz (THz) bands. They are finding new applications in precision sensing, imaging, spectroscopy and security applications. The objective of this project is to develop of a QCL source system to be used in a compact THz imaging solution. THz radiation, in fact, can penetrate into organic materials (like plastics, fabric and paper), but it is reflected by metallic materials, thus allowing easy identification of concealed dangerous items (i.e. explosives and/or arms). Furthermore, the project aims at substantially reducing the physical dimensions of current QCLs and their power consumption through the design of micro-cavity resonators and the use of novel materials such as graphene. The compact, high-efficiency THz QCL sources developed within THESEUs and their integration with high-performance THz cameras will enable the implementation of a portable imaging/scanning system for security applications. THESEUs bears the potential of substantially improving the efficiency of existing detection systems, thereby adding to NATO's efforts of enhancing prevention, protection and response to terrorist threats.

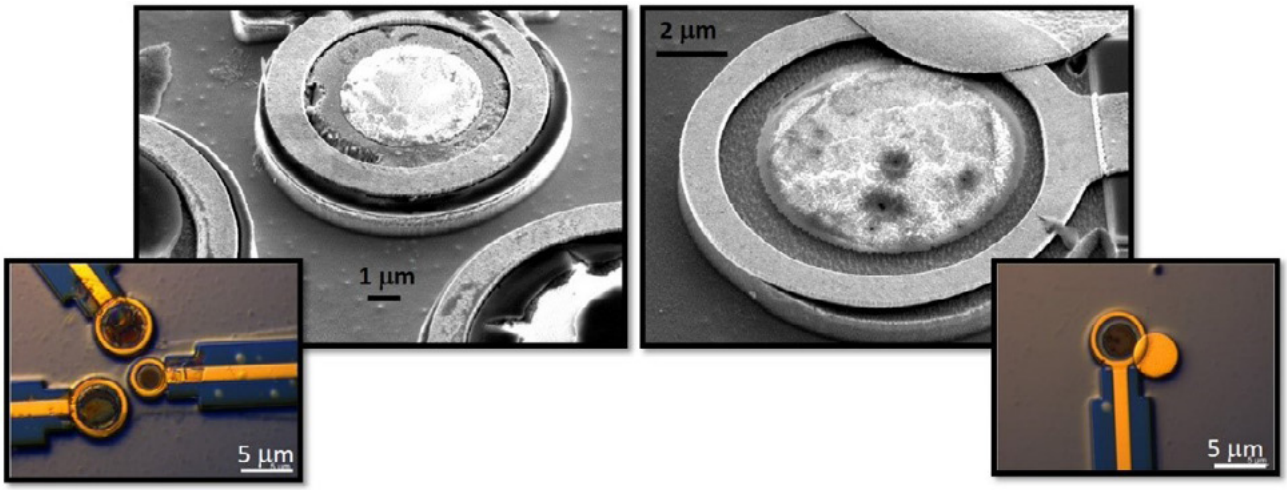


Figure 36 – Scanning Electron Microscope (SEM) and optical images of fabricated final structures.

G5796 – MYP *Single Microwave Photon Counter based on Tunable Fluz Qubit*

NEW

Participating countries: *France, Ukraine, Slovakia, Sweden*

Single photon counters are key enablers for the full spectrum of emerging quantum technologies. For example, quantum computing requires quantum bits (qubits), i.e. the basic unit of quantum information, to be measured and processed; measuring a quantum bit requires an efficient and low noise single-photon detection and photon correlation techniques. Similarly, measuring and correlating the arrival time of photons with very high temporal resolution make quantum communications possible and the emergence of concepts of "quantum illumination" and "quantum radar" for low-energy short-distance object detection and ranging. Acting at the edge of physically possible sensitivity, this project aims at developing an advanced single microwave photon counter with reduced dark counting rate, and elevated speed. The project was put forward in response to the Special Call for Proposals in the field of Advanced Technology, and was launched in October 2020 through an online meeting that gathered the co-directors, involved scientists and the SPS team.

G5797 – MYP *Developing Physical-Layer Security Schemes for Internet of Things Networks*

NEW

Participating countries: *Portugal, Qatar, Jordan*

Submitted in response to the Special Call for Proposals in the field of Advanced Technologies, this SPS Multi-Year Project aims at developing lightweight security mechanisms tailored for Internet of Things networks based on physical-layer security (i.e. at the level of electrical, mechanical or procedural interfaces). Considering the wide range of applications, the impact of the project outcomes will cover many fields including surveillance, border security and military applications. The project was kicked-off through an online meeting in November 2020 and is the second Multi-Year Project with Qatar.

G5794 - MYP *Optical Magnetic Sensing System for Security Checkpoints*

NEW

Participating countries: *Latvia, Armenia, France*

Kicked-off in 2020 and responding to the Special Call on Advanced Technologies, this project involves the University of Latvia, the Institute for Physical Research of National Academy of Sciences of Armenia and the Laboratoire Interdisciplinaire Carnot de Bourgogne. The proposed system will include a compartment for feedback-based real-time cancellation of a background magnetic field (allowing the fast and reliable revealing of potentially dangerous metal objects) and a wide-range magnetometer (allowing localization of harmful objects and evaluation of their danger level). The system will warn when people or goods passing through the checking compartment produce a magnetic field or alter its background value over the set limit. In case of an alarm, the high-spatial-resolution magnetometer will be used to locate the source position and the field value in the same checking compartment. Besides homeland security and safety applications, the proposed system

can also find industrial, technological and medical applications, exploiting its advantages of unshielded operation, unprecedented wide measurement range, and cost-effectiveness. This project will enable transformative advances in this technology through the innovative use of optical magnetometry, which underwent significant progress in the past decades. It will result in the development of a new approach for the detection of hazardous metal objects at security checkpoints, which will provide higher sensitivity, reliability and immunity against external influences compared to existing systems, while keeping the same screening time.

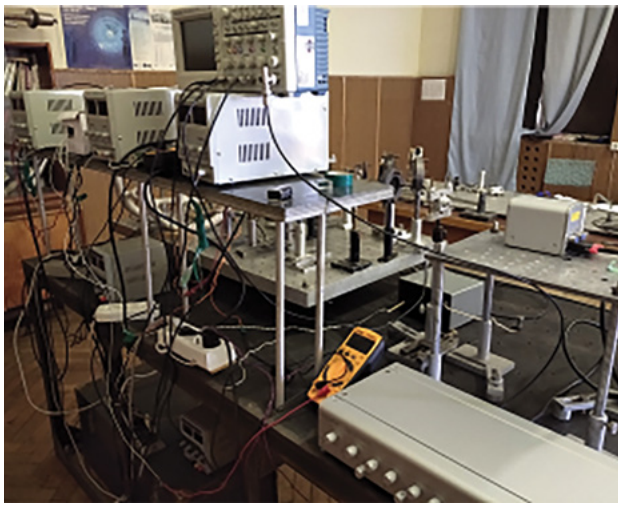


Figure 37 – Assembled experimental setup at the Institute for Physical Research of National Academy of Sciences of Armenia.

NEW

G5795 - MYP *Gases and Analytes with TErahertz Sensors (GATES)*

Participating countries: *Slovakia, Australia*

Recent years have been marked by an increase in demand for rapid detection of a broad range of gaseous and biological species in low concentrations, for applications in security, environmental monitoring and drug discovery. The GATES project, launched in 2020, responds to the Special Call on Advanced Technologies and addresses the objective of gas and molecule detection by applying the terahertz Four-Wave Mixing technique to novel micro-structured polymer optical fibers that confine radiation to the sub-wavelength scale. The novelty of the proposed fiber-based approach over existing technology lies in the flexibility, compactness and reduced complexity of a device that can be immediately integrated with existing systems. Furthermore, higher sensitivity is expected from cryogenically cooled detection of analytes, together with substantial size and cost reduction, improved bandwidth and scalability of the system in comparison to available platforms.

G5618 – MYP *Biological and Bioinspired Structures for MultiSpectral Surveillance*

ONGOING

Participating countries: *Croatia, Serbia*

The project takes inspiration from the biological world, and in particular from butterfly wings, for the development of a multispectral surveillance camera, which will cover ultraviolet, as well as visible and infrared radiations. The secret of butterfly wings' colours is hidden in the intricate structures of tiny scales covering their whole surface. This project has demonstrated that butterfly wings are very sensitive to illumination in a broad spectral range; as such, employing nanotechnology, the project will develop a multispectral camera prototype composed of arrays of micron-sized, nano-patterned platelets, similar to butterfly wing scales. The project started in October 2019 and will deliver its final prototype in 2022.

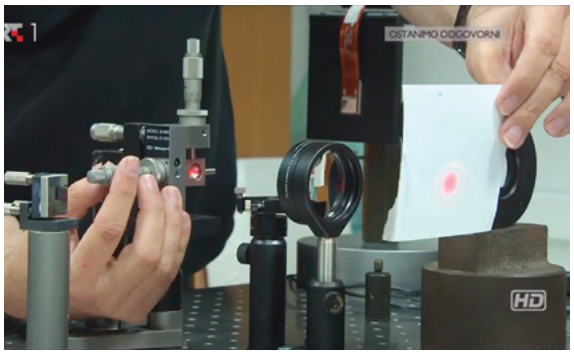


Figure 38 – Demonstration of the multispectral surveillance cameras.

G5248 – MYP *Compact Eye-Safe Lidar Source for Airborne Laser Scanning (CALIBER)*

COMPLETED

Participating countries: *Italy, Israel, Finland*

This project developed a novel, efficient and compact laser source to be installed on small drones to protect critical infrastructure and strategic sites. Light Detection and Ranging (LIDAR) systems offer a powerful remote sensing technique, which uses laser light to retrieve information about the environment and surroundings, to measure distances with high accuracy and to build a 3D map of the scanned area. The project developed a final prototype of a high precision LIDAR and paved the way to future investigations in this domain. The final meeting of the project was held online in October 2020.

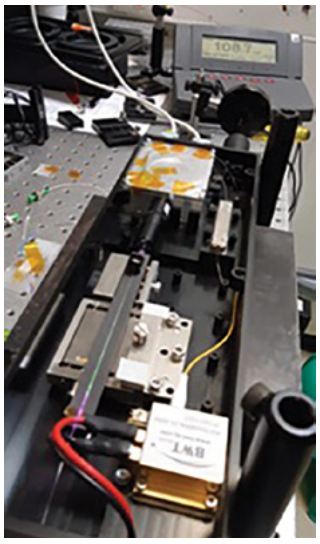


Figure 39– Laboratory setup for Lidar measurement. Preliminary operation of the prototype.

G5406 – MYP *Collaborative Augmented Navigation for Defence Objectives (CANDO)*

COMPLETED

Participating countries: *Norway, Finland*

The goal of this project was to design, develop and test a seamless indoor-outdoor collaborative navigation system for blue force tracking and human-machine teaming in urban environment in real time. Collaborative navigation concepts allow users to determine their positions by fusing their own sensor data with data shared by other users via a common communication network. This concept provides two primary benefits: enhancement of absolute and relative position information for every cooperating members, allowing extended indoor operation independently from access to satellite navigation signals, and enhancement of situational awareness information to every member of the formation. Typical application scenarios include situations involving emergency crews and first responders. The project was concluded in February 2020 and directly contributed to NATO's Emerging and Disruptive Technologies (EDT) Roadmap, paving the way to future innovation concepts, such as human machine-teaming, swarming and autonomy.

Figure 40 – Researchers working on this SPS MYP.

Mine and Unexploded Ordnance Detection and Clearance

Improvised explosive devices (IEDs), mines and unexploded ordnance (UXOs), and other explosive remnants of war compromise the safety of civilian populations and military personnel. The SPS Programme supports international cooperative efforts, which are crucial to conducting and assisting humanitarian demining. The Programme also sponsors the development of new capabilities and technologies to tackle the threat posed by mines, UXOs and IEDs, and to manage the consequences of their proliferation, in line with the 2018 Brussels Summit Declaration.

Furthermore, at the London Meeting of December 2019, Heads of State and Government confirmed the need for the Alliance to stand firm in the commitment to the fight against terrorism. Hence, projects in this area add to NATO's efforts of enhancing prevention, protection and response to terrorist threats.
SPS activities under this Key Priority assist partner nations in developing more robust national and operational programmes capable of addressing the threat of mines, UXOs and IEDs. The SPS Programme provides further support by organizing training courses and providing assistance in the implementation of policies and programmes in the management of explosive hazards.

One SPS MYP was completed under the Key Priority of UXO detection and clearance in 2020. This project, led by co-directors from Spain and Jordan, provided support to maintain and enhance a flexible and highly-responsive C-IED capability in the Jordanian defense and security forces, in order to withstand current and anticipated future IED threats.

Overview of the 2020 Special Call for Proposals in the field of Explosives Detection

In late 2019, SPS issued a Special Call for Proposals in the field of Explosives Detection, taking into account the growing need for efficient methods to detect explosives in both military and civilian environments.

The Special Call for Proposals focused on long-term research in hard sciences, as well as in social disciplines, on multi sensors systems, robotics and autonomous technology, preparation for actual field conditions and data analysis.

With this call, SPS aimed to support the development of new capabilities and technologies to tackle the significant threat posed by explosive hazards (e.g. mines, UXOs, IEDs, etc.), and to manage the consequences of their proliferation.

NEW

G5731 – MYP *Multi-Sensor Cooperative Robots for Shallow Buried Explosive Threat Detection (Demining Robots)*

Participating Countries: *Italy, Ukraine, USA, Jordan*

This flagship project is a multi-year initiative building upon the previous SPS project 'Holographic and Impulse Subsurface Radar for Landmine and IED Detection (U-GO 1st)', which developed a remotely operable, multi-sensor, robotic device for the detection of landmines, UXOs and IEDs. The U-GO 1st prototype was displayed at the SPS 60th Anniversary, which took place in November 2018 at NATO HQ.

The main goal of 'Demining Robots' is to demonstrate the feasibility of a safe landmine and IED detection system by using a team of cooperative robotic vehicles, each carrying specialized sensors. The robots will be capable of digitally mapping potential threats in a geo-referenced coordinates system available for local authorities and neutralization teams. All robots will securely share the data in real time with remote terminals and portable devices.

This novel approach will allow the collection of multi-par metric data, avoiding direct human-to-mine contact until the threat removal stage, and ultimately introducing a safer demining proc dure. Demining Robots will protect operators and improve the dete tion of landmines in post-war zones. This project will consolidate and enhance the Alliance's support for Ukraine, and will contribute to highlighting NATO's practical cooperation with Ukraine due to its high public diplomacy value.

For more information on this Multi-Year Project:

Project brochure: Multi-Sensor Cooperative Robots for Shallow Buried Explosive Threat Detection - DEMINING ROBOTS

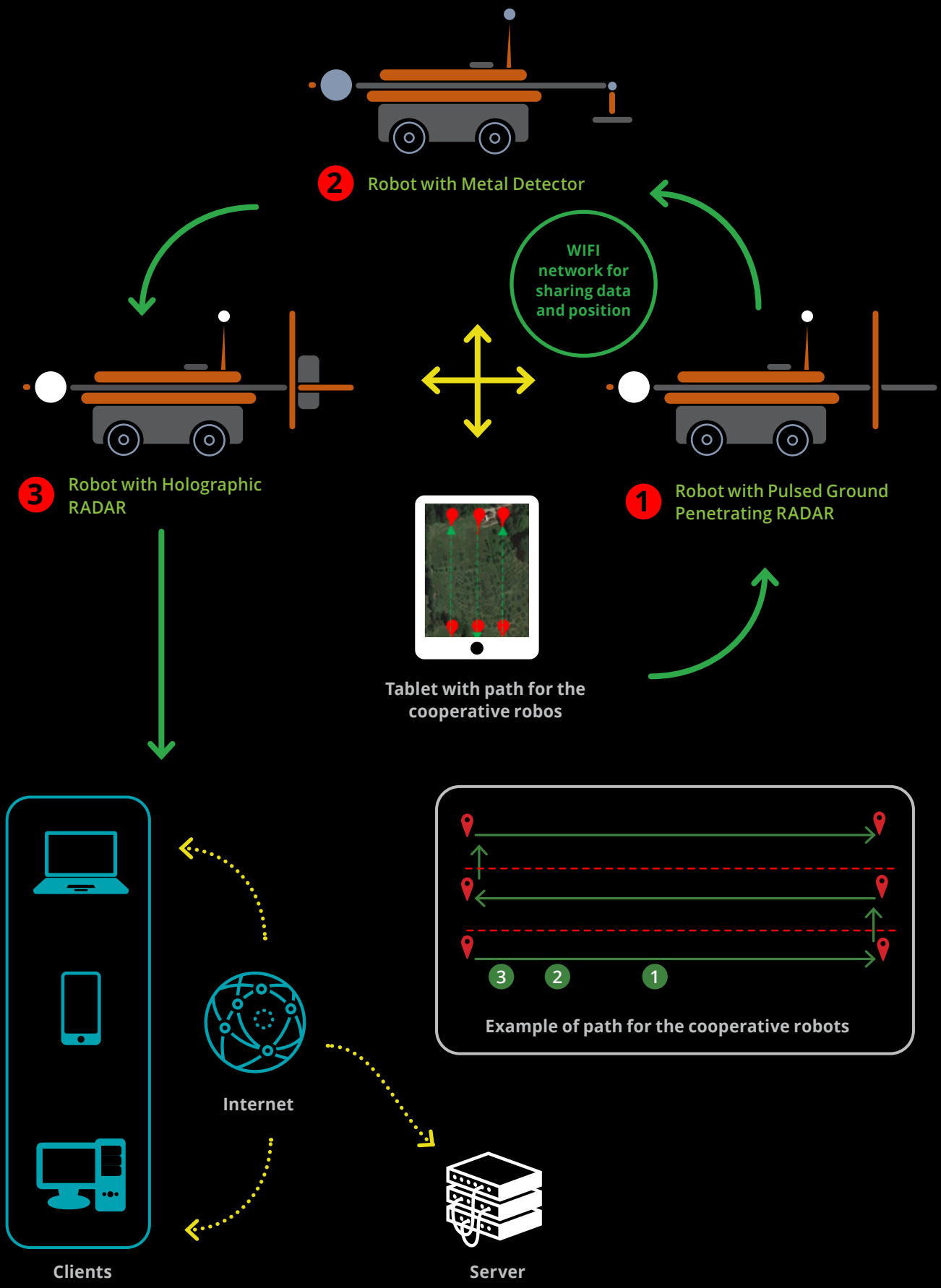


Figure 41 – Overview of the cooperative setup of the SPS MYP 'Demining Robots'.

G5711 – MYP *Virtual Evidence Capture Tool for Ordnance Recovery (VECTOR)*

NEW

Participating countries: *United Kingdom, Bosnia and Herzegovina, Greece, Republic of North Macedonia*

This Multi-Year Project aims to fill a critical gap in explosive ordnance identification by enabling detailed remote analysis and communication between off-site experts and units on the ground. It will do so by developing a command and control platform combining cutting-edge technologies such as 3D photogrammetry, image recognition, and augmented and virtual reality.

VECTOR will enable explosive ordnance disposal units to receive real-time support from off-site specialists, particularly in remote areas, to identify measures to neutralize the ordnance. VECTOR's technology will also contribute to countering IEDs, by providing an automated object detection to identify and classify explosive devices, and ultimately to determine the threat level and suitable interventions. This project is in line with the Individual Partnership Action Plans (IPAP) between NATO and Bosnia and Herzegovina, which underlines the significant threat posed by mines and UXOs to the population and the social and economic development of the country. It will provide innovative technological solutions and contribute to NATO's objectives to protect the population and personnel from mines and unexploded devices, and to promote regional security and cooperation in the Western Balkans.

Figure 42 – Presentation of the SPS MYP 'VECTOR' in the framework of UXO public awareness activities

G5751 - MYP *Optical Nose GRId for Large Indoor Area Explosives' Vapors MONitoring (ORION)*

NEW

Participating countries: *United Kingdom, Serbia, USA*

Kicked-off in 2020, the ORION project responds to the Special Call on Explosives Detection and aims at developing a new technology addressing the monitoring of explosives' vapors and resulting into a game-changing autonomous system, to be employed in critical infrastructures, such as mass transportation hubs. At their London Meeting in December 2019, Heads of State and Government confirmed the need for the Alliance to stand firm in the commitment to the fight against terrorism, and this project directly contributes to the updated "Action Plan on Enhancing NATO's Role in the International Community's Fight against Terrorism". This system will consist of a highly innovative large area grid-type sensing platform for explosives' vapors' detection and of miniaturized sensing devices based on photo-thermal luminescence for vapors' recognition. An artificial intelligence data processing unit will also be integrated within the system in order to minimize false positive reports and to exploit readings from multiple sensors. The project overcomes the current pitfalls in vapors' detection and, compared to existing technology, foresees to reach a remarkably higher degree of specificity and precision (i.e. minimizing the number of false positives), thereby improving security and safety of critical infrastructures. Further upsides stem from the wide transferability and scalability of the technology in the broader fields of sensing and detection.

G5607 – MYP *Accelerating Mine Clearance in Humanitarian Demining Operations*

NEW

Participating countries: *the Netherlands, Japan, Bosnia and Herzegovina*

This Multi-Year Project was launched virtually in December 2020. It will substantially contribute to scientific and technological advancements in the field of mine clearance thanks to the dedication and contribution of scientists from the Netherlands, Japan, and Bosnia and Herzegovina with experience in leading SPS projects. This MYP aims to assess the benefit of a newly developed dual-sensor detector – the Advanced Land Imaging System (ALIS) – for demining operations, and to establish associated standard operating procedures. ALIS can visualize buried landmines on a tablet PC screen so that operators can easily understand the shape of buried objects and can discriminate mines from other metal fragments.

Currently, manual demining is a slow process, mostly because of the significant amount of time and energy necessary to extract metal fragments from the ground. The ALIS dual sensor detector combines a metal detector for standard metal indication search and a ground penetrating radar, which will require less operators and shorten inspection time during demining operations.

Landmines, cluster munitions and other explosive and toxic remnants of war still have serious social, economic, environmental and security impact in Bosnia and Herzegovina. This project will contribute to further advance mine clearance in this country, and support its efforts to reach its Mine Ban Treaty obligations. It will also enhance the country's partnership with NATO and cooperation with SPS as stated in its IPAP, in order to contribute to common security and stability, and promote regional security in the Western Balkans.

For more information on this Multi-Year Project:

Project brochure: Accelerating mine clearance in humanitarian demining operations

Figure 43 – Field demonstration of the ALIS detector.

Human and Social Aspects of Security

Since 2013, the SPS Programme has supported partnerships in areas beyond purely scientific cooperation, including in the implementation of the Women, Peace and Security (WPS) agenda, as set forth in several United Nations Security Council Resolutions (UNSCRs). In coordination with the NATO Secretary General's Special Representative for WPS, the SPS Programme has contributed to the implementation of the WPS agenda through concrete deliverables in cooperation with partner nations, and by providing an important platform for debate, and exchange of views and best practices. Other activities under this SPS Key Priority include the study of contemporary social and human security issues and their impacts on our societies, policy-making, and the management of emergencies.

Two ARWs were organized throughout 2020 under the Key Priority of Human and Social Aspects of Security. They addressed topics such as security of cultural heritage in war zones or instable areas, climate change, pandemics and their transatlantic implications, and Artificial Intelligence. The events took place both online and on-site, and gathered around 400 participants and speakers from 20 NATO and partner countries.

G5830 – ARW *Game Changers 2020: A New Future Dawns on International Security*

COMPLETED

Participating countries: *Italy, Morocco*

The ARW 'Game Changers 2020: A New Future Dawns on International Security ' took place virtually on 10-11 December 2020, and was co-organized by experts from the NATO Defence College Foundation in Italy, and the Policy Center for the New South in Morocco. In the run up to the event the Foundation announced a specialised dossier "Game Changers Dossier 2020", where 12 security issues that are relevant to the global strategic calculus were laid out by 17 respected international specialists. These issues were separated in three main themes covered during the workshop: Climate Change and competition for scarce resources, implications of COVID-19 on transatlantic cooperation, and Artificial Intelligence.

A first panel on climate change discussed how foreseeable climate change will influence strategic variables relevant for military operations; the impact of these changes on the control and competition for water resources in crisis areas; and finally how crop scarcity, land grabbing and droughts can affect migratory crises and regional conflicts. The second panel assessed the impact and consequences of the coronavirus pandemic on the Euro-Atlantic relationship. It also discussed what lessons can be learned at operational level, where contingents in out-of-area operations are called to alleviate complex emergencies while protecting their forces in fragile countries. The third panel explored in a lively debate the pros and cons of Artificial Intelligence and its impact on international security, particularly in deterrence management, autonomous systems and cyber operations.

The discussion among speakers on stage was live-streamed on a new engaging, interactive digital arena that achieved considerable impact compared to the usual webinars. This event gathered more than 300 participants connected from around 15 different countries, and 234 participants attended the final session. The audience actively contributed to a lively and timely debate on three topics that will revolutionise the future of global security. The event received broad media coverage in the Italian press and via social media, benefiting from the proactive approach of the event organizers.

Figure 44 – NDCF President and former NATO Deputy Secretary General, Alessandro Minuto-Rizzo, at the SPS ARW 'Game Changers 2020: A New Future Dawns on International Security'.

G5730 – ARW *Cultural Heritage's Safety and Security in Zones of War or Instability*

COMPLETED

Participating countries: *Italy, Tunisia*

This ARW took place online on 25-27 November. This event was co-organized by Italian and Tunisian experts, and aimed at sharing information among practitioners in various disciplines of relevance to the topic of Cultural Property Protection (CPP). Presenters provided perspectives on subjects such as the discovery and preservation of cultural heritage sites, technical sensing and imaging of cultural property items, countering the trafficking of stolen items, as well as dealing with cultural heritage in the context of NATO operations. This ARW broadened the knowledge on CPP, as well as the community of practice that was brought together during previous SPS-supported events between 2014-2016.

This event was one of the few ARWs carried out entirely online in 2020. Although the adaptation of the event to an online format reduced the opportunities for interaction among participants that are typical for these workshops, the organizers, participants and external evaluators welcomed the event and expressed appreciation for the quality and variety of the topics addressed.

G5570 - MYP *Responding Emerging Security Challenges in NATO's Southern Neighborhood*

ONGOING

Participating countries: *Spain, Morocco, Jordan, United Kingdom*

Progress was achieved in the multi-year project 'Responding Emerging Security Challenges in NATO's Southern Neighborhood', led by the Elcano Royal Institute(Spain) and the Moroccan Center for Strategic Studies, with the Center for Strategic Studies (Jordan) and the Institute for Statecraft (United Kingdom). Through various scenario-based discussions, recently organized online due to the COVID-19 pandemic, the project is analyzing the sources of change in NATO's southern neighborhood, with a view to gaining a better sense of their possible political and security implications. Its objective is to provide foresight, early warning mechanisms and scenarios to inform policy planning and policy making within NATO and its member states. The project's main deliverable will be a report titled "Southern Neighborhood Futures 2030: Trends, Dynamics and Strategies", to be published in 2021.

Figure 45 – Expert discussions during the SPS MYP 'Responding Emerging Security Challenges in NATO's Southern Neighborhood'

Hybrid Challenges

Hybrid threats are strategic challenges and a growing concern to the Alliance as new technologies develop in the cyber space. NATO's position is that nations carry the primary responsibility as de facto first responders in the case of hybrid warfare. However, NATO stands ready to assist Allies in developing the capacity to anticipate, resist and respond to hybrid threats. NATO works with partner nations and international organizations on strategic communications, public diplomacy to counter disinformation, and sharing of best practices to support efforts to build resilience with a particular focus on practical cooperation and capacity building. The Alliance assists partners in reinforcing their abilities to address vulnerabilities and improve situational awareness.

COMPLETED

G5686 - ARW *Zagreb Security Forum 2020: Hybrid Threats and Wars in 21st Century - Making Society and Critical Infrastructure Resilient*

Participating countries: *Croatia, Israel*

Following the last minute postponement of this workshop in March 2020, the event finally took place on 7-8 September 2020 in Zagreb, Croatia. Led by co-directors from Croatia and Israel, the 2020 Zagreb Security Forum focused on hybrid and cyber security challenges and their impacts on our societies. It aimed to assess current and future hybrid threats in order to develop resilient national strategies, crisis management and emergency response plans. Particular emphasis was placed on defined models that could be used as early warning instruments against 21st century emerging security challenges, especially hybrid threats.

Despite the difficult circumstances due to the COVID-19 pandemic, the workshop successfully managed to bring together on-site and online participants from 22 countries, and international organisations such as NATO and the EU, with expertise in the fields of cyber defence, critical infrastructure protection and hybrid warfare. They had the opportunity to share best practices, analyze case studies, discuss policy options, and develop a regional network of experts in Eastern and South Eastern Europe in order to enhance critical infrastructure protection, and increase resilience against modern hybrid threats. The panels of speakers included experts and high-level officials representing a wide range of governmental institutions, academia, think tanks, and international organisations.

Figure 46 – The NATO Senior SPS and Partnership Cooperation Advisor, Dr. Deniz Beten, delivering welcome remarks at the 'Zagreb Security Forum 2020'.

The Forum had a high public diplomacy value due to the importance of the topics discussed during the event, the high-level participation, the wide media attention, and the public information materials prepared on this specific occasion. To this end, a postcard with the NATO logo and the hashtag 'We Are NATO' has been printed by the Croatian Postal Office to celebrate the fifth edition of the Zagreb Security Forum and to highlight NATO's support of the event. In this regard, the NATO SPS Programme has supported three out of five editions of the Zagreb Security Forum. Furthermore, a number of Croatian TV broadcasters recorded the Forum, while the keynote speeches session was live-streamed on the national TV station N1.

The event set-up proved to be an excellent example of physical and virtual combination meetings that can be held successfully and in line with local pandemic rules and restrictions.

ONGOING

G5442 – MYP *Resilient Civilians in Hybrid and Population Centric Warfare (Resilient Civilians)*

Participating countries: *Norway, Ukraine, the Netherlands*

This Multi-Year Project, co-led by Norway's Artic University and Ukraine's University of Odessa, with the Netherlands Defence University, Norwegian Institute of International Affairs, and the European Centre of Excellence for Countering Hybrid Threats also continued its activity, despite the COVID-19 outbreak. The Resilient Civilians project draws from past operational experience and new data collection of conflict drivers within civilian communities in Europe to identify potential hybrid threats and establish hybrid warfare scenarios that can inform training and planning for hybrid crises in Europe.

It aims to generate policy recommendations and best practices based on empirical evidence, and to conduct evidence-based research to support policy recommendations and best practices. The project uses analytical tools to recognize the complexity of the civilian environment where gender, race, ethnicity, wealth/poverty, inform our understanding of civilian resilience and agency in conflict settings.

Figure 47 - Participants in a project meeting at the Arctic University of Norway.
Source: https://site.uit.no/hybrid/research-team/

CHAPTER 3
Facts and Figures

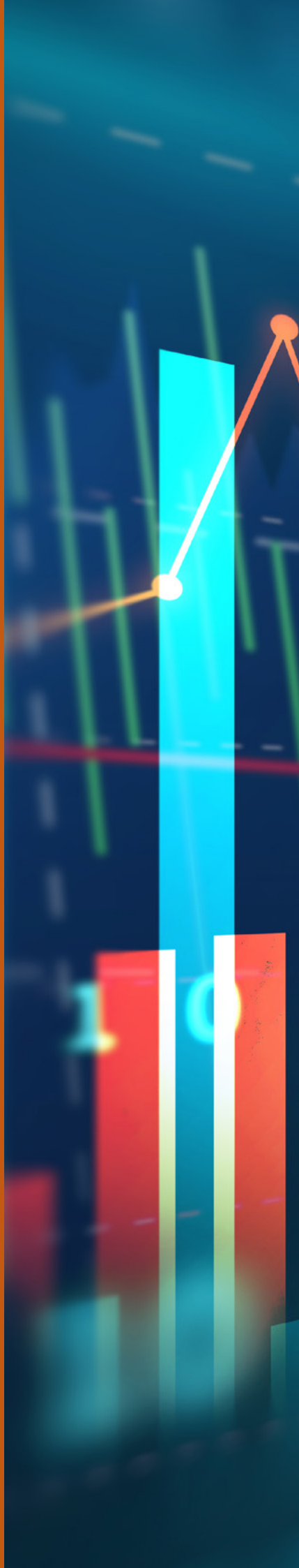
Evaluation and Approval Process

SPS Award Cycle in 2020
In 2020, the SPS Programme received a total of 173 applications in response to an Open Call and two Special Calls for Proposals in the fields of Advanced Technology and Explosives Detection. The award cycle covers applications received, pre-screened by SPS Advisors in collaboration with experts from other NATO sections and divisions, peer-reviewed by the scientific experts of the Independent Scientific Evaluation Group (ISEG), and finally approved by Allies in the Partnerships and Cooperative Security Committee (PCSC).

The Independent Scientific Evaluation Group (ISEG)
In 2020, the ISEG was composed of 35 scientists and experts nominated by NATO countries and appointed by the PCSC. The main role of the ISEG is to evaluate the scientific and technical merit of the SPS applications through peer-review. In addition, the ISEG members follow and evaluate ongoing SPS projects in their areas of expertise as so-called 'godparents'. This direct involvement of the scientific community is indispensable for the integrity and maintenance of the high scientific standard of the SPS Programme.

ISEG members are also invaluable in designing and supporting SPS Special Calls for Proposals, including the two Special Calls in the areas of Security-related Advanced Technologies, and Explosives Detection that closed in 2020. To this end, the ISEG members help to identify focus areas of future research, and take part in the thorough evaluation of applications received in response to Special Calls.

In 2020, due to COVID-19 pandemic, the ISEG reviewed all the eligible applications electronically. In this regard, a total of 134 SPS proposals were assessed by the ISEG members, of which 59 were recommended to Allies. Moreover, the ISEG experts continued to share updates and summaries on the implementation of the SPS activities they followed as an evaluator.



The Partnerships and Coopertive Security Committee (PCSC)

All activities recommended by the ISEG within the framework of the SPS Programme are closely reviewed by Allies for approval in the Partnerships and Cooperative Security Committee (PCSC).

In 2020, because of the COVID-19 pandemic, the PCSC reviewed and approved electronically all the SPS award recommendations put forward to their attention. To this end, Allies were presented and approved 70 SPS award recommendations for funding. Allies also provided important guidance for the implementation of the SPS Programme, including the approval of the annual SPS Work Programme. Furthermore, the PCSC continued to be updated regularly on the launch of new initiatives, the development of ongoing projects, and the outcomes of completed SPS activities.

The chart below provides an overview of the SPS award cycle process.

Reception of Applications

Applicants submit their applications to the SPS Programme in response to a Call for Proposals published on the SPS website

Eligibility Screening

SPS Advisors and NATO experts pre-screen applications before sending them for independent evaluation

Independent Scientific Review

Members of the Independent Scientific Evaluation Group (ISEG) meet two to three times per year to peer-review applications received based on scientific and technical merit

Political Approval by Allies

Allies review the factsheet of each project proposal at the Partnerships and Cooperative Security Committee (PCSC) meeting in SPS format

Evaluation Outcome
Facts and Figures

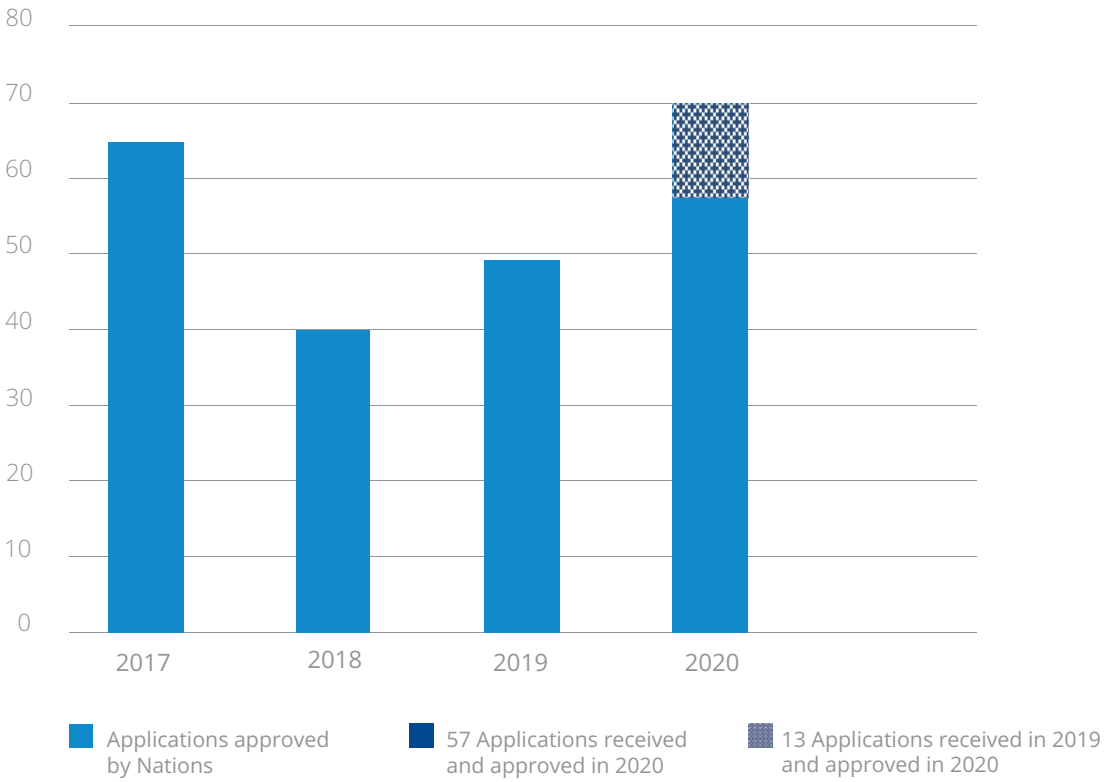
The SPS Programme supports both top-down and bottom-up activities. A 'top-down' application is initiated by NATO International Staff (IS) in cooperation with Allies and/or partner delegations. In 2020, these proposals represented 13% of all activities approved by PCSC. 'Bottom-up' applications are submitted directly to the SPS Programme by independent scientists and experts themselves, mostly via the SPS website. A more detailed breakdown regarding the distribution of top-down versus bottom-up proposals can be found in the chart below.

SPS Award Cycle		Top-Down	Bottom-Up	Total
Eligibility Screening	Applications Received	11	162	173
	Ineligible Applications	1	34	35
	Applications withdrawn by applicants	0	4	4
Independent Review	Reviewed by ISEG	10	124	134
	Recommended by ISEG	9	50	59
Political Review	Approved by PCSC in 2020	9	50	57*
	Applications pending final decision in 2021	0	2	2

* In the course of 2020, the PCSC reviewed and approved 57 applications received during the 2020 round of applications and 13 proposals received in the previous year. Two applications recommended by the ISEG in late 2020 will be considered by Allies in 2021

The chart below provides an overview of the applications approved for funding over the last four years.

SPS Activities approved by PCSC in the last four years



Approved activities by Grant mechanism

The SPS Programme supports collaboration with partners through several established grant mechanisms, namely MYPs, ARWs, ATCs and ASIs. The chart below provides the breakdown of new activities over the 2020 calendar year according to SPS grant mechanisms.

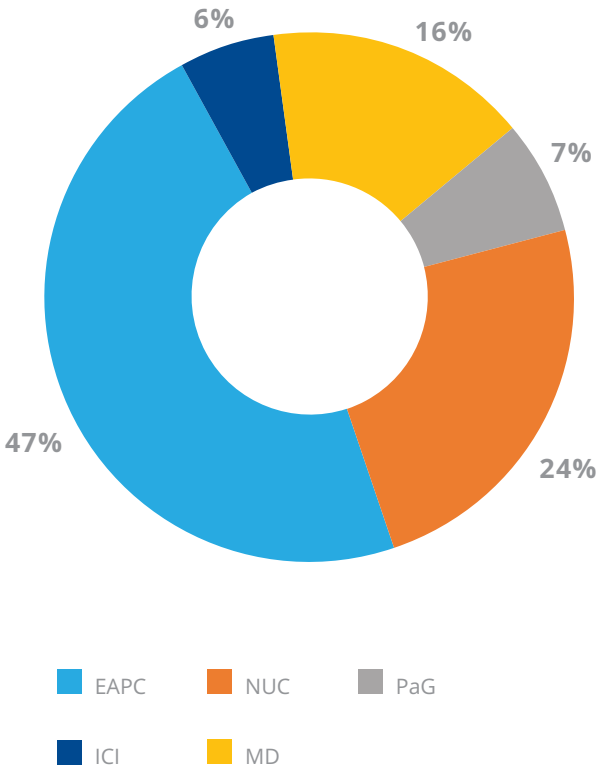
Mechanism		TOP-DOWN	BOTTOM-UP	TOTAL
MYP	Multi-Year Project	4	44	48
ARW	Advanced Research Workshop	3	13	16
ATC	Advanced Training Course	3	3	6
ASI	Advanced Study Institute	0	0	0
	Total			**70**

Approved activities by Partnership Framework

In 2020, the SPS Programme initiated 70 new activities involving 23 different partner countries. The chart below provides a breakdown of activities approved in 2020 by Partnership Framework.

Partnership Framework		Top-Down	Bottom-Up	Total
EAPC	Euro-Atlantic Partnership Council	6	27	33
NUC	NATO-Ukraine Commission	1	16	17
PaG	Partners across the Globe	0	5	5
MD	Mediterranean Dialogue	1	10	11
ICI	Istanbul Cooperation Initiative	2	2	4
	Total			**70**

Distribution of new SPS activities by Partnership framework



In 2020, the SPS Programme continued to bring together Allies and Partners from all of NATO's partnership frameworks in a balanced, 360 degrees approach, to deliver tailor-made and demand-driven activities.

A large number of the new activities (47%) were developed in the framework of the Euro-Atlantic Partnership Council (EAPC), involving a total of 13 partners from Eastern and Western Europe, the Balkans and Central Asia.

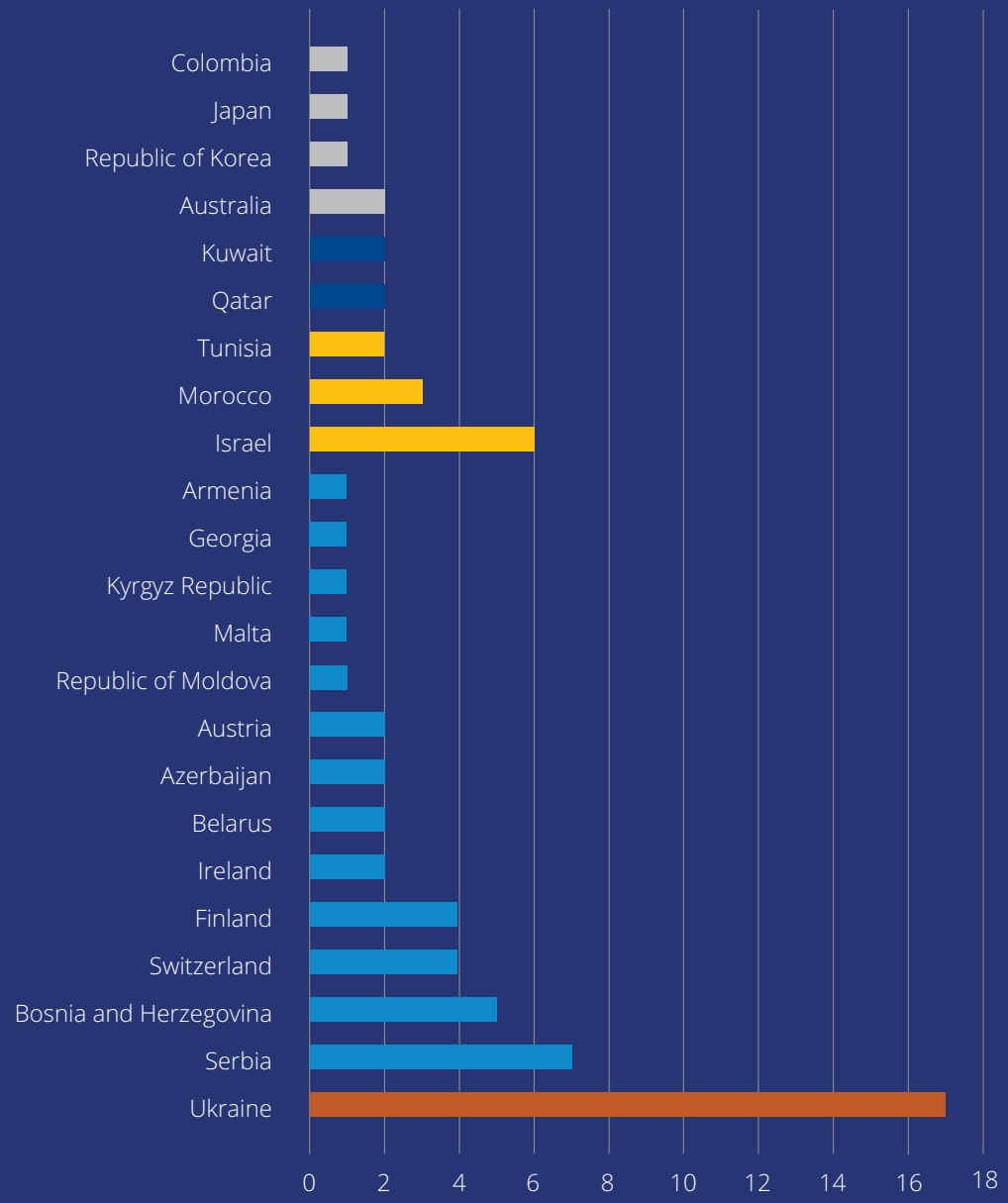
SPS also continued to serve as a valuable programme for enhancing practical cooperation with Ukraine throughout 2020. The SPS Information Day held in Kyiv in November 2019 as well as the frequent high-level interactions between NATO and Ukrainian officials resulted in a great number of applications submitted by Ukraine over the past year. Thus, 24% of the new activities were initiated under NATO-Ukraine Commission (NUC) in line with the Allied political guidance and the priority areas of cooperation identified and discussed at the 16th meeting of the NATO-Ukraine Joint Working Group on Scientific and Environmental Cooperation that took place in Brussels in March 2019.

Projecting stability with partner countries from the South continued to remain a priority for the SPS Programme in 2020. While the activities involving Mediterranean Dialogue partners decreased from 31% in 2019 to 16% in 2020, the number of activities led by Istanbul Cooperation Initiative countries increased from 2% to 6%, in comparison to the 2019 figures. Among MD partners, Israel was the most active due to a number of successful bottom-up applications. The increase in activities with ICI partners can be attributed to the approval of a new package of ATCs to be implemented at the NATO-ICI Regional Centre and the growing involvement of Qatar in scientific cooperation projects.

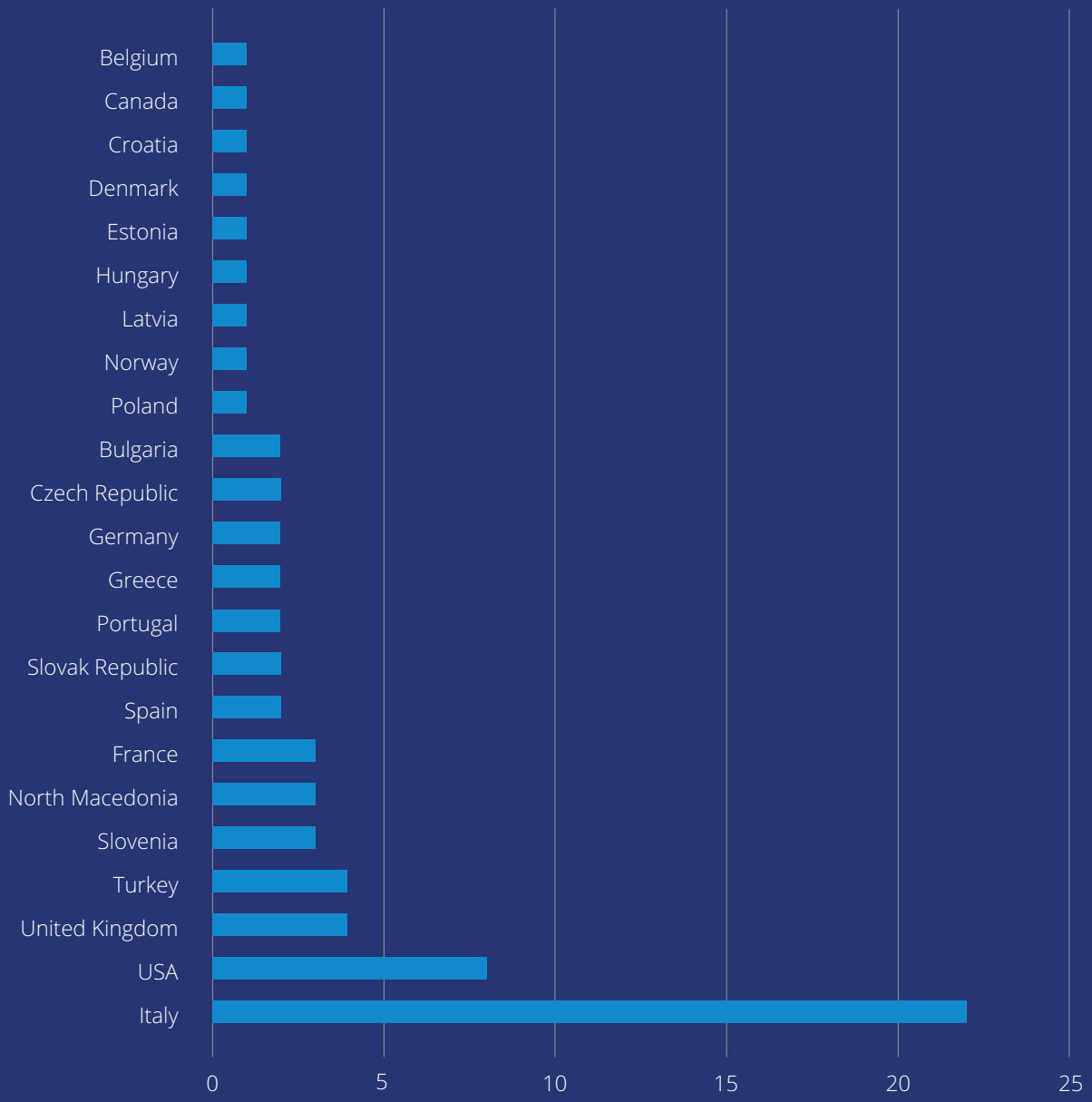
Four new activities (7%) with Partners across the Globe were approved in 2020, half of them being top-down projects with a significant impact.

The following charts represent a breakdown of Allied and partner countries that have assumed leading roles in the SPS activities approved in 2020.

Number of new SPS Activities by Lead Partner Nation



Number of new SPS Activities by Lead NATO Ally



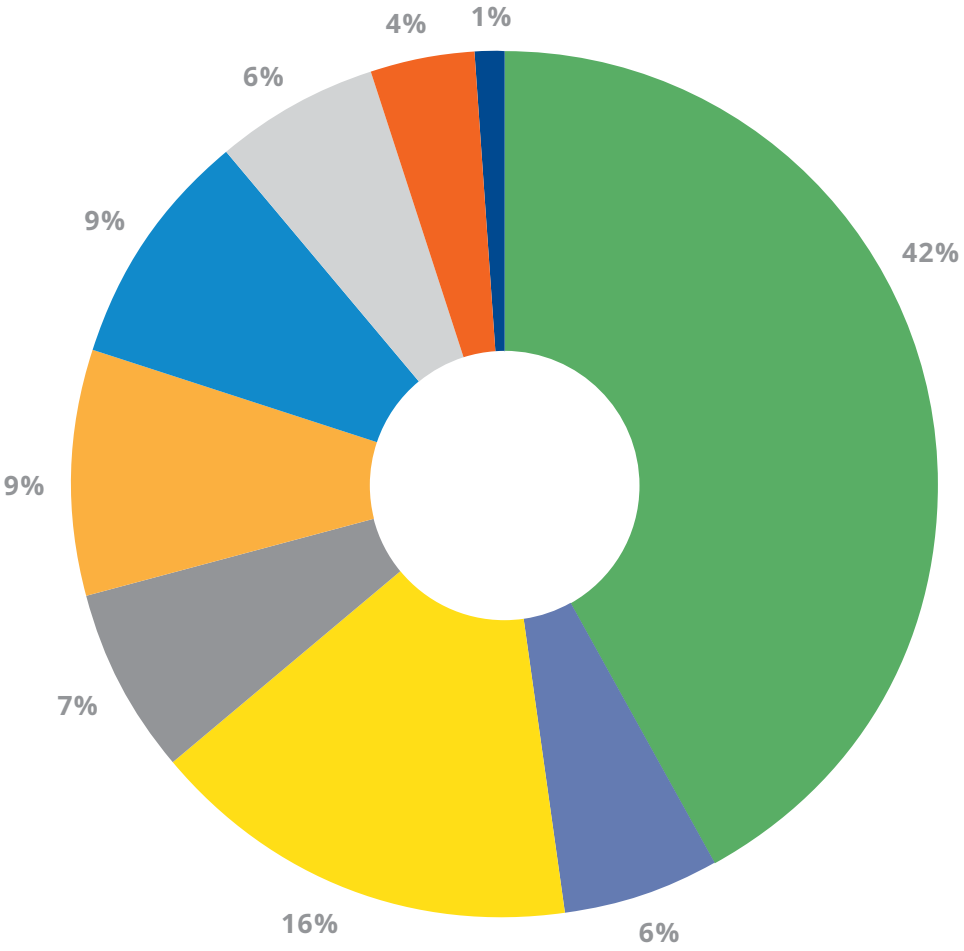
Approved activities by SPS Key Priority

The SPS Programme is embedded in the Emerging Security Challenges Division, which serves as NATO's source of expertise on a growing range of non-traditional risks and challenges. Terrorism, cyber-attacks, energy security, hybrid warfare, and CBRN threats are major contemporary challenges to international peace and security. The focus of the SPS Programme spans across these new security challenges and strives to bring together scientists, experts, and policy makers from NATO and Partner countries to tackle them through scientific and practical cooperation.

New SPS activities by key priority		Top-Down	Bottom-Up	Total
1a.	Counter-Terrorism	2	4	**6**
1b.	Energy Security	1	5	**6**
1c.	Cyber Defence	2	3	**5**
1d.	Defence against CBRN Agents	2	9	**11**
1e.	Environmental Security	0	4	**4**
2.	Support for NATO-led Operations	0	0	**0**
3a.	Advanced Technology	2	28	**30**
3b.	Border and Port Security	0	1	**1**
3c.	Mine and UXO Detection and Clearance	0	3	**3**
3d.	Human and Social Aspects of Security	1	3	**4**
4.	Other Security Threats Related to NATO's Strategic Objectives	0	0	**0**
	Total	**10**	**60**	**70**

In 2020, the SPS Programme initiated 70 new activities in line with the SPS Key Priorities. The most active area of cooperation was Advanced Technology at 42%, reflecting the high number of applications received in response to the related Special Call for Proposals. It was followed by CBRN Defence representing 16% of the newly approved activities, Counter-Terrorism, and Cyber Defence, each at 10%. The table above and the chart below provide an overview of new activities by SPS key priority area.

New Activities by SPS Key Priorities



- Counter-Terrorism
- Energy Security
- Cyber Defence
- CBRN Defence
- Environmental Security
- Advanced Technology
- Border and Port Security
- Mine and UXO Detection and Clearance
- Human and Social Aspect of Security
- Other

CONCLUSION

Through civil science, technology, innovation, and capacity building, the NATO SPS Programme will continue to deliver practical cooperation between scientists and experts. It is ready to help addressing issues related to the emerging challenges that lie ahead, such as the response to COVID-19.

Looking towards 2021, SPS is prepared to explore ways to contribute to NATO's efforts in the field of innovation and Emerging and Disruptive Technologies by proposing new projects on topics such as quantum technologies, autonomy, data, and artificial intelligence. For instance, a planned SPS ARW will facilitate exchange of information and knowledge by mobilizing a multi-disciplinary network of experts on quantum computing and quantum physics. Moreover, in the field of autonomy, SPS will sponsor a series of discussions dedicated to strategic foresight planning by focusing on the past, present, and future of technologies to counter hostile drones.

The Programme will also seek new opportunities for activities complementing NATO's efforts to tackle climate change and environmental security. Moreover, SPS will continue to deliver on the updated Action Plan on Enhancing NATO's role in the International Community's Fight against Terrorism. It will do this not only by advancing the DEXTER Consortium, but also through activities on C-IED, security-related advanced technologies, defence against CBRN agents, cyber defence, among other topics.

Finally, it will also continue to further promote the high public diplomacy value of SPS projects, by giving visibility to the tangible deliverables of its activities both in NATO and partner counties.

ANNEXES

Annex 1

New SPS Activities approved by PCSC in 2020

Key Priority	SPS reference	Top-Down	Grant Mechanisms	Title	NATO Country	Partner Country	Other Countries	Partnership Framework
CT (1a)	G5674		MYP	Enhancing Security at Borders and Ports (E-SiCure2)	HRV	JPN	SVN PRT	PaG
CT (1a)	G5812		MYP	netwoRk for alErting And managing publiC safeTy and resilience - REACT	ITA	GEO	USA	EAPC
CT (1a)	G5814		MYP	Nanomaterials for Explosive Traces Detection with SERS (acronym - NOOSE)	SVN	ISR	UKR GRC	MD
CT (1a)	G5816		ATC	Monitoring and Protection of Critical Infrastructure by Unmanned Systems	ITA	MDA		EAPC
CT (1a)	G5825	X	MYP	Smart Patch for Life Support Systems (SP4LIFE)	SVK	SRB		EAPC
CT (1a)	G5865		MYP	Designing Bio-Secure Metallic Surfaces	USA	ISR		MD
ES (2a)	G5717		ARW	Integrity of Pipelines: Building on a Decade of Progress	ITA	TUN		MD
ES (2a)	G5737	X	ATC	Critical Energy Infrastructure Protetion and Resilience Course	USA	KWT		ICI
ES (2a)	G5772		MYP	Portable chargers for Soldiers	ITA	UKR	NMA	NUKR

Key Priority	SPS reference	Top-Down	Grant Mechanisms	Title	NATO Country	Partner Country	Other Countries	Partnership Framework
ES (2a)	G5831		ARW	Energy Strategies 2020. Europe and the Mediterranean: Security Trends towards a Connected Energy Market	ITA	MAR		MD
ES (2a)	G5836		MYP	Carbon-Based Batteries and Supercapacitators	SVN	SRB	MNE	EAPC
ES (2a)	G5853		MYP	Plasma and Pulse Technologies for Efficient Thin film Flexible CIGS Solar Cells	BEL	UKR		NUKR
CD (3a)	G5704		ARW	Artificial Intelligence (AI) and Digital Technologies for Countries Experiencing Crisis	SUA	UKR		NUKR
CD (3a)	G5742	X	ATC	Introduction to Network Security Course (27 September-8 October 2020) and Introduction to Network Vulnerability Course (29 November-10 December 2020)	DEU	KWT		ICI
CD (3a)	G5744		ARW	Cybersecurity of Industrial Control Systems	POL	AZE		EAPC
CD (3a)	G5813	X	ATC	Advanced Cyber Defense Training Courses for Azerbaijan	TUR	AZE		EAPC
CD (3a)	G5818		ATC	Strengthening SEE Resilient Cyber Defense against Hybrid Threats (STRENGTH)	NMA	BIH		EAPC
CBRN (4a)	G5668		ARW	Biotechnological Decontamination of CBRN Agents	BGR	UKR		NUKR
CBRN (4a)	G5685	X	MYP	The Anthrax Transporter: from Molecular Mechanism to Medication	TUR	ISR	ISR	MD

Key Priority	SPS reference	Top-Down	Grant Mechanisms	Title	NATO Country	Partner Country	Other Countries	Partnership Framework
CBRN (4a)	G5713		MYP	Biofriendly Decontamination of Chemical Warfare Agents (EnzIL)	PRT	FIN	TUN	EAPC
CBRN (4a)	G5757		MYP	Smart Nanomaterials and a Soldier Alarm Badge to Detect Toxic Gases by Mobile Devices	FRA	UKR		NUKR
CBRN (4a)	G5759		MYP	Nanotechnology based Biosensor with Photo-Responsive Liquid Crystals	ITA	KOR		PaG
ADV (3a)	G5779	X	ARW	Security-related Advanced Technologies in Critcal Infrastructure Protection	HUN	SRB		EAPC
ADV (3a)	G5787		MYP	Light and Strong Titanium-Based Composite Armor	USA	UKR		NUKR
ADV (3a)	G5790		MYP	Acoustic Multi-Functional Composites for Environmental Risks and Health Hazards Reduction	BGR	BLR		EAPC
ADV (3a)	G5792		MYP	Spintronic Devices for Microwave Detection and Energy Harvesting Applications	GRC	UKR	DEU, FRA, ESP, HUN	NUKR
ADV (3a)	G5794		MYP	Development of Optical Magnetic Sensing System for Security Checkpoints	LVA	ARM	FRA	EAPC
ADV (3a)	G5795		MYP	Gases and Analytes with Terahertz Sensors (GATES)	SVK	AUS		PaG
ADV (3a)	G5796		MYP	Single Microwave Photon Counter based on Tunable Fluz Qubit	FRA	UKR	SVK SWE	NUKR

Key Priority	SPS reference	Top-Down	Grant Mechanisms	Title	NATO Country	Partner Country	Other Countries	Partnership Framework
ADV (3a)	G5797		MYP	Developing Physical-Layer Security Schemes for Internet of Things Networks	PRT	QAT	JOR	ICI
ADV (3a)	G5802		ARW	Practical Applicatons of Advanced Technologies for En-handing Security and Defence Capabilities: Perspectives and Challenges for Western Balkans	NMA	BIH		EAPC
ADV (3a)	G5828		MYP	SeaSec: DroNets for Maritime Border and Port Security	ITA	QAT		ICI
ADV (3a)	G5839		MYP	HADES: Hazards Detection with Quantum Sensors	ITA	SWI		EAPC
ADV (3a)	G5850		MYP	OPTIcal liMIting and SwiTching with nanoscale photonic structures (OPTIMIST)	ITA	AUS		PaG
ADV (3a)	G5859		MYP	MW-Magnon-Optic Conversion Technologies for Quantum Sensing and Secure Communications	TUR	UKR		NUKR
ADV (3a)	G5862		ARW	Fighting Disinformation in a Pandemic World: the Role of AI and Cognitive Sciences	ITA	UKR		NUKR
ADV (3a)	G5884		MYP	Cybersecurity for Safe Underwater Acoustic Communica-tions (SAFE-UComm)	ITA	ISR	CAN GBR	MD
ADV (3a)	G5888		MYP	CLARIFIER: frequenCy agiLe rAdar lidaR chip For surveil-lancE moving platfoRms	ITA	COL	SVN	PaG
ADV (3a)	G5894		MYP	Quantum Cybersecurity in 5G Networks (QUANTUM5)	CZE	BIH		EAPC

Key Priority	SPS reference	Top-Down	Grant Mechanisms	Title	NATO Country	Partner Country	Other Countries	Partnership Framework
ADV (3a)	G5902		MYP	Collaborative Augmented Navigation for Defence Objectives - II (CANDO2)	NOR	FIN		EAPC
ADV (3a)	G5905		MYP	Nanocoatings for Multi-Protective Textiles used for Military Clothing (MULProTex)	USA	SRB	NMA	EAPC
BRDR (3b)	G5719		ARW	Security and Legal Impacts of Strengthened Border Protection in Western Balkans: Lessons Learned from 2015 and 2016	CZE	SRB		EAPC
UXO (3c)	G5711		MYP	Virtual Evidence Capture Tool for Ordnance Recovery (VECTOR)	GBR	BIH	GRC FYR	EAPC
UXO (3c)	G5731		MYP	Multi-Sensor Cooperative Robots for Shallow Buried Explosive Threat Detection	ITA	UKR	USA JOR	NUKR
UXO (3c)	G5751		MYP	The Optical Nose Grid for Large Indoor Area Explosives' Vapours Monitoring - ORION	GBR	SRB	USA	EAPC
HUM (3d)	G5730		ARW	Cultural Heritage's Safety and Security in Zones of War or Instability	ITA	TUN	SRB	MD
HUM (3d)	G5811		ARW	Resilience Research Workshop in North-East Ukraine	EST	UKR		NUKR
HUM (3d)	G5824		ATC	Gender Mainstreaming in Counter Terrorism Efforts in Western Balkans	NMA	BIH		EAPC
HUM (3d)	G5903	X	ARW	A Gendered Lens Approach to Military to Civilian Transition and Reintegration for Ukraine Joint Forces Operations (JFO) Women Combatants	CAN	UKR		NUKR

Annex 2
SPS Events (ARW, ATC, ASI) hosted

SPS Ref.	Top-Down	Grant mechanism	Title	NATO Country	Partner Country	Location	Dates	Format
G5649	X	ATC	Network Security	USA	TUN	Tunis, Tunisia	December 2019-February 2020	On-site
G5675	X	ATC	Network Security and Network Vulnerability Assessment and Risk Mitigation Courses	DEU	NMA	Skopje, North Macedonia	January-August 2020	Online
G5686		ARW	Hybrid Threats and Wars in 21st Century - 5th Zagreb Security Forum	HRV	ISR	Zagreb, Croatia	7-8 September 2020	Online/ On-site
G5742	X	ATC	Introduction to Network Security Course (27 September-8 October 2020) and Introduction to Network Vulnerability Course (29 November-10 December 2020)	DEU	KWT	Kuwait City, Kuwait	September-December 2020	Online
G5730		ARW	Cultural Heritage's Safety and Security in Zones of War or Instability	ITA	TUN	Rome, Italy	25-27 November 2020	Online
G5737	X	ATC	Critical Energy Infrastructure Protection and Resilience Course	USA	KWT	Kuwait City, Kuwait	22-26 November 2020	Online
G5830		ARW	Game Changers 2020. A new future dawns on International Security	ITA	MAR	Rome, Italy	10-11 December 2020	Online/ On-site

Annex 3

SPS Multi-Year Projects (MYP) Completed in 2020

SPS Ref.	Top-Down	NATO Country	Partner Country	Other Countries	Title	Key Priority Area
G4936		Italy	Jordan	USA	Hybrid Sensor Networks for Emergency Critical Scenarios	Counter-Terrorism
G5048		Spain	Japan	Australia, Turkey, Lithuania	High-Efficient Color-Resolved Infrared Photosensors Based on Stopped Light	Advanced Technologies
G5055		Italy	Ukraine		Development of Novel Methods for Improved Safety Assessment of Gas Pipelines	Energy Security
G5079		Spain	Australia		Improving Efficiency and Operational Range in Low-Power Unmanned Vehicles Through the Use of Hybrid Fuel-cell Power Systems	Energy Security
G5094		USA	Ukraine		Reliable Nuclear Materials Identification Technology From Spectrometry Data	CBRN Defence
G5147		USA	Finland		Ultra-Sensitive Opto-Electrochemical Detection of Liquid Explosives Fabrication	Counter-Terrorism
G5148		Slovakia	Ukraine		Development of New Cathodes for Stable and Safer Lithium-Sulfur Batteries	Environmental Security
G5176		USA	Ukraine		Agile Tyre Mobility for Severe Terrain and Cyber-Threat Environments	Advanced Technologies

SPS Ref.	Top-Down	NATO Country	Partner Country	Other Countries	Title	Key Priority Area
G5228		Iceland	New Zeeland	Lithuania, USA	Small States and the New Security Environment (SSANSE)	Other
G5244		Spain	North Macedonia		Graphene / Polymer based Sensor	Advanced Technologies
G5248		Italy	Israel		Compact Eye-Safe Lidar Source for Airborne Laser Scanning (CALIBER)	Advanced Technologies
G5266		Bulgaria	North Macedonia	Turkey, USA	A field Detector for Genotoxicity from CBRN and Explosive Devices	Defence against CBRN Agents
G5269		Canada	North Macedonia		Flash Crowds Management via Virtualized Network Resources (FALCON)	Cyber Defence
G5281	X	Belgium	Montenegro	Netherlands	Creation of Computer Incident Response Team and Securing the IT Infrastructure	Cyber Defence
G5293		Italy	Israel	Canada	Autonomous Platform for Securing Marine Infrastructures	Advanced Technologies
G5319		France	Morocco	USA	Threat Predict: From Global Social and Technical Big Data to Cyber Threat Forecast	Cyber Defence
G5320		UK	Serbia	USA	Photo-BioNuclear Reactor Radiation Hormesis for Higher Microalgae Biofuels Yield	Energy Security
G5340	X	Belgium	Republic of Moldova	Netherlands	Development of the Moldovan Armed Forces Cyber Defence Capabilities	Cyber Defence

SPS Ref.	Top-Down	NATO Country	Partner Country	Other Countries	Title	Key Priority Area
G5381		Italy	Republic of Moldova	UK	MIDAS - Control of Team of Mini-UAVs to Support Counter-Terrorism Missions	Advanced Technologies
G5387	X	Spain	Jordan		Comprehensive Jordanian C-IED DCB Package 2017-2018	UXO Detection and Clearance
G5402		UK	Serbia		Improved Security through Safer Cementation of Hazardous Wastes	Defence against CBRN Agents
G5406		Norway	Finland		Collaborative Augmented Navigation for Defence Objectives	Advanced Technologies
G5437		Italy	Republic of Moldova	UK	WITNESS: Wide InTegration of sensor Networks to Enable Smart Surveillance	Advanced Technologies
G5528		Iceland	New Zealand	Lithuania, USA	Small States and the New Security Environment (SSANSE)	Other

Annex 4
NATO Science Series Publications in 2020

SPS reference	Title	Editors	Series	Publisher	Volume
G5516	Cybersecurity and Resilience in the Arctic	**Trump, B.D.; Hossain, K.; Linkov, I.**	D: Information and Communication Security	**IOS Press**	58
G5470	Space Infrastructures: From Risk to Resilience Governance	**Tatar, U.; Gheorghe, A.V.; Keskin, O.F.; Muylaert, J.**	D: Information and Communication Security	**IOS Press**	57
G5549	Maritime Security: Counter-Terrorism Lessons from Maritime Piracy and Narcotics Interdiction	**Lucas, E.R.; Rivera-Paez, S.; Crosbie, T.; Jensen, F.F.**	E: Human and Societal Dynamics	**IOS Press**	150
G5617	Toward Effective Cyber Defense in Accordance with the Rules of Law	**Brill, A.; Misheva, K.; Hadji-Janev, M.**	E: Human and Societal Dynamics	**IOS Press**	149
G5385	Risk Management of Terrorism Induced Stress. Guidelines for the Golden Hours (Who, What and When)	**Vermetten, E.; Frankova, I.; Carmi, L.; Chaban, O.; Zohar, J.**	E: Human and Societal Dynamics	**IOS Press**	148
G5573	Advanced Nanomaterials for Detection of CBRN	**J. Bonca; S.Kruchinin.**	A: Chemistry and Biology	**Springer Netherlands**	
G5535	Toxic Chemical and Biological Agents	**Giovanni Sindona et al.**	A: Chemistry and Biology	**Springer Netherlands**	

SPS reference	Title	Editors	Series	Publisher	Volume
G5622	Modern Magnetic and Spintronic Materials	A. Kaidatzis et al.	B: Physics and Biophysics	Springer Netherlands	
G5611	Nanoscience and Nanotechnology in Security and Protection against CBRN Threats	P. Petkov et al	B: Physics and Biophysics	Springer Netherlands	
	Advanced Technologies for Security Applications	C. Palestini	B: Physics and Biophysics	Springer Netherlands	
G5347	Functional Nanostructures and Sensors for CBRN Defence and Environmental Safety and Security	A. Sidorenko; H. Hahn.	C: Environmental Security	Springer Netherlands	
G5524	Soft Target Protection	L. Hofreiter et al.	C: Environmental Security	Springer Netherlands	
G5566	Building Knowledge for Geohazard Assessment and Management in the Caucasus and other Orogenic Regions	Fabio L. Bonali et al	C: Environmental Security	Springer Netherlands	

Annex 5
SPS Grant Mechanisms

Grant Mechanisms
The SPS Programme provides funding and expert advice for security-related activities in the forms of Multi-Year Projects (MYP), Advanced Research Workshops (ARW), Advanced Training Courses (ATC), and Advanced Study Institutes (ASI) involving at least one expert from a NATO Ally and one expert from a NATO partner nation, and addressing at least one SPS key priority.

Multi-Year Project (MYP)
MYPs are research and development projects related to NATO's Strategic Objectives and aligned with the SPS key priorities. Projects involving more than one partner nation are encouraged, as is the participation of young scientists. The projects aid scientists from partner nations in growing their networks within the NATO scientific community, while contributing to a strong scientific infrastructure in their home country. These projects have an average duration of two to three years.

Advanced Study Institute (ASI)
ASIs are high-level tutorial courses on the latest developments in SPS key priority areas for advanced-level audiences. An ASI lasts roughly seven working days. Lecturers of international standing report on new advances in different aspects of security-related civil science to pre and post-doctoral level scientists with relevant backgrounds in the subject. Young scientists from NATO partner nations are especially encouraged to participate.

Advanced Training Course (ATC)
Through ATCs, specialists share their security-related expertise in one of the SPS key priority areas with participants from NATO and partner countries. An ATC is not intended to be lecture-driven, but interactive. The course contributes to the training of experts in partner nations and enables the formation and strengthening of international expert networks. The tailor-made modular courses respond to the needs of partner nations. Trainees are chosen on the basis of their qualifications and experience, and the benefits they may draw from the ATC in their future activities. ATCs typically take place over five to seven working days.

Advanced Research Workshop (ARW)
ARWs are dedicated expert workshops, providing open platforms for experts and scientists to share their experience and knowledge in order to promote spin-off SPS activities such as MYPs. ARWs typically take place over two to five days and gather 20-50 participants. Workshops are preferably held in the participating partner nation.

Annex 6
SPS Key Priorities

All activities funded by the SPS Programme must address at least one of the SPS key priorities and have a clear link to security. The SPS key priorities are based on NATO's Strategic Concept agreed by Allies at the Lisbon Summit in November 2010, and the strategic objectives of NATO's partner relations agreed in Berlin in April 2011. The current SPS key priorities are:

01 Facilitate mutually beneficial cooperation on issues of common interest, including international efforts to meet emerging security challenges

a Counter-Terrorism

- Methods for the protection of critical infrastructure, supplies and personnel;
- Human factors in the defence against terrorism;
- Detection technologies against the terrorist threat for explosive devices and other illicit activities;
- Risk management, best practices and technologies in response to terrorism.

b Energy Security

- Innovative energy solutions for the military; battlefield energy solutions; renewable energy solutions with military applications;
- Energy infrastructure security;
- Maritime aspects of energy security;
- Technological aspects of energy security.

c Cyber Defence

- Critical infrastructure protection, including sharing of best practices, capacity building and policies;
- Support in developing cyber defence capabilities, including new technologies and support to the construction of information technology infrastructure;
- Cyber defence situational awareness.

d Defence Against CBRN Agents

- Methods and technology regarding the protection against, diagnosing effects, detection, decontamination, destruction, disposal and containament of CBRN agents;
- Risk management and recovery strategies and technologies;
- Medical countermeasures.

e Environmental Security

- Security issues arising from key environmental and resource constraints, including health risks, climate change, water scarcity and increasing energy needs, which have the potential to significantly affect NATO's planning and operations;
- Disaster forecast and prevention of natural catastrophes;
- Defence-related environmental issues.

02 Enhance support for nato-led operations and missions

- Provision of civilian support through SPS key priorities;
- Provision of access to information through internet connectivity as in the SILK-Afghanistan Programme;
- Cultural and social aspects in military operations and missions;
- Enhancing cooperation with other international actors.

03 Enhance awareness on security developments including through early warning, with a view to preventing crises

a Security-related Advanced Technology

Emerging technologies including nanotechnology, optical technology, micro satellites, metallurgy and the development of UAV platforms.

b Border and Port Security

- Border and port security technology;
- Cross border communication systems and data fusion;
- Expert advice and assessments of border security needs and best practice.

c Mine and Unexploded Ordnance (UXO) Detection and Clearance

- Development and provision of advanced technologies, methodologies and best practice;
- Solutions to counter improvised explosive devices (IED).

d Human and Social Aspects of Security Related to NATO's Strategic Objectives

04 Any project clearly linked to a threat to security not otherwise defined in these priorities may also be considered for funding under the SPS Programme. Such proposals will be examined for links to NATO's strategic objectives