annual REPORT



Joint Air Power Competence Centre

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foreword

Today, NATO Air Forces stand on the verge of the most meaningful transformation of technology and capability in our history, a transformation which continues to be enabled in part by the independent thought and analysis from the recognized air and space power experts in the Joint Air Power Competence Centre. This edition of the Annual Report summarizes what was a busy 2019 and provides a glimpse into the work JAPCC will be engaged in across the Air and Space domains for 2020.

The shifting strategic environment and emerging technologies are bringing new threats and challenges. Hypersonic missiles, autonomous weapons and offensive cyber capabilities are just a few of the systems being developed specifically for military use that we must be prepared not only to employ, but to counter.

Our Air Forces have demonstrated operational excellence in recent operations, but we cannot become complacent. Fifth generation aircraft are now operating throughout European airspace and participating in a wide range of NATO operations and exercises. These new platforms represent a game-changing leap in capability and complement our current force structure. The next step is for these aircraft to maximize interoperability fighting along-side existing platforms, developing and refining tactics, techniques, and procedures to enable improved performance of legacy systems. Maximizing the force multiplying capabilities of fifth generation platforms is a vital element of how we counter the rapid advancement of potential adversaries' offensive and defensive weapons. We continue to focus on this integration with JAPCC Subject Matter Experts.

The JAPCC Opposition Forces (OPFOR) Air Team continued to provide extensive support to the Joint Warfare Centre in Stavanger in the preparation and conduct of Exercise Trident Jupiter. In November, the team was able to present a number of Joint All Domain challenges to the Training Audience at both the operational and strategic levels, testing our Alliance

at the peer-to-peer level. We must use the lessons learned from this and other exercises to evolve our Alliance into a connected, Joint All Domain fighting force that is agile and capable of acting at speed that future conflicts will require. I have great confidence that our Nations and our people will work closely with industry to innovate and create solutions to the challenges we face.

Furthermore, in December 2019, NATO Defence Ministers took important decisions for NATO's continuing adaptation process, including an agreement to recognize Space as a new operational domain for NATO, alongside Air, Land, Sea and Cyberspace. The JAPCC Space Team is actively working with AIRCOM to further military thought in this area while assessing the expanded implications of this declaration on NATO planning and strategy. These efforts will continue to grow the Space expertise the JAPCC has provided for NATO since the CoE was established in 2005.

In closing, I would like to thank our Sponsoring Nations for continuing to support the JAPCC and seize this opportunity to encourage other Nations not currently participating in the JAPCC to look at taking on an active role as a Sponsor or Contributing Nation. Presence in the JAPCC provides access to a unique network of experts in the Air and Space domains and allows members to contribute to work that influences decision-making at the highest levels in our Alliance. With that in mind, I commend to you this 2019 JAPCC Annual Report. I trust you will find it relevant to your nation or organization.

Good Reading!

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Jeffrey L. Harrigian General, USA AF Director, JAPCC

who we are

Established in 2005, the JAPCC was the first NATOaccredited Centre of Excellence (CoE). We provide subject matter expertise across a broad range of Joint Air & Space (A&S) Power topics including the development of Concepts and Doctrine, Capability Development, Education and Training, and Lessons Learned in accordance with NATO MC (M) 236.

The JAPCC seeks to maximize its contribution to the improvement and transformation of Joint A&S Power through a well-formulated engagement strategy. This strategy not only guides the Centre's approach to organizations within NATO and our Sponsoring Nations, but also enables outreach to other national organizations and academia, allowing the CoE to tap into a comprehensive and diverse pool of Joint A&S Power subject matter experts. The Joint Air Power Competence Centre (JAPCC) was formed on 1 January 2005 to provide a strategic level proponent for Joint Air and Space (A&S) Power that was missing in NATO¹. Soon thereafter, JAPCC was accredited as NATO's first Centre of Excellence (COE) and, as such, is charged with the development of innovative concepts and solutions required for the transformation of A&S Power within the Alliance and the Nations.

Based on a Memorandum of Understanding (MoU), the JAPCC is sponsored by 16 NATO nations who provide a variety of experienced Subject Matter Experts (SME) from across the Air Force, Army, Navy and Space services. Through its multi-discipline organization, the JAPCC chooses the most suitable SMEs for the task and combines their knowledge and experience to fully contribute to transforming NATO's A&S Power. More importantly, the JAPCC is not constrained by the need for political consensus in developing ideas. It can offer objective independent military advice across the spectrum of A&S Power to NATO HQs and national policy making bodies.



Director (USA AF) General Jeffrey L. Harrigian

Executive Director (DEU AF) Lieutenant General Klaus Heinrich Habersetzer



A&S Power SMEs drawn from the Land, Maritime, Air, Cyberspace and Space components of the 16 MoU nations conduct collaborative research into areas in which JAPCC assistance is requested by leveraging their independent thought and a global network of experts that reach across the military, academic and industrial spheres. The resulting analysis and solutions are disseminated via studies, reports, journal articles, seminars, panels and conferences.

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Director's Vision

To be NATO's catalyst for the improvement and transformation of Joint A&S Power, delivering effective solutions through independent thought and analysis.

Mission

The JAPCC, as a team of multinational experts, is to provide key decision-makers effective solutions on A&S Power challenges, in order to safeguard NATO and the Nations' interests.

Leadership

The JAPCC is headed by the Director, General Jeffrey L. Harrigian (USA AF), who has led the centre since May 2019. General Harrigian also serves as the Commander, Allied Air Command and the Commander, United States Air Forces in Europe and Air Forces in Africa (USAFE-AFAFRICA) at Ramstein Air Base.



Assistant Director (ITA AF) Brigadier General Giuseppe Sgamba



Chief of Staff (USA AF) Colonel Brad A. Bredenkamp





The JAPCC's Executive Director, Lieutenant General Klaus Habersetzer (DEU AF), also commands the German Air Operations Command (AOC) and the German Joint Force Air Component Headquarters (DEU JFAC HQ) as well as Combined Air Operations Centre Uedem (CAOC U).

On site, Brigadier General Giuseppe Sgamba (ITA AF) serves as the Assistant Director (AD), and together with the Chief of Staff, Colonel Brad Bredenkamp (USA AF), provides day-to-day leadership for the JAPCC team.

Lieutenant Colonel Thomas Schroll (DEU AF) is Branch Head Assessment, Coordination and Engagement (ACE) and Colonel Matthew Willis (USA AF) is Branch Head Combat Air (CA). Colonel Marco Galgani (ITA AF) is the Branch Head C4ISR+S and Colonel Ben van Daatselaar (NLD AF) is the Branch Head Air Operations Support.



The JAPCC has lost capability and capacity due to decreasing manpower over the past years. The numbers stabilized in 2019, with JAPCC ending the year with an overall manning of 64 percent, but a Subject Matter Expert (SME) manning of only 59 percent.

The JAPCC continues to actively mitigate these shortfalls through cross utilization, internal education and training as well as creative technological solutions.



However, in order to better address the spectrum of air and space subject matter areas relevant to NATO, and to better support the Joint Warfare Centre and major NATO exercise programs, JAPCC needs Sponsoring Nations to consider increasing their participation, and needs other NATO nations who may be benefitting from the Centre's work to consider joining.

Budgeting and Finance

Based on the JAPCC Medium Term Finance Plan and taking into account of the actual number of assigned staff officers, the JAPCC budget for 2019 remained just below 850,000 Euros. Our Senior Resource Committee

(SRC) continues to provide full support to our budget on the basis of 'minimum military-requirements'. As described in the JAPCC Operational Memorandum of Understanding, the sponsoring nations contribute to the budget according to the number of staff officers in their bid. The current corresponding annual cost per staff officer is approximately 14,650 Euros. For Fiscal Year 2019, the approved budget of 849,300 Euros was expended primarily on travel, supplies and services (62%), personnel related expenditures (22%) and replacement of furniture, as well as hard- and software upgrades for automated information systems (16%).

Stakeholders

Our primary customers are NATO Headquarters (Allied Command Operations, Allied Command Transformation, NATO Joint Commands and Air Command) and sponsoring nations. However, the JAPCC also accepts Requests for Support (RfS) from other sources via our RfS form, which can be accessed through the JAPCC website. With numerous successful products and ever-increasing connections with industry and academia, the JAPCC continues to build upon its reputation as NATO's pre-eminent advocate for the development and enhancement of Joint A&S Power.

The JAPCC Provides Solutions to Address Air and Space Power Challenges

To fulfil our mission, the JAPCC conducts its own research and advocacy, as well as responding to the needs of NATO and its member nations. Our Programme of Work (PoW) comprises projects, activities, and tasks, which are dynamic in nature and are adjusted monthly based upon the acceptance of Requests for Support (RfS). Independently, the JAPCC also hosts a number of major events, including an Annual Joint A&S Power Conference, the biannual meeting of the Air Operations Working Group (AOWG), the Maritime Air Coordination Conference (MACC), one session of the biannual meeting of Air-to-Air Refuelling WG, the JAPCC Steering Committee (SC) meeting and the Senior Resource Committee (SRC) meeting.



key developments

The JAPCC is vigorously active in areas in which it has SMEs available. This section summarizes the efforts the organization has made in the past year in support of NATO's Joint Air and Space Power; however, due to space constraints in this report, these are top-level summaries of activity. For more detail on any specific area, please visit our website or contact us directly.

Joint Air Power Development

The JAPCC's support to Joint Air and Space Power development in 2019 includes the following:

- The Rotary Wing Focus Group (RWFG);
- Fifth Generation Integration Efforts in the European AOR;
- Air Force Protection Support to NATO Air Command, Ramstein;
- Alliance Future Surveillance and Control Project (AFSC);
- Support to Centre of Excellence for Confined and Shallow Water (COE CSW) Study on Integration of Unmanned Systems into Maritime Operations;
- Support of the NATO S&T study about Hypersonic Operational Threats;
- Close Air Support Project;
- Czech Air Force Tactical Forces Review Project;
- Support to FIT for Confined and Shallow Waters (CSW) project – Smart Defence Project 1.1044;
- Support of NATO STO study SCI-301 Defeat of Low Slow and Small (LSS) Air Threats;
- Contribution to the STO SCI-311 Research Task Group – Collaborative Space Domain Awareness Data Collection and Fusion Experiment;
- Command and Control of a Space Surveillance and Tracking (SST) Network;
- Cyberspace;
- Space support in NATO operations;
- Support to DEU AF/ACT study Artificial Intelligence in Air Command and Control (AirC2).

The Rotary Wing Focus Group (RWFG). The JAPCC/ RWFG is to increase awareness and coordination among the assigned Rotary Wing SMEs and their branch heads, in order to improve the quality of their work through a well-defined working method.

Today the RWFG counts six JAPCC SMEs with varying backgrounds from four different nations, split between the Air Operations Support and Combat Air branches within the JAPCC.

The RWFG also reaches out to other experts, within the JAPCC, the Allied Air Command, Combined Air Operations Command Uedem and the German Air Operations (ZLO) Command Kalkar, in order to support the development of specific projects or the organization of specific events. Due to the inherent process of consensus making, this working method significantly increases JAPCC credibility within the larger community of helicopter users.

Examples of projects and objectives to be managed by the RWFG are studies and white papers regarding future rotorcraft in support of the Next Generation Rotorcraft Capability Team of Experts (NGRC ToE), development and maintenance of NATO standardization, as well as improvement of interoperability of helicopter operations doctrines in cooperation with the NATO Helicopter Inter Service Working Group (HIS WG).

Fifth Generation Integration Efforts in the European

AOR. Integrating fifth generation systems into existing allied forces has been an effort for many years. As the F-35 is now in the European theatre, the effort has been increasing, with much of the 'shared' work primarily being led by three organizations, with significant participation of partner groups, including the JAPCC. The overarching aim of the integration effort is to smoothly incorporate new capability inherent in fifth generation platforms into existing fourth (and older) generation systems, enabling fifth generation platforms to truly become a force multiplier. In 2019, the JAPCC participated in the following (ongoing) 5th generation integration efforts:

• European Air Group (EAG). The EAG's Combined Air Interoperability Program (CAIP) began in 2016 as a task from the EAG Steering Group. The aim of the CAIP is 'to resolve the issues that result from integrating 4th and 5th generation weapons systems, in order to achieve a higher level of interoperability in future combined air operations'. The CAIP lists 16 'challenges', placed in four subject areas: General, Air Operations, Air Enablers, and Air Command and Control.

The JAPCC was heavily involved in EAG's CAIP. The JAPCC maintained the lead of multiple CAIP challenges including 5th Generation Doctrine development and ROE/National Caveat Management development. Additionally, the JAPCC is supporting many other 'challenges' through participation in two CAIP workshops and providing assistance with focus areas currently under investigation. The JAPCC Combat Air Branch Head also participates in the CAIP management board.

• Allied Air Command (AIRCOM). AIRCOM is the NATO lead for fifth generation integration and maintains the operational perspective, along with advising SACEUR on strategic matters. In November 2016, AIRCOM published a Study Paper entitled Modern Aircraft Integration (MAI) which provided an initial analysis of actions to be taken for effective MAI in AIRCOM's area of responsibility. AIRCOM maintains an active 'AIRCOM Work Plan' that addresses items such as Air Policing, AirC2, and Training and Exercises, and it also includes plans for recurring workshops. 7

The JAPCC has maintained involvement in AIRCOM's MAI Work Plan, and the lines of effort have synergistic effects with the EAG's CAIP. The JAPCC's participation is primarily through taking the lead of Caveat Management development and potential legal considerations with 5th generation capabilities in terms of Positive Identification (PID) and Rules of Engagement (ROE).

• U.S. Air Forces in Europe (USAFE). The USAFE A3I (i.e. Operations Integration) branch was formed in December 2017. The A3I team serves as the secretariat of the 'European F-35 Users Group' consisting of a General Officer Steering Group (GOSG) and an OF-5 Working Group. The GOSG, with representatives from each European nation that is procuring the F-35 (including non-NATO nations), meets annually. The Users Group Working Group (UGWG) meets twice a year. The group focusses on common areas of concern throughout the F-35 nations.



The JAPCC's participation is primarily through participation in USAFE's F-35 Users Group Working Group (UGWG). Though much of the information presented is non-releasable to NATO, writ large, the Users Group provides a unique insight into the beddown and national level integration of the F-35. This level of access is proving key to understanding where the true friction points for F-35 integration likely lie. The JAPCC SMEs are also working with national representatives in the F-35 community to enhance 5th generation awareness and education by acquiring and disseminating releasable documents to the Alliance.

Contribute Joint A&S expertise to Alliance decisionmaking processes through active leadership of and participation in NATO committees, Working Groups and fora.

Air Force Protection Support to NATO Air Command,

Ramstein. This consists of two primary deliverables. First is robust support to Ramstein's Annual Senior Officers' Force Protection Seminar.² In 2019, the JAPCC led a session based on the JAPCC's work looking at how the Force Protection Practitioner might use existing counter-threat methodologies to counter adversary use of Unmanned Systems. This session was based on a discussion that arose from the 2018 Seminar and led to the production of 'The Implications for Force Protection Practitioners of Having to Counter Unmanned Systems' think-piece. The thesis advanced was that significant effects could be achieved through the application of a little intellectual rigour and without the immediate need for new and potentially unproven technologies. The second deliverable is more difficult to quantify where the JAPCC acts as an extension of the AIRCOM Force Protection Cell and provides a platform where ideas can be exposed, discussed and tested before being exposed to a broader Air or Joint audience. It is offered that this is a superb example of where the JAPCC functions as NATO's dedicated Air and Space Warfare Centre and provides direct support to the Command Structure.

Alliance Future Surveillance and Control Project (AFSC). The NATO AWACS fleet is scheduled to retire from service in or around 2035. Consequently, the North Atlantic Council tasked the Conference of National Armaments Directors (CNAD), to determine requirements and advice on options and possible ways to deliver a follow-on to the AWACS capability under the heading of the Alliance Future Surveillance and Control initiative, or AFSC.

At the 2016 NATO Warsaw Summit, the North Atlantic Council approved the AFSC Pre-Concept Stage report and Heads of State and Government declared: 'By 2035, the Alliance needs to have a follow-on capability to the E-3 AWACS. Based on high-level military requirements, we have decided to collectively start the process of defining options for future NATO surveillance and control capabilities.'

Based upon the NAC's direction and within the boundaries of the approved AFSC Concept Stage model, the Concept Stage will be conducted in three Phases:

Phase 1. Development of refined capability requirements and deliverance of AFSC capability architectures capturing alternative operational concepts. Furthermore, the conduct of knowledge gap analysis in order to identify study objectives to inform Phase 2.

Phase 2. Studies of selected AFSC High-Level Technical Concepts by capability architectures and related project architectures including down-selection of the preferred AFSC capability architecture and project architectures for which materiel solutions have to be procured in Phase 3.

Phase 3. Development of programmatic arrangements necessary to initiate procurement programme(s) at the conclusion of the Concept Stage.

Throughout the Concept Stage, each Phase will end with a decision point where Allies will have the opportunity to examine the deliverables and provide direction and guidance to the NSPA (AFSC Host Nation) on how best to proceed.



In order to govern and manage this effort, an AFSC Support Partnership Committee (SPC) and AFSC Project Office has been established.

The Concept Stage started in January 2017 and is expected to be concluded in Q4 2022.

HQ-SACT requested the support of JAPCC to contribute to the AFSC Program Office venues (i.e. multiple Workshops on Requirement development, Requirement review and Gap Analysis). Writing support to Phase 1 program report and Phase 2 Framework plan was provided. Finally, JAPCC SME's are supporting the development of the assessment criteria to evaluate industry provided High Level technical Concepts.

Support to Centre of Excellence for Confined and Shallow Water (COE CSW) Study on Integration of Unmanned Systems into Maritime Operations. The JAPCC continues to support the COE CSW study on the Integration of Unmanned Systems into Maritime Operations. COE CSW and the JAPCC have been invited to join, and are taking part in, NATO's Maritime Unmanned Systems Steering Board to align and coordinate the project with their work. A first draft is expected mid-2020.

Support of the NATO S&T study about *Hypersonic Operational Threats.* JAPCC supported the NATO S&T study with expertise about Integrated Air and Missile Defence (IAMD) and helped to shape the overall focus on military relevance. In close cooperation with the Competence Centre for Surface Based Air and Missile Defence (CC SBAMD), the JAPCC analysed the operational impact of emerging hypersonic threats on NATO's current posture. It is planned to support a follow-on study in 2020.

Close Air Support Project. The aim of this project is to provide recommendations on how the CAS and Joint Terminal Attack Controller (JTAC) communities should adapt and leverage emerging capabilities to meet future operational requirements in the long term (defined for this study as 10–15 years). The JAPCC plans to publish this study at the beginning of 2020.

Czech Air Force Tactical Forces Review Project. The Czech Air Force made a request for support to the JAPCC in evaluating options to modernize their tactical air forces to meet both sovereign airspace defence and NATO air policing missions. A tiger team was established and met with the Czech AF representatives at the JAPCC to determine the scope and desired outcomes for the study. Subsequently, the team travelled to the Czech Republic to hear first-hand the issues in consideration, speak with operators and leaders and tour their existing facilities to understand the missions and requirements under consideration. The JAPCC final report will be submitted to the Czech Air Force in March 2020.

Support to FIT for Confined and Shallow Waters (CSW) project – Smart Defence Project 1.1044. JAPCC support with Air expertise this project led by the CSW CoE from Kiel. The feasibility study is conducted to investigate the possibility of developing and operating a set of compatible components, thus enabling nations to maintain a broad(er) set of affordable and effective capabilities for maritime, combined, and potentially also joint operations, specially designed for the comprehensive and challenging scenarios in CSW. The study should investigate and define, from a holistic approach, possibilities and requirements for a variety of systems that are capable of being deployed from a myriad of multinational platforms and shore installations available. The outcome should be used for follow on investment, development and procurement planning.

Support of NATO STO study SCI-301 Defeat of Low Slow and Small (LSS) Air Threats. JAPCC is contributing to a three-year study headed by the NATO Science and Technology Organization (STO) on the future of Counter-UAS systems. While conventional threats remain of concern, deployment of Small Unmanned Aerial Systems (SUAS) has provided one of the most significant military capability enhancements of recent years. Challenges posed by SUAS are many and range across the complete kill chain. Traditional systems and first-generation C-UAS systems may be unable to cope with this challenge in the future. The Goal of the study is to provide recommendations to support a 'Second Generation' C-UAS networked system. JAPCC is currently involved in drafting the group's final report which is to be provided mid-2020 to the STO.



Contribution to the STO SCI-311 Research Task Group – Collaborative Space Domain Awareness Data Collection and Fusion Experiment. The JAPCC is involved in this two-year-long STO project as an active contributor. Today, space-related data and products from different NATO nations include variations in data protocols and sensor attributes. However, to ensure the timely and effective exploitation of these data and products, a common integrated environment within NATO planning and operations domains is required. In particular, combined effort based on effective collaboration strategies can considerably improve NATO Space Situational Awareness by providing greater geometric diversity, enhanced observability of space objects, and timeliness of reporting. The aim of this project is to experiment on the benefits of collaborative Space Domain Awareness (SDA) data collection and mutual exchange among NATO nations. It involves personnel and hardware/software resources from seven NATO countries: Germany, Italy, Poland, Romania, Spain, the UK, and the US. The final report on this ex-

Command and Control of a Space Surveillance and Tracking (SST) Network. This project is based on a Request for Support from the Italian Air Force Staff from 2016 and aimed at analysing and defining the best solution for a C2 model for a multinational SST network. It also emphasizes the advantages of an EU SST network for the Alliance and promoted the importance of Space Situational Awareness and SST in support of NATO military operations. This white paper was published in June 2019.

perimental activity is expected to be delivered in 2020.

Cyberspace. JAPCC expanded and strengthened its network of collaboration and engagement by becoming a member of the European Air Group (EAG) Cyberspace committee, the Cyberspace Annual Discipline Conference (ADC) and through direct liaison on Cyberspace with the Air Operations Centre of Excellence (CASPOA). During the EAG Cyberspace meetings in Berlin, JAPCC briefed on its projects and the White Paper with the title NATO Joint Air Power and Offensive Cyber Operations. EAG members were particularly interested in the proposal for how offensive effects might be incorporated into the air planning processes and with the air operations centres. NATO has published the framework mechanism for how Cyberspace effects offered voluntarily by allies are to be integrated into operations; however, this document is classified. JAPCC provided expert advice during the ADC and for the Discipline Alignment Plan (DAP) for training Cyberspace SMEs participating in exercise development and execution.

JAPCC provided a Cyberspace SME as OPFOR Cyber for the concept development, scripting and execution phases of Exercise Trident Jupiter 19-01 in order to provide a realistic and challenging Cyberspace campaign for exercise participants.

Space Support in NATO Operations. The JAPCC continued to champion the evolution of Space Power within NATO, mainly through its participation in the Bi-Strategic Command Space Working Group (NBiSCSWG), which reports directly to the NATO Military Committee (MC) and which is committed to the evolution of space support for alliance military operations. Within the frame of the actual mandate 'NATO's approach to space – follow-on work', the JAPCC contributed to the production of a 'NATO Overarching Space Policy (OSP)' that was published in June 2019. JAPCC contributed to an advice paper for the International Military Staff (IMS) that led to a declaration in December 2019 that NATO recognizes Space as an operational domain.

Support to studies of the NATO Army Armament Group/Joint Capability Group Vertical Lift (NAAG/ JCGVL), 'LAMP reference: VL-001'. The JAPCC liaises with the JCGVL, which meets twice each year. The JAPCC also has the vice-chairmanship of the recently assigned NGRC WG. The UK-JAPCC led WG is performing a study to identify a Next Generation Rotorcraft Capability concept for 2035–40 and beyond. The study will extend over 2 years in order to provide NATO nations and Partners with a Statement of Intent (SOI) for further consideration.

Support of NATO STO AVT-329 study 'Next Gen Rotorcraft impact on Military operations'. JAPCC is also involved in the STO AVT 329 study which will support the NGRC WG SOI by defining the trade space for the NGRC. Support to DEU AF/ACT Study Artificial Intelligence in Air Command and Control (AirC2). JAPCC has participated in this study since its beginning, with stakeholders such as ACT (sponsor), DEU AF (owner/ manager), DEU JFAC (AirC2 experts), FRA AF (support), JAPCC (AirC2 experts) and CAE (contractor).

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The study is researching the AirC2 JFAC planning cycle and exploring and recommending applications of Artificial Intelligence. Work packages will include overviews and analyses of concepts to be improved in both the planning cycle as well as during training (ETEE).

The study will demonstrate, through a Software Demonstrator, the possible solutions to an analytical process within the JFAC in the 4th quarter of 2021.

Education/Training and Exercises/Evaluation (ETEE)

In 2019, the JAPCC was active in the following ETEE areas:

- Support to Major NATO Exercises;
- Air Transport Exercises;
- Air-to-Air Refuelling Training;
- Air Force Protection (FP) support to the European Air Group (EAG);
- Think-pieces on Force Protection;
- NATO Force Protection Training (Introduction to Force Protection in NATO Course);
- Development of NATO Advanced FP (Practitioners) Course;
- Air FP Training for Baltic Nations (Support to Baltic Air Policing);
- Cyberspace Support;
- NSO Comprehensive Operational Planning Course (COPC);
- Surface Based Air and Missile Defence;
- Education and Training on Space Operations.

Support to Major NATO Exercises. In April, JAPCC supported AIRCOM during its annual Exercise RAMSTEIN AMBITION 19. JAPCC provided an OPFOR air team for Exercise Control (EXCON), which executed a highly dynamic air scenario for the training audience.

JAPCC was requested by the Joint Warfare Centre (JWC) to support both the development of the exercise scenario and the actual exercise planning and execution for Exercise TRIDENT JUPITER 19. In November, a combined JAPCC team deployed to Stavanger, Norway, to support the Command Post Exercise Trident Jupiter 19-1. JAPCC personnel were augmented by SMEs from the AOCC of the 1st German-Netherlands Corps, the Netherlands Air Force and Joint Force Command Naples, all of whom deployed as members of the JAPCC team. The deployed JAPCC team, as part of the overall OPFOR concept, challenged the Training Audience with a host of modern warfare threats including Anti Access/Area Denial (A2AD), peer-to-peer adversaries, TBM- and Space operations and Cyberspace. After the conclusion of exercise Trident Jupiter 19-1, the JAPCC continued to further plan for the execution of the second part of this exercise, Trident Jupiter 19-2 which will be conducted in March 2020.

Air Transport Exercises. The JAPCC continued its cooperation with the European Tactical Airlift Centre. JAPCC provides a Flight Safety Manager in the tactical course and contributes to the EATC Symposium as POC between NATO and EU Air Transport community. The JAPCC is following the development of the centre with the idea of acting as a focal point for future endorsement of the courses.

Air-to-Air Refuelling Training. This year also saw the continued use of the Standardised Heavy Air Refuelling Course, a course created by JAPCC and AIRCOM personnel to train JFAC AAR planners and practitioners, culminating in the graduation of more than 120 multinational students. In the beginning of the year, JAPCC personnel in conjunction with NATO HQ IS-DI, EDA, and the Royal Netherlands Flight Test Centre conducted the third annual two-day course focused on what it takes to obtain an AAR Clearance. This training was attended by 39 personnel from 16 nations representing 33 different organizations. The Table Top Exercise (TTE) was very well received and overwhelmingly requested to be a semi-annual event with the next iteration taking place Poggio Renatico in autumn 2020. The JAPCC also hosted a Military Aviation Authority (MAA) workshop in Poggio Renatico with a



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focus on collaboration between MAAs regarding the airworthiness implications of tanker/receiver pairings. These results were briefed at the AVC.

Air Force Protection (FP) Support to the European Air Group (EAG). Throughout 2019, the JAPCC has continued to work closely with the EAG on Force Protection and Force Protection-related issues. This collaboration works extremely well as the EAG gets the benefit of broader expertise and experience and the JAPCC can use the smaller EAG community as the starting point for consensus-building regarding NATO products (noting that EAG nations are also all NATO nations). As with previous years, the JAPCC supported the EAG's VOLCANEX Force Protection exercise and focused this year on developing Job Descriptions for Force Protection specialist staffs within the Air Component and also a discreet one-off task to produce a draft paper for the Deputy Director EAG to go to Air Chiefs explaining the ongoing value of continued support for, and participation in, VOLCANEX. Some one-on-one

mentoring was also undertaken with exercise players. As above, the EAG and JAPCC collaborated on the development of 'The Implications for Force Protection Practitioners of Having to Counter Unmanned Systems – A Think-Piece' and looking forward there is the potential for collaboration on the next JAPCC think-piece which has a working title of 'NATO Force Protection on a Knife Edge'. The JAPCC attends EAG Force Protection meetings and seminars as a matter of routine and has a standing briefing slot at all.

Think-pieces on Force Protection. The concept of producing think-pieces has gained traction with Allied Command Transformation (ACT) as issues can be raised and discussed in order to promote debate, without the need to necessarily provide solutions for which there is consensus.

1. The Implications for FP Practitioners of Countering Adversary Use of Unmanned Systems

The subject of the NATO AIRCOM Ramstein, Senior Officers' Force Protection (FP) Seminar 2018³ was Air Force Protection's efforts to counter adversary use of Unmanned Air Systems (UAS). The consensus was that the nature of the problem needed to be properly captured and the many apparently disparate approaches to counter the threat needed to be explored. The ultimate intent was to develop a piece of work that would lay the foundation for an update of ATP-3.3.6, NATO Force Protection Doctrine for Air Operations. A number of nations and the European Air Group (EAG) stated their desire to partner with the JAPCC on the development of a Think-Piece and a number of workshops were held throughout the remainder of 2018. An early step was to decide that any input into doctrine needed to, if possible, be 'future-proofed'. It was decided that our adversaries would not limit themselves to just using unmanned air vehicles and that as unmanned systems existed in all domains, then Air FP Practitioners needed to develop a multi-domain Counter-Unmanned Systems mindset. A think-piece methodology was chosen as this provided the greatest scope for exploring a complex and rapidly evolving area in a manner that allowed relatively rapid publication of a piece of work stated as being urgently required by the Air FP Community of Interest. The final

paper development workshop was held at the EAG, 17-18 January 2019 and by 25 January 2019, project partners had reached consensus on content and the think-piece went to printing before being distributed on 7 May 2019. The paper consisted of an analysis of the problem and does briefly describe the possible use of emerging technologies. However, the focus of the paper was on how existing counter-threat approaches could be modified in order to counter the Unmanned Systems threat. The JAPCC briefed the paper and distributed copies at the NATO HQ C-UAS Working Group on 9 May 2019. The paper has remained in high demand throughout 2019 primarily because it offers immediate and enduring ways of countering the threat, rather than looking at what might be in the future.

2. NATO FP on a Knife Edge – A Think-Piece (Working Title)

The idea for this paper arose out of discussions that took place during the Pilot, Advanced Force Protection (Practitioners) Course. The perceived challenge is to identify the Force Protection requirements and, some if not all, of the likely challenges that will present themselves in a scenario where a peer/near-peer adversary is seeking to achieve their (military) objectives, whilst simultaneously not creating a situation where the threshold for consensus on an Article V response can be reached. The intent will be to identify vulnerabilities. Consider how these vulnerabilities might be addressed and in doing so, what resources will be required. The paper will also attempt to identify the key



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challenges for a force operating in a contested environment yet, without the freedom of action that Article V would bring. A working draft will be produced and exposed for discussion with interested parties in a series of workshops before a final product is delivered. Anticipated completion is by no later than the end of Q3 of 2020.

NATO Force Protection Training (Introduction to Force Protection in NATO Course). The JAPCC has been the Office with Principle Responsibility (OPR) for this course since 2008 and 3-iterations of the course are run each year at the NATO School Oberammergau.⁴ The course was significantly re-structured in early 2015 following the end of International Security Assistance Force (ISAF) Mission, Afghanistan. The course is continuously evolving as threats change and as counter-threat methodologies develop. The course is consistently well received with a close to 90% student satisfaction rating. All iterations of the course in 2019 have been fully subscribed and courses for 2020 are already almost full. In terms of attendance and course critique capture, the perspective of students remains that it is consistently one of the best of the 120+ courses run at the NATO School. Consistent feedback on the desire for more advanced training led to the development, by the JAPCC, of a NATO Advanced Force Protection (Practitioners) Course.

Development of NATO Advanced FP (Practitioners)

Course. At the NATO Force Protection Working Group (FPWG) of October 2017, the Nations endorsed the requirement for more in-depth training for FP Practitioners both for employment within the NATO Command and Force Structure and within the Nations themselves. This requirement was subsequently supported by both the NATO Command Structure (NCS) and the NATO Force Structure (NFS) in the Force Protection Advisory Group (FPAG) immediately following the FPWG. JAPCC was requested by SHAPE, as the defacto NATO Requirements Authority for Force Protection, to undertake a Training Needs Analysis and subsequently deliver a Training Proposal. This work was undertaken in a series of Working Groups run by and hosted at the JAPCC throughout 2018. The output of this work was then shared with the NATO School Oberammergau and further work undertaken by the

JAPCC led to the development of Course Control Documents (CCDs) which in turn underpinned the delivery of a Pilot, NATO Advanced Force Protection (Practitioners) Course, during the first week of June 2019. Feedback from the first batch of students was extremely positive and whilst a comprehensive course critique was undertaken, it was clear that the stated requirement had been met if not exceeded. Following the Pilot Course, issues raised in the critique have been addressed and both the CCDs and course programme have been revised. At the time of writing, the CCDs are in the process of being signed and the NATO Advanced Force Protection (Practitioners) Course, will become a NATO Approved Course for 2020 with two iterations planned⁵, both of which are already oversubscribed. In the longer-term, the aspiration is to merge the 2 courses into a single but, modular format.

Air FP Training for Baltic Nations (Support to Baltic Air Policing). In 2015, the Director tasked the JAPCC to investigate the Force Protection posture of the Baltic Air Policing (BAP) Mission and to then explore how that might need to be enhanced should the BAP Mission ever have to transition to Air Defence. This work, that continued well into 2016, has brought about positive, substantive change to Air Force Protection in the region in terms of both enhanced plans and increased resources. In addition, it has created lasting linkages between the Air Force Protection specialists in the 3 Baltic States and JAPCC Force Protection. In 2019 the JAPCC was requested to provide a weeklong, bespoke Air Force Protection package to officers from all 3 nations attending the Air Force Staff Officers' Course at the Lithuanian Defence College in Vilnius.⁶ This was a substantial undertaking that comprised of 35 lessons and approximately 200 hours of preparation. Initial verbal feedback from both staff and students was extremely positive and the lowest mark achieved by a student during the end-of-module assessment was 76%. This indicates that students learned a considerable amount and initial plans are in place to make this event an enduring part of the staff college curriculum.

Cyberspace Support. JAPCC provided one of the two Cyber SMEs in OpFor/ExCon Cyberspace for Exercise Trident Jupiter 2019, and assisted in the concept



development process, preparation of Cyber injects and the Cyberspace Exercise Control/Opposing Forces cell during the Execution Phase. JAPCC also participation in the Cooperative Cyber Defence COE-hosted International Conference on Cyber Conflict 2019.

NSO Comprehensive Operational Planning Course

(COPC). COPC in NATO School Oberammergau (NSO), being one of the leading courses, is normally run with the expertise assistance of Liaison Officers from the functions (navy, army, air, SOF) and JAPCC provided the SME already attending the current review of the Comprehensive Operational Planning Document. The lack of planners at all levels (tactical and operational) requires the NSO to run 8–10 iterations per year. Those iterations fulfil only approximately 25% of the planning requirements for NATO. This indicates the high value of the course as well as it shows the great demand. JAPCC continues to support it.

Surface Based Air and Missile Defence. In preparation for the Air and Missile Defence Committee meeting, JAPCC is contributing to the Panel on Air and Missile Defence (PAMD) Large and Focus Group meetings and the related workshops. In these meetings, significant NATO policy documents, like the NATO IAMD Policy were created and amended.

JAPCC is a member of the Joint Capability Group on Ground Based Air Defence and supports the Capability Area Facilitator GBAD, under the Capability Development Establishment Board (IS/IMS); both under the responsibility of the Conference of National Armaments Directors.

When requested, JAPCC provided subject matter expertise to other workshops, like the AirC2IS Requirements Integrated Project Team, BMD Operational User group, the NATO ESSM Procurement Group, the BiSC NATO A2AD Simulation Study or the NATO Science and Technology study about Hypersonic Operational Threats. In this regard, JAPCC personnel provided presentations in several national and multinational conferences and workshops.

In addition, JAPCC supported SBAMD courses at NATO School Oberammergau and in the DEU/NLD binational Competence Centre SBAMD. The JAPCC

also participates in and supports the European Ground Based Air Defence Working Meeting, an initiative (DEU/NLD Framework lead) to bundle the scarce GBAD assets in Europe in the areas of Education, Training and Exercises.

Since mid-2015, JAPCC has been an active member of the multinational BMD experiment Nimble Titan and fills the deputy position in the War Game Control Group as well as support for the Analysis and Reporting Team. Furthermore, JAPCC provides the deputy in the Operational Control Group for the main IAMD exercise in the European theatre, Joint Project Optic Windmill, which was executed in March 2019, with the preparations for the 2021 version already underway. Also, SBAMD expertise was provided for the preparation and execution of the Exercise Ramstein Ambition and the Trident series of JWC.

Education and Training on Space Operations

Since May 2016, JAPCC is the Department Head (DH) for the discipline 'Space Support to NATO Operations'. As the DH for Space, the JAPCC coordinates findings and develops solutions for the E&T requirements identified by the Requirements Authority (SHAPE DCOS SDP). The 3rd Annual Discipline Conference (ADC), which was focussed on discussing current and future developments and changes in Education and Training issues in the space discipline was executed during the 16th Meeting of the BiSCSWG due to availability of attendees. The final work on the creation of a new *Space Support Coordinators Course* at NATO School Oberammergau was one of the main activities of this year's E&T function.

The JAPCC also continued to foster the integration of Space into NATO operations by contributing to the space training experimentation into the Trident exercise series. For that, the design of an OPFOR Space structure, including all relevant documents, was designed for Trident Jupiter 2019. Within the execution of Trident Jupiter 2019-01, in November 2019, the roles as OPFOR Space as well as an educational role for the training audience were fulfilled. The preparation of Trident Jupiter 2019-02 by designing the OPFOR Space structure is already on-going.

Active Engagement

The JAPCC continues to actively engage with various air power stakeholders through working groups and other face-to-face meetings. These engagements included but were not limited to:

- Annual Joint Air and Space Power Conference;
- Think Tank Forum (TTF);
- Joint Air and Space Power Network (JASPN) Meeting;
- NATO's Long-Term Military Transformation (LTMT);
- COE Programme of Work (POW) Workshop;
- Safety & Security Professionals Network;
- 13th European Space Policy Institute (ESPI) Autumn Conference;
- Kindelan Seminar at Air Warfare Center of Spanish Air Force;
- Aircraft Cross-Servicing (ACS);
- Joint Personnel Recovery (JPR);
- Air-to-Air Refuelling (AAR);
- Maritime Air Coordination Conference (MACC);
- Participation in the Air and
- Missile Defence Committee and Subordinate Bodies;
- AEROSPACE CAPABILITY GROUP 2 (ACG2).

Promote and showcase the effectiveness and relevance of Joint A&S Power as a critical element in Air, Land and Maritime operations.

Annual Joint Air and Space Power Conference. The JAPCC hosted a multinational team of distinguished speakers and panellists at the annual Joint Air and Space Power Conference, held in Essen, Germany, October 8 to 10.

The theme of this year's conference was 'Shaping NATO for Multi-Domain Operations of the Future' and it was discussed in four themed panels.

The first panel explored a working definition of what constitutes Multi-Domain Operations (MDO) and addressed prevailing environmental views from the



JAPCC Joint Air and Space Power Conference 2019, 8–10 October 2019.



Think Tank Forum, Greece, Air Force HQ, 27–28 February 2019.



Joint Air and Space Power Network Meeting, Germany, Kalkar, 20 November 2019.

Air, Land, Sea, Space and Cyberspace domains, in order to set a baseline for discussion of MDO and what distinguishes it from Joint, Hybrid, and Effects-Based Operations.

The second panel examined the foundational requirements associated with Multi-Domain Operations. In this context, the panel discussed the legal and policy requirements for conducting multinational MDO to improve understanding of the role of political and military decision-makers. The panel also looked at the impact of Multi-Domain Operations on the Airpower principle of centralized command and decentralized execution, as well as the increasing criticality of assured access to and control of Space and Cyberspace domains.

Panel Three addressed the challenges NATO may face in order to meet the requirements discussed earlier. Potential challenges may include educational, psychological and behavioural adaptations in order to ensure that the individual service member can cope with the increasing speed of operations and decision cycles as well as develop a sufficient depth of understanding joint capabilities, which is necessary for conducting future Multi-Domain Operations. Other potential key issues comprise securing the Electromagnetic Spectrum and protecting the Space and Cyber infrastructure to enable the information gathering, sharing and communications essential for Multi-Domain Operations. Other challenges to legal, command and control as well as data sharing aspects raised in Panel Two were addressed as well.

The last panel expanded on new technologies such as artificial intelligence, hypersonic weaponry and robotics, as well as mining, managing and exploitation of Big Data as potential key enablers for effective Multi-Domain Operations. Finally, the panel addressed the paradigm shifts required to effectively transition from traditional command and control to a truly joint and unified command relationship that will characterize future Multi-Domain Operations.

Additional information may be found in the recently published Conference Proceedings at www.japcc.org/ conference.

Think Tank Forum (TTF). The sixth Think Tank Forum was conducted in Andravida, Greece from 26–28 February 2019, graciously hosted by the Hellenic Air Force Air Tactics Centre (HAFATC). The objective of this forum was to have an inter-organizational exchange of POWs as well as to share information regarding NATO's future Air Power Strategy, Air & Space Power related challenges and shortfalls and awareness of the key areas of effort of the participants. Main contribution points were; manpower, collective training, 5th generation aircraft and systems integration, UAS, hybrid warfare, space, rotary wing systems and lessons learned.

Joint Air and Space Power Network (JASPN) Meeting.

JAPCC hosted the Joint Air and Space Power Network Meeting from 20-21 November 2019 with participants from NATO HQ, HQ AIRCOM, NATO Science and Technology Organization (STO), Competence Centre for Surface Based Air and Missile Defence (CC SBAMD), NATO Air Operations Centre of Excellence (CASPOA), Integrated Air and Missile Defence Centre of Excellence (IAMD COE), European Defence Agency (EDA), European Space Agency (ESA), European Air Transport Command (EATC), Movement Coordination Centre Europe (MCCE), and European Air Group (EAG). Similar to the Think Tank Forum, the JASPN meeting helps to develop better synergies within the Air & Space Power community. However, it brings together NATO and European multinational organizations instead of the sovereign national entities that attend the TTF. The main objective of the Forum is to share information regarding the transformation of Joint Air and Space Power in order to gain awareness of key areas of effort and discuss potential areas of cooperation and prevent duplication of effort. Main discussion areas of JASPN 2019 were; 4th and 5th generation integration, cross-border MOB and diplomatic clearance, AAR clearance and integration, AI, C2 & decision speed, ACS & resilient basing and spacebased support.

NATO's Long-Term Military Transformation (LTMT).

The NATO Long-Term Military Transformation (LTMT) programme addresses the full range of security challenges, applies a unifying vision, and advances a conceptual framework for forces and capabilities required

to succeed in future operations. To support this programme, JAPCC took part in all three workshops for the Strategic Foresight Analysis (SFA) update in 2019. As the Framework for Future Alliance Operations (FFAO) was finalized in April last year, there was no activity with regards to reviewing.

The first of three SFA workshops in 2019 was conducted in Madrid (April 2019), the second in Helsinki (June 2019), and the last one in Oslo (September 2019). The SFA provides the basis for the FFAO, which in turn feeds the NDPP in both, Step 1 and Step 2 - Determination of Requirements. Since the SFA 2017 was published (November 2017), the two workshops in 2018 focused on discussions on the impacts of regional development on the global security context. The three workshops in 2019 were convened by HQ SACT in support of the development of reports on North Africa and the Sahel, Russia and Eastern Europe, and the Arctic/High North. The results of all previous regional workshops will serve as a foundation for the Regional Perspective Report scheduled for release in March 2020. JAPCC will continue to support the LTMT in 2020 as requested by ACT.

COE Programme of Work (POW) Workshop. To make the Request for support (RfS) process more accurate, responsive and transparent, ACT created a web-based tool named TRANSNET available to all COEs, managed by ACT. It allows registered customers to transmit an RfS in a very easy way to the COEs, which makes cooperation more efficient, transparent and easy. As a result, JAPCC received a portion of RfS (13 of the 42) via TRANSNET to support NATO HQ, its subordinate commands and JAPCC member nations. In accordance with NATO-wide RfS for POW-2019, JAPCC will continue engagement in the requested activities, projects, and working groups on the subjects of NATO exercises, Lessons Learned, Remotely Piloted Aircraft Systems, Space, Autonomous Systems, Optimization of Air Land Integration, NATO Future ASW Concept, 5th Generation Integration, Integration of UAS into Maritime Operations, NATO Defence Planning Process (NDPP), Strategic Foresight Analysis (SFA), Framework for Future Alliance Operations (FFAO), Aircraft Cross Servicing and NATO Global Programming.

Safety & Security Professionals Network. This network allows JAPCC Force Protection to connect with individuals who are responsible for what the military describes as Force Protection but, are working in the academic or industrial sector. While there is a significant benefit to be gained from participation in the form of capturing emerging best practices (i.e. for incorporation in doctrine and/or training), all participants in the network agree that the relationship between participants is symbiotic and the mutually derived benefit is improvements to Safety, Security and Force Protection for all. During the Reporting Period, the JAPCC hosted a visit to the European Air Groups' VOLCANEX7 Force Protection exercise and used the opportunity to discuss the development of NATO Airs' approach to Risk Management and build consensus on the need to develop a common approach to asset protection. The Hague University of Applied Sciences acts as the facilitator for the network and the JAPCC supports both a Counter-Terrorism module run by the university and is helping shape their approach to Risk Management for 2021 and bevond. The network will prove invaluable as the JAPCC looks to review ATP-3.3.6, NATO Force Protection Doctrine for Air Operations and concurrently looks to develop an International Standard, through the International Standards Organization (ISO) for Asset Protection; both during 2020. This engagement with academia and industry ensures that the JAPCC's Force Protection output is not only multinational and multidomain but, is also comprehensive.

13th European Space Policy Institute (ESPI) Autumn Conference. This year's ESPI Conference focused on the theme of *European Space Strategy in a Global Context: The Role of Space Diplomacy.* The JAPCC Assistant Director provided a NATO Military perspective during a session examining Space Diplomacy for Security and Defence, and participated in a panel question and answer exchange. The proceedings from this conference were published by the ESPI.

Kindelan Seminar at Air Warfare Center of Spanish Air Force. This year's Kindelan Seminar topic was Air Forces and the Outer Space – A challenge of international cooperation. This provided the JAPCC with an opportunity to give a keynote speech on 'NATO and Space' through the Assistant Director and to discuss current aspects and challenges of the emerging Space Domain in an international workshop. All results were published by Spanish AF HQ.

Aircraft Cross-Servicing (ACS). In 2019, SHAPE reactivated the ACS programme. JAPCC is supporting AIRCOM by providing guidance and recommendations on the most effective and efficient way to rebuild the ACS capability in the area of processes, organizational structure, and documentation, and assess potential additional ACS capability options for future employment to enhance this operational capability. JAPCC, as the custodian of the Allied Aircraft Cross-Servicing Publication (AASSEP-13), provided the Ratification Draft of the Publication. Currently, the ratification by nations is ongoing.

Joint Personnel Recovery (JPR). In addition to the PR/SAR WG, JAPCC was engaged (via RFS) by the US Joint Personnel Recovery Agency (JPRA) to support a Multinational Capability Development Campaign (MCDC) in 2019–20 project entitled 'JPR 2040 – a global perspective'. The global Joint Personnel Recovery (JPR) community requires an assessment of collective Capability, Capacity, Interoperability and Commitment (CCIC) to improve and ensure the effectiveness of the full JPR System now and over the next two decades.

The JPR 2040 project attempts to assess this lack of priorities by approaching the problem from different perspectives. This kind of approach aims to deliver recommendations with which nations and organizations can develop a number of interoperable capabilities.

The project is not limited to military entities, but it intends to reach out to diplomatic (Departments of State, Foreign Ministries, United Nations), civil (Non-Governmental and Inter-Governmental Organizations), as well as potential commercial stakeholders.

Air-to-Air Refuelling (AAR). The AAR SMEs conducted 15 presentations in 3 nations throughout the year focused on the education and increasing interoperability within the AAR enterprise world-wide. Two academic articles were published, three NATO STANAGs and four Standards Related Documents received substantial review and re-writes this past year. The AAR SMEs continue to meet with NATO HQ IS-DI and EDA on a quarterly basis to ensure that the strategic direction of the three agencies remains pointed in the right direction.

Maritime Air Coordination Conference (MACC).

The MACC 2019 was hosted at the Marcom HQ in Northwood UK on 4th June 2019. The Bi-SC annual conference, focusing on maritime air component integration, was co-chaired by the JAPCC Assistant Director (on behalf of ACT), and the Commander Maritime Air NATO (on behalf of ACO). The theme of this year's conference was 'Maritime Air Operations in a Contested Environment'. In addition to the JAPCC and MARAIRNATO staff, the MACC was attended by 24 Officers representing eleven NATO nations and three NATO entities.

Participation in the Air and Missile Defence Committee and Subordinate Bodies. The JAPCC remains an active participant in the Air and Missile Defence Committee and the PAMD and its subordinate working and focus Groups. Through continuous participation in these various bodies, the JAPCC supports the development of Integrated Air and Missile Defence policy.

AEROSPACE CAPABILITY GROUP 2 (ACG2). The JAPCC hosted (as Vice-Chairman) the 27th Meeting of ACG2. The primary mission of ACG2 is to achieve interoperability between NATO and national forces in Effective Air Engagement by developing and providing standardization in the area of air weapons systems. Among the relevant activities on the meeting agenda, support was provided by the ACG2 to future capabilities and weapon effectiveness methodology for NATO's Targeting Process.

JAPCC Involvement in NATO Activities and Working Groups

JAPCC personnel fill chairmen, co-chairman, and panel positions on numerous NATO steering bodies as well as providing custodianship to a number of NATO Doctrine documents, as highlighted below.

Chairmanship

- Air Operations Working Group (AOWG);
- Maritime Air Coordination Conference (MACC Co-Chair);
- NATO Air-to-Air Refuelling Working Group (AAR WG);
- NATO Air Transport Working Group (ATWG);
- Doctrine, Organisation, and Interoperability (DOI) Panel, NATO Force Protection WG;
- Vice Chairman with the UK Next Generation Rotorcraft Capability Working Group.

Exercise/Campaign

- Nimble Titan 20, Wargame Control Group and Analysis Team;
- Operations Control Group Joint Project OPTIC WINDMILL (JPOW);
- OPFOR Air-, Space- and Cyberspace support to Exercise Trident Jupiter 19-1;
- OPFOR Air support to exercise Ramstein Ambition 19.

Panel Member/Working Group

- Allied Future Surveillance & Control Project Group (AFSC PG);
- Air Capability Group 3 and NATO Electronic Warfare Air Group;

- NATO AEW&C Programme management Organization Board of Directors (NAPMO BOD);
- JPR Forum;
- Air & Missile Defence Committee (AMDC);
- Force Protection (FP) Task Force;
- NATO Special Operations Headquarters (NSHQ) in support of Air Development Program (ADP) for SOF aviation;
- Personnel Recovery/Search and Rescue Working Group (PR/SAR WG);
- NATO Army Armaments Group/Joint Capability Group Vertical Lift (NAAG/JCGVL);
- Helicopter Inter Service Working Group (HISWG);
- European Personnel Recovery Centre (EPRC) calendar;
- Joint Capability Group Unmanned Aircraft Systems (JCGUAS);
- Joint Capability Group Ground Based Air Defence (JCGGBAD);
- Maritime Operations (MAROPS) Working Group;
- Global Helicopter Operations from Ships other Than Aircraft Carriers (HOSTAC) WG;
- Multinational Through-deck and Aircraft Carrier Crossdeck Operations (MTACCOPS) Working Group;
- ACG 2 Effective Engagement;
- ASSEWG Aircraft Servicing and Standard Equipment Working Group (ASSEWG);



Exercise Trident Jupiter 2019, Norway, Stavanger, October-November 2019.

- NATO Bi-Strategic Command Space Working Group (BiSCSWG);
- Next Generation Rotorcraft Capability Team
 Working group;
- NLD SBAMD Policy Group;
- NLD Knowledge Network on SBAMD;
- Panel on Air & Missile Defence (PAMD) Large Group;
- PAMD Workshops and Focus Group;
- European Air Group Cyberspace Committee;
- Cyberspace Annual Discipline Conference;
- BMD Operational User Group;
- RIPT AirC2IS;
- NATO Cooperative Cyber Defence Centre of Excellence (CCD COE) 11th International Conference on Cyber Conflict Panellist;
- NAPMO Board of Directors for NATO AEW programme;
- CNAD/NAFAG/ACG3 Effective survivability, more particular, EW in the aerospace domain;
- NEWAC/NEWWG NATO EW Concept & Doctrine;
- CNAD/NNAG/AWWCG EW sessions;
- STO AVT 329 study (Next Gen Rotorcraft Impact on Military Operations);
- STO SCI-301 Study Group;
- STO MSG-SET-183 Specialist Meetings.

Doctrine, Standards, and Procedures

Over the last year, the JAPCC led and participated in the following doctrine efforts:

Custodianship of MC-0656, Military Committee (MC) Policy for Force Protection of Alliance Forces.

This document was finally promulgated on 24 January 2018 and represented the end of seven years of JAPCC work to deliver a NATO Capstone Document for Force Protection (FP). The purpose of the Policy is to create a common, agreed understanding of the subject as well as allocate responsibility for the provision of FP across the spectrum of conflict, irrespective of whether that conflict is within or external to NATO borders. Having an overarching policy in place considerably simplifies the current review of AJP-3.14, Allied Joint Doctrine for Force Protection. FP, as described in policy, is a complex area that requires the activity of many 'cross-cutting domains' (to include Security and Defence Against Terrorism (DAT)) to be coordinated. As a result, the JAPCC is engaged with other stakeholders to review both Security Policy and then subsequently the Alliances' DAT Concept. The eventual goal is a single NATO Protection Policy that brings together in a coherent manner, many associated but currently uncoordinated disciplines. A single approach will eliminate gaps that could be exploited by any adversary and make the delivery of Force Protection far more resource efficient.

Custodianship of AJP-3.14. The JAPCC has been heavily involved in the development of Joint FP doctrine since 2010 and has been the Custodian of AJP-3.14 since 2015. The purpose of assuming custodianship of this Joint Doctrine was twofold: Firstly, to ensure that this crucial document was'owned' by an entity that possessed proper Force Protection knowledge and was fully connected to NATO operations and Capability Development. Second, the NATO Air Component requires up-to-date and fit-for-purpose componentlevel doctrine and development of ATP-3.3.6, NATO Force Protection Doctrine for Air Operations, which was being significantly hampered by the inability of the broader Force Protection Community to reach consensus (see below). The way to unblock this impasse was identified as to take ownership of the problem through custodianship. As a Level 2 Doctrine, the AJP is subject to a 3-year review cycle and a Request for Feedback (RFF) was distributed to the Nations in December 2017. This led to a Data Fusion Workshop (DFW) being run in the UK during April of 2018. Out of this cascaded the Doctrine Review Task which was eventually issued by ACT in March 2019. However, following the DFW, the JAPCC developed a review timeline and commenced immediate work. A first workshop was held at the JAPCC in September 2018 and has been followed by two further workshops in 2019. This has led to the JAPCC producing a first working draft of the reviewed publication in July 2019 and work is well under way to have a first study draft with the Nations for comment by the end of Quarter 1 (Q1) of 2020. The JAPCC has ensured that NATO and the Nations have remained informed of progress through the regular submission of Custodian's Reports to the Allied Joint Operations Doctrine (AJOD) Working Group. In May 2019 the JAPCC provided a face-to-face briefing on progress to the AJOD in Brussels.

Authorship and Custodianship of ATP-3.3.6. The JAPCC initially authored this publication in 2010 at the request of the Nations in the forum of the NATO Air Operations Working Group (AOWG). Unfortunately, having produced a substantive draft, the Nations were reluctant to proceed with ratification as the overarching AJP was under review. The ATP was eventually promulgated in April 2016 and as a result, should have gone into review during 2019. However, once again the development of this doctrine is being hampered by the laborious and time-consuming task of reviewing the overarching AJP 3.14. Notwithstanding this challenge, as author and custodian of the ATP, the JAPCC has maintained a working copy of the document, into which have been incorporated developments as they have occurred. As a result, AOWG 1 of 2019⁸ accepted the JAPCC's recommendation that the JAPCC should be authorized to produce a working draft of the ATP, without the need for Working Groups. This would then be offered to the Nations for consideration; the intent is to reduce both the time and cost needed for review. With current progress on the AJP review, it is envisaged that the JAPCC will be in a position to offer a fully revised and updated ATP-3.3.6 to AOWG 2 of 2020 (October or November 2020). Moving forward, it is suggested that AJP-3.3.6 be considered a stand-alone document and its future development be de-coupled from that of AJP-3.14. The JAPCC has ensured that NATO and the Nations have remained informed of progress through the regular submission of Custodian's Reports to the Air Operations Working Group (AOWG).

AJP 3.3 Allied Joint Doctrine for Air and Space

Operations. The JAPCC is the custodian of NATO's doctrine on joint air operations, AJP 3.3, Allied Joint Doctrine for Air and Space Operations. JAPCC succeeded in drafting a new version of the AJP 3.3 and had it ratified and promulgated (old version was dated 5 November 2009). Simultaneously, JAPCC prepared the request for feedback required for the next edition of AJP 3.3. A new doctrine task was issued in early 2017 and the first draft of Edition C (Working Draft 1) was published in November 2017. The Study Draft 1 (SD1) has been published in December 2018 and a new draft (SD2) incorporating all feedbacks coming from NATO nations and NATO bodies will be

published as soon as possible. The goal is to have AJP 3.3. Edition C entering the ratification process in 3^{rd} of 2020.

NATO Joint Intelligence Working Group (JINTWG).

Due to the Vacancy of the Intel SME during 2019, JAPCC did not support JINTWG. In October 2019, the new Intel SME arrived at JAPCC and will continue to support JINTWG. Furthermore, in October 2019 JAPCC participated in the *Meeting of Intelligence-related CoEs* at NATO HQ organized by the Joint Intelligence and Security Division (JISD).

ATP 3.3.4.1/3/4 Custodianship. The new editions of those studies were reviewed during the year and were ratified. The ATP 3.3.4.4 is now reopened and under discussion for a new version that will be ready by next year. As the JAPCC holds the NATO ATWG Chairmanship, it continues to manage the focus of the AT community. The JAPCC also continues to be a contact point for coordination between NATO and EU organizations involved with AT.

ATP 3.3.4.2. The JAPCC remains active in the management of AAR Doctrine, Standards and Procedures. In addition to continuing as the NATO AAR WG Chair, the JAPCC continued its management of the global AAR compatibility and clearance matrix and built upon its relationships with other key AAR stakeholders, producing, updating and disseminating standardized AAR documents (6 STANAGs/4 NATO Standards Related Documents (SRDs)/1 SRD template/26 National and Organizational SRDs).

ATP-49 Custodianship. Within the Helicopter Inter Service Working Group (HISWG), the Helicopter Operations Panel (HelOps Panel) is responsible for helicopter standardization. In order to improve the interoperability of staff and operators, the HIS WG is tasked by the MC LSB to restructure the entire HIS standardization portfolio. The ATP-49 is being revised as ATP-3.2.49. This revised standard will consist of a top-level document supplemented with identified operational areas describing Tactics, Techniques and Procedures. In coordination with the chairman of the HelOps Panel, the JAPCC, as custodian of the ATP-49, is leading the revision task, which started in April 2018 and is expected to be accomplished by mid-2021. The future ATP-3.2.49 custodianship will remain within the JAPCC.

Helicopter Underslung Load (USL) and Helicopter Underslung Load Equipment (HUSLE) Certification and Interoperability Database. On request of the HISWG, in close coordination with the HUSLE panel, the JAPCC is developing a *Helicopter USL/HUSLE Certification & Interoperability Database*. The request is in accordance with the recommendations of the USL Certification study, published by the JAPCC in November 2017.

The database will provide NATO nations and partners an information and guidance tool regarding relevant helicopter USL and HUSLE aspects and procedures. Furthermore, the database is to be used as a reference guide to confirm and/or determine if a USL can be accepted for transportation by any available helicopter.

JAPCC is currently building an initial database with the information provided by the NATO and Partner Nations. IOC is expected in Q2 2020.

JAPCC Doctrine Development (Custodianship and Contribution)

- MC 064/12 NATO EW Policy;
- AJP-3.3 Custodian;
- AJP-3.6 (NATO Joint EW Doctrine) Contribution;
- AJP-3.14 Allied Joint Doctrine for FP Custodian;
- AJP-3.3.3 Air-Maritime Coordination (Part of AMCWG);
- AJP-3.7 Allied Joint Doctrine for recovery of personnel in a hostile environment (contribution);
- ALP-4.3 Air Forces Logistic Doctrine and Procedures (contribution);
- ATP-3.6.2 EW in the Land Battle;
- ATP-3.3.3.1 Maritime Air Coordination
 Procedures;
- ATP-3.3.4 | AT Doctrine (Custodian);
- ATP-3.3.4 II AAR Doctrine (Custodian);
- ATP-3.3.4.1 Tactics, Techniques and Procedures for NATO Air Movement Operations (Custodian);

- ATP-3.3.4.2 Air-to-Air Refuelling (Custodian);
- ATP-3.3.4.2.1 SRD 1 Guide to Obtaining AAR Clearances and Compatibility;
- ATP-3.3.4.2.2 SRD 2 Recommended AAR Aircrew Certification and Currency;
- ATP-3.3.4.2.3 SRD 3 Tanker Capabilities;
- ATP-3.3.4.2.4 SRD 4 Tanker/Receiver Clearance Compatibility Matrix;
- ATP-3.3.4.3 Tactics, Techniques and Procedures for NATO Air Transport Operations (Custodian);
- ATP-3.3.4.4 Tactics, Techniques and Procedures for NATO Airborne Operations (Custodian);
- ATP-3.3.4.5 AAR Boom-Receptacle Requirements;
- ATP-3.3.4.6 AAR Pro-Drogue Characteristics;
- ATP-3.3.4.7 AAR Signal Lights in Hose and Drogue Systems;
- ATP-3.3.4.3 TTPs for NATO AT Operations (Custodian);
- ATP-3.3.6 NATO FP Doctrine for Air Operations (Custodian);
- ATP-49 (STANAG 2999) Use of Helicopters in Land Operations (Custodian);
- MC-0610, FP Policy for NATO-Led Operations
 Custodian;
- AD 80-25 ACO Force Protection Directive Custodian;
- MPP-02 Vol I Helicopter Operations from Ships Other Than Aircraft Carriers (HOSTAC);
- MMP-02 Vol II Multinational Through-Deck and Aircraft Carrier Crossdeck Operation (MTACCOPS);
- AASSEP-13 Allied Aircraft Cross-Servicing Publication
 (Custodian);
- Functional Planning Guide for Joint Air Operations Planning (FPG AIR);
- Cyberspace Discipline Alignment Plan.

- 2. 21-23 May 2019.
- 3. 11-12 Apr. 2018.
- 4. 17-23 Feb., 26 May-1 Jun. and 10-16 Nov. 2019.
- 5. 1-5 Jun. and 16-20 Nov. 2020.
- 6. JAPCC Force Protection Temporary Duty to Vilnius, $2\!-\!8$ Nov. 2019.
- 7. 15–17 May 2019 at RAF Honington, United Kingdom.
- 8. 23 May 2019 at Ramstein Airbase, Germany.

The Concept for the Joint Air Power Competence Centre, (31 July 2003, MoD Bonn) established that JAPCC would serve as the CoE for Joint Air and Space Power as reflected in the statement: 'This synergistic application of air, space and information systems from and for all services to project military power is summarized with the term Joint Air Power'. This is also reflected by the inclusion of Space, Cyber, and Electronic Warfare positions in the JAPCC Peacetime Establishment in the JAPCC Operational MOU.



2020 outlook

2020 Focus Areas

Introduction. JAPCC regularly reviews and transforms its Focus Areas, PoW and organizational structure to ensure that it can continue to address current and future challenges and to provide key decision-makers effective solutions on Air and Space Power challenges, in order to safeguard NATO and the Nations' interests. The JAPCC Focus Areas are approved by the Steering Committee at their annual meeting. In the broadest sense, the JAPCC could address any topic or capability within the realm of Air and Space Power, but closely following current developments throughout the world and within NATO, there are several topics requiring more prominent attention than others.

Space Support in NATO Operations. NATO's operations are heavily dependent on data and services from space assets, specifically in the areas of communications, surveillance and reconnaissance, global positioning, navigation and timing, meteorology, friendly force tracking, space situational awareness and early warning. In 2020, the JAPCC will continue to work to ensure NATO's space dependencies are understood and addressed appropriately, within the construct of the BiSCSWG (NATO Bi-Strategic Command Space Working Group).

After contributing to the recent 'Overarching Space Policy', published in June 2019, the JAPCC is eager to support further actions like recognizing Space as an operational domain for NATO as well as the implementation plan following the decision made in 4th to 5th December in London.

Under the JAPCC's 'Education & Training' Focus Area, JAPCC Space Team, as the Department Head for Space Support in Operations, will prepare and conduct the 4th Annual Discipline Conference (ADC) 2020 to assess the status of NATO Education & Training in the 'Space Support in Operations' discipline. In addition, JAPCC Space Team, in close cooperation with other space experts from the NATO Command Structure, will support the Trident Jupiter 2019-02 as well as the STEADFAST JUPITER 2020 exercises to assess and refine operational concepts, command and control, command relationships for space support in operations. From the space operators' perspective, the aim of the exercises is to continue to integrate space capabilities into terrestrial operations as well as pursue space-related training objectives for the TRIDENT and STEADFAST series of exercises.

With respect to JAPCC studies related to space support in operations, the JAPCC is working on two new studies: 'Space Resiliency as a Combined Challenge' and 'Requirements for a National Space Operations Centre with Regards to NATO's Need for Information'. These white papers are expected to be published mid 2020.

The recognition of Space as an Operational Domain by NATO in December 2019 will lead to a changed significance of Space within NATO and in its spacefaring member nations. JAPCC, as a member of NATO Space community will be one of the key actors in the discussion of future developments in this evolutionary domain by providing independent thought and solutions.

Countering Unmanned Aircraft Systems. Technology is developing rapidly, in many cases, faster than the defence industry or NATO can react. Additionally, NATO's focus on the low, slow, and small end of the C-UAS spectrum covers only a fraction of current UAS technology and excludes most military applications. Peer competitors to NATO can be expected to employ UAS at the same level of technology, and under comparable operational principles, as in the Alliance. Consequently, NATO has to anticipate enemy use of UAS in the same mission sets as with friendly UAS, covering the spectrum from Intelligence, Surveillance and Reconnaissance to unmanned airstrikes, conducted in Line of Sight (LOS) as well as Beyond Line of Sight (BLOS) operations, utilizing the electromagnetic spectrum and the space domain in the same way as NATO.

The JAPCC established a Counter-UAS Focus Group (CUASFG) comprised of Subject Matter Experts from Intelligence, Surveillance, and Reconnaissance, Surface Based Air and Missile Defence, Force Protection, Close Air Support and Air Interdiction, Electronic Warfare, Space Operations, Cyber Warfare and, of course, Unmanned Systems.

The JAPCC's CUASFG will liaise between the different subject matter areas and to provide cross-domain expertise with regard to the defence against the full spectrum of UAS.

A comprehensive JAPCC study on C-UAS, to include a perspective from law enforcement agencies, is planned in the 2020 timeframe.

Exercise and Experimentation Support. JAPCC will continue to provide substantial support to NATO exercises in 2020 by providing highly dynamic and realistic Opposing Forces (OPFOR) Air, Space and -related Cyber play in support of OPFOR's Concept of Operations and Exercise Training Objectives by building and executing an OPFOR Air Tasking Order (ATO) and injecting incidents through the Joint Exercise Management Module (JEMM). The expertise brought by the JAPCC OPFOR AIR Team SMEs in (multi-layered) Air Defence, Tactical Ballistic Missiles, Space, Cyber and Intel play will be integral for upcoming exercises such as Ramstein Ambition 20 at AIRCOM and TRIDENT

JUPITER 19-2/STEADFAST JUPITER 20 at the Joint Warfare Centre (JWC) in Stavanger. JAPCC continues to support the JWC in developing and updating exercise scenarios with the latest developments in joint (and aerial) warfare.

Also, JAPCC will further support Nimble Titan and JPOW in core functions in developing, executing and analysing the overall campaign and events.

Unfortunately, NATO is faced with a shortfall in Air Command & Control manning, primarily due to overreduction of personnel at AIRCOM and the fact that the augmentation system for Joint Force Air Components is not institutionalized. This is exacerbated by the fact that some air forces seem reluctant to maintain or expand their knowledge of Air C2 processes and, as a result, the overall knowledge of these processes within NATO is bleeding away, sometimes at an alarming rate. JAPCC also suffers from a shortfall in manning with only one Air C2 and one Air Operational Planning position filled. However, the importance of Air Command & Control and Operational Planning requires that JAPCC remains actively involved in most of these topics to the extent that limited manning allows.

Against the backdrop of the changing security environment, C4ISR in NATO shows several shortfalls in policies, concepts, and structures which need to be addressed in order to maintain the operational edge. The adaptation of concepts and structures, the willingness to share information, and the availability of trained operators in sufficient numbers in the NATO Command Structure and in NATO Force Structure C2 elements are essential to nearly all improvement measures. Partnering with capable national JISR and Joint Force Air Component staffs is an indispensable prerequisite. JAPCC will play a contributing role in several working groups dealing with a multitude of topics.

Logistics. NATO is required to be able to carry out a range of smaller but demanding operations, and the Alliance must retain the capability to conduct large-scale high-intensity operations, including in support of collective defence. To undertake these missions, the Alliance must be able to launch and sustain these missions. Since only a few Allies can independently

deploy and sustain their forces, it is important that NATO and Allies continue to pursue Collective Logistics in order to provide NATO commanders the greatest flexibility on current and future NATO operations. Therefore logistics work in NATO will be pursued along four main lines of effort: develop more capable and interoperable joint logistics capabilities at the required readiness; optimize Command and Control (C2) of logistics support; improve deployability of NATO forces and enhance sustainability of NATO forces. JAPCC is engaged in these topics and will continue to be so.

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Joint Precision Strike, including PGMs. A workshop on Network Enabled Weapons (NEWs) took place on the first day of the 27th meeting of the Aerospace Capability Group 2 held at the JAPCC. The advent of network enabled weapons and recent advances in weapon capability have established a need for the Alliance to survey the ACG2 on NEW issues (i.e. implementation of Link 16 STANAG, demonstrations the Group could support, mission planning tools used by Allies, and Information Exchange Requirements) in order to achieve cross domain synergies on this subject. Since 2016, the JAPCC assumed an important role in the ACG2, which will continue to devote much of its effort in the upcoming years toward addressing this priority area.

Electromagnetic Operations (EMO). Within NATO, EMO involves the deliberate transmission and reception of EM energy in the Electromagnetic Environment (EME) for military operations such as communications, navigation, attack, battlespace awareness, and targeting. EMO not only enables operations in each domain but also is the 'glue' that links and integrates military force across the domains of Air, Maritime, Land, Cyber and Space. Even though NATO still recognizes the EME as an operating environment, the Aerospace Capability Group 3 (ACG3) of NAFAG and the top level EW military committee, the NEWAC/NEWWG, are evolving Electronic Attack (EA), EW, and Suppression of Enemy of Air Defence (SEAD) in order to enable the missions and support a NATO Campaign. JAPCC will continue to engage with the aforementioned bodies in order to provide support with Subject Matter Experts. In 2020 JAPCC is

conducting a review of the SEAD Policy in support of a series of Military Committee tasks intended to facilitate the implementation of the SEAD Concept of Employment.

Air Support to Special Operations Forces. One of the most important events held by the NSHQ Air Development Program (ADP) is the NATO SOF Air Conference. With the purpose of discussing the continuing development of interoperable Special Operations Air Capabilities, the conference gives the NATO SOF Air community the opportunity to share lessons learned and to discuss current issues and solutions related to developing NATO SOF Air capabilities. In this context, JAPCC supported the ADP by providing a speaker to exchange relevant information and reinforce mutual knowledge through capability and organizational briefings. As a result, ADP acquired key knowledge to pursue its mission and prioritize efforts.

Maritime Air Coordination Conference. The MACC 2020 is scheduled for Spring 2020 in the Kalkar venue. The consolidated topic for the annual Bi-SC Conference on maritime air component integration will be 'Carrier Strike Group – C2 within NATO'.

JAPCC Joint Air and Space Power Conference, Essen Convention Centre, Germany, 6–8 October 2020. The Annual Conference is one of the most important events on the JAPCC's annual calendar. It brings together senior NATO and national military and political leaders, members of academia and industry partners in a forum that encourages open discussion of issues of strategic interest to the Alliance and partners. The topic for the JAPCC Conference 2020 will be 'Leveraging Emerging Technologies in Support of NATO Air & Space Power'.

Conclusion. Thank you for taking the time to read the JAPCC Annual Report for 2019. We hope you have found this report informative, and that it has given you a greater understanding of and appreciation for the value and relevance of the JAPCC to the Alliance. For more information on the JAPCC, please contact us via email at contact@japcc.org or visit our website at www.japcc.org.

JAPCC invites you to attend the **2020** AIR AND SPACE POWER CONFERENCE

Leveraging Emerging Technologies in Support of NATO Air & Space Power

6–8 October 2020, Essen, Germany



Joint Air Power Competence Centre

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www.japcc.org/conference





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