SEMINAR REPORT

INDIGENISATION OF CRITICAL COMPONENTS CURRENTLY BEING IMPORTED FROM FOREIGN OEMs IN THE AREAS OF UAV & C-UAS

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INDEX

EXECUTIVE SUMMARY

1. In contemporary military operations, UAVs (Unmanned Aerial Vehicles) play a crucial role in various aspects of warfare, including intelligence gathering, precision strikes, and even logistics. They enhance situational awareness, minimize risks to human personnel, and offer cost-effective solutions. Given this kind of role and importance, the C-UAS also becomes equally important.

2. These platforms are proving their importance the world over in all type of conflicts whether between states or between states and non-state actors. Closer home, during **Operation Sindoor**, the capability demonstration of these platforms is a validation of their indispensability. It is also an assertion of India's defence indigenization capabilities. Still, the reliance on imports from foreign OEMs for crucial/critical components, many of which are essential for drone manufacturing, is an issue of concern due to security and related reasons.

3. In response to *Hon'ble Prime Minister's clarion call of* 'AtmaNirbhar Bharat', Hon'ble Raksha Mantri Shri Rajnath Singh has aptly said that "Indigenisation is not just a responsibility but the Duty of every Indian". In an effort to strengthen domestic UAV and Counter-UAS ecosystem and to accelerate indigenisation efforts, the event aimed at meaningful handholding and catalysing inclusive technology innovation in this area. Through knowledge sharing, capability determination, gap identification, and policy recommendations, the event intended to strengthen sovereign ecosystem and dispense with the dependence on foreign OEMs for crucial/critical components.

OBJECTIVES OF THE SEMINAR

4. The event was aimed to bring together the representatives of military services, paramilitary forces, DRDO, PSUs, academia and industry with an objective to amalgamate the specific requirements, expertise, capabilities and challenges. The event witnessed more than 250 attendees of various categories and 30 industries exhibiting their products. The importance of the event can be gauged by the fact that CDS himself gave the keynote address highlighting the importance of subject. The objectives of the event were :-

4.1 To catalyse innovation and collaboration, contributing to a vibrant and sustainable UAV and Counter-UAS manufacturing ecosystem in the country.

4.2 To provide inputs for formulation of strategy and chart a roadmap for indigenisation of critical components being used in manufacture of UAV & C-UAS co-opting the expertise of DRDO as well as the Private Sector in the country.

4.3 To identify key procedural, technological and financial *challenges faced by the domestic Industry and seek their solution in a collaborative manner.*

5. **Strategic Context**.

5.1 One of the important common global takeaways from recent conflicts across the globe, which needs to be duly incorporated in India's defence production ecosystem, is indigenous development of UAVs and Counter-UAS.

5.2 The indigenous development of UAVs and counter-UAS are not merely technological challenges, but are strategic imperatives.

5.3 The agility, versatility, and increasing autonomy of UAVs have made them an indispensable asset across the whole spectrum of tactical, operational and strategic operations.

5.4 The proliferation of UAVs from micro and mini drones to advanced tactical systems across all the domains of warfare necessitates indigenous development of counter-UAS. This will facilitate not only the scaling-up of production when necessitated but also ensure that no country is able to insert any backdoor malware.

5.5 The entire gamut of technologies associated with UAV and C-UAS need to be indigenous and adaptive, leveraging advances in hardware, artificial intelligence, quantum, sensors and control systems. Technological cooperation with friendly foreign countries' is also an inescapable necessity.

INAUGURAL SESSION

6. **Keynote Address by Gen Anil Chauhan, PVSM, UYSM, AVSM, SM, VSM, Chief of Defence Staff.** In his keynote address, Gen Chauhan said that throughout the human history, we have witnessed evolutionary as well as revolutionary changes in warfare. The evolutionary changes happen gradually over a period of time while revolutionary changes impact the very character of war, necessitating organisational, doctrinal, functional and structural changes. These also engender new ideas, innovations, imagination and new kind of thoughts. In the context of UAVs, their development is kind of evolutionary, but their employment has been revolutionary as far as warfare is concerned. Initially, their development was for small applications, limited ranges, restricted payloads, however, as the realization of their scope of deployment, utility and success increased, defence forces started using drones in a revolutionary kind of warfare. Their unbridled and rampant use in modern-day conflicts proved not only their utility, but also their ubiquity. They augment manned systems and enable militaries to conduct simultaneous operations across multiple domains with fewer resources and minimal danger to human lives.

6.1 As a human being, it's our cognitive thinking that makes us to look or prefer things which are faster, bigger, more sophisticated and more costly. Even

the motto of the Olympics that is "Citius, Altius, Fortius", which is Latin for "Faster, Higher, Stronger" is an assertion of this innate human trait. However, a drone or UAV is the antithesis of conventional warfare thinking. It's smaller, unimaginative and aerodynamically clumsy. They are cheaper, noisier, unsophisticated, inexpensive and yet they're effective and they're one of the biggest tools of warfighting. This is their USP, that beats conventional thinking.

6.2 From a factual and conceptual viewpoint, factually drones are a proven reality. We know that they're widespread utility in recent conflicts and have demonstrated how they can shift tactical balance disproportionately to their size or price. Its applications in modern warfare is challenging traditional ideas about air superiority, ground manoeuvre, and force protection. Strong tactics, autonomous and intelligent operations, MUMT, asymmetric drone warfare are making large platforms vulnerable and driving militaries to rethink the conceptual aspects of air doctrines, development of a counter-UAS system, and adaptive rules of engagement. In the conceptual realm, the airspace was considered as homogeneous and indivisible. Today airspace has been redefined to include space at the upper side and at the bottom side. The 50 feet height and below is being used for UAVs operation. During Operation Sindoor, on 10th of May Pakistan had used drones. None of them actually could inflict any damage to Indian military or civil infrastructure. Most of them were neutralized through a combination of kinetic and non-kinetic means. And some of them, in fact, could be recovered in almost intact conditions. We need to focus on combat in future in this particular lower airspace. The ability to use LEO satellites for control of UAVs with enhanced communication, navigation services and increased range will increase its functionality manifold.

6.3 Counter UAS operations are extremely complicated operations. Detecting, identifying, tracking and neutralizing drones involves creation of a counter-UAS grid that must be capable of integrating and networking multiple technologies such as radars, sensors, jammers, as well as directed energy weapons. The effectiveness of this architecture will hinge upon seamless coordination and integration across air defense networks, civil aviation regulators and local command and control structures to avoid gaps, fratricide and operational blind spots. The modern counter UAS system grid is not only about technology. It's about fusing disparate assets into a resilient, adaptive ecosystem that can dynamically respond to the evolving aerial threats in a contested lower airspace.

6.4 Operation Sindoor has showed as to why ingeniously developed counter UAVs and counter UAS systems, built for our terrain and our needs, are crucial. We cannot rely on imports as these technologies are crucial for our offensive and defensive missions. Dependence on foreign technologies weakens our preparedness, limits our ability to scale our production, results in shortfall of critical spares for sustenance and round the clock availability. Another important aspect of this capability is that in case of foreign weapons and sensors, their capabilities are known to all and adversaries can predict our tactics and doctrinal concepts based on the capabilities of this particular system. If we develop systems of our own, their capabilities are not known to the enemy and that may add an element of surprise, some initial encounters at

least. Hon'ble Raksha Mantri Shri Rajnath Singh has aptly said that “Indigenisation is not just a responsibility but the Duty of every Indian”. In warfare, we cannot win with yesterday's weapon systems in today's warfare. In fact, today's warfare has to be fought with tomorrow's technology.

6.5 The focus needs to be on increased impetus on defence R&D to deliver next generation solutions. Then, encourage modular, upgradable design so that new technology payloads, AI modules, EW technology can be integrated quickly. Developing standardised open architecture for plug-and-play modules are prerequisite for effective counter-UAS both for kinetic and non-kinetic systems. Creation of a counter-UAS system testbeds for start-ups and DRDO and investment in secure sovereign software for UAV control and anti-jamming are prerequisite for a robust and resilient ecosystem.

SESSION 1: PROBLEM EXPERIENCED/ ENVISAGED BY USERS DUE TO USE OF IMPORTED COMPONENTS IN UAV & C-UAS

7. As moderator cum speaker**, Maj Gen CS Mann, AVSM, VSM, ADG ADB**, in opening remarks, the Maj Gen CS Mann, as Chair said that most of the drone components, especially the semiconductors are all made in China. In 2015, China has passed a regulation under cyber security and data privacy laws and regulations, purportedly for the purpose of military civil fusion, which mandates all Chinese firms for all their products to provide data accessed within China and around the world. How it can be accessed, whether in real time or at a particular frequency or by some other means once it is connected to internet and things like that is a matter of detail, but surely the data is vulnerable whenever it gets accessed. So, the importance to develop a truly indigenous drone ecosystem to avoid dependencies on foreign suppliers can’t be stressed more. Therefore, the need is to formulate a practical and implementable regulatory framework so as to keep a balance between our requirements and the present ecosystem. The challenges which need to be overcome include interception of communication links and hijacking of drone's navigation Control. The need is to identify the components from where these vulnerabilities can come in. The components used in electronic speed controllers, flight controllers, transmitters and receiver units, encryption and authentication system can introduce a wide range of vulnerabilities.

7.1 To identify whether it is a Chinese component or not is a big challenge. However, while originating from China, components get routed through multiple countries and then reaching India making it very difficult to identify its Chinese roots. Therefore, supply chain traceability is a challenge as of today. But is there a guarantee that even indigenous components are secure? Not necessarily because still there may be some firmware which again may be vulnerable. To overcome this, we need to carry out a testing or validation in such a manner that vulnerabilities related to the security are taken care of. This framework has already been evolved and is under approval by the competent authority. It will also imply at the RFI and RFP stage, the components/ system will undergo a series of tests to rule out any associated vulnerability. During the trial stage, these tests are going to be conducted on components/ systems. Post-contract

, the firmware and patch updates by the vendor will be strictly implemented. In the entire process, if at any time it is found that somebody is fabricating, falsifying or forging the documents with respect to these critical components, then they are liable to be blacklisted.

7.2 The bottleneck faced by the Indian industry at present is lack of industrial licenses for the explosives. There are very few companies who are able to supply us lighter munitions or the kamikaze drones. But on further delving deep into it, it was observed that there are 42 industries who have the licenses for explosives. But practically, there are only 10 of them who are actually making it. There are 32 of them who have got the licenses but are not actually utilizing it.

7.3 For indigenous UAV ecosystem, it has to be a whole of nation approach. If becoming L1 is the primary objective, obviously the industry is not incentivized to go in for the indigenous components. At the national level, policies are required for some kind of incentivization as well as some kind of equivalence factors need to be worked out for an indigenous component vis-a-vis an imported component.

8. **User's Experience & Requirements: IA**. Colonel Sabel while speaking on IA's Experience & Requirements said that as far as the tactical battle area is concerned, there is a definite requirement to have surveillance of the forward areas and get real-time info to the tactical commanders and enhance our influence in potential area of dominance. This is achievable with combatised drones. While using combatised drones, the challenge of storing them needs to be addressed. In one of the cases, for storing a particular drone, the batteries were supposed to be discharged to a particular suboptimal level and it took a lot of time to recharge the batteries when required for operations. Secondly, the challenge of size and dimensions of the drones capable of operating 25 kilometers and upwards. There is a definite requirement to either make the drone in a manner that it is disassembled and miniaturized so that the carriage part in field conditions is easy. There are certain systems which require dipropionate manpower for moving them from point A to point B including the logistics requirement, making them operationally untenable. In the past, IA expected certain capability which was promised, however there were gaps and shortcomings in the delivered products. However, IA is cognizant of Industry capabilities. When a certain RFP is floated, there is a lot of thought that goes behind it. However, it still remains an iterative journey and IA is committed to hold industry's hand.

9. **User's Experience & Requirements: IAF.** While speaking, Gp Capt Dhami said that operationally the most popular role of UAVs in the last three decades has always been of ISR. Post 2021, when CIA armed the remotely piloted aircraft, the next two decades saw its use as a strike platform for anti-terror operations. Unmanned aerial aviation is currently moving from the observation to strike and electronic warfare at a fast pace. We are seeing a proliferation of unmanned aerial systems ranging from unmanned aerial systems by special forces to stealthy unmanned bombers to manned unmanned teaming machines. A case in point is attack by Ukraine on 21 April 25, which took place at four Russian airfields destroying 40 strategic bombers of Russia. UAVs are low cost solution for neutralizing high value targets. UAV's use is enabling, complementing and even surpassing manned aviation. Manned unmanned teaming is

a niche technology adoption and IAF has decided to invest heavily in this route of unmanned development. Under Make in India initiative, the Mehr Baba competition came into being in October 2018. So far two of these competitions have taken place. The present challenges include limited detection of hovering drones and drones on fiber & 5G network as well as autonomous drones. Mitigation of threat of swarm drones used for multidirectional attack is also a challenge.

10. **User's Experience & Requirements: IN**.

10.1 While speaking on the subject, Commander Siddharth Gupta said that modern naval warfare is undergoing a revolutionary transformation with the integration of UAVs. Naval forces around the globe are now leveraging the power of drones to enhance surveillance, precision strike capability and electronic warfare. The technology has evolved from basic reconnaissance platforms to highly sophisticated combat systems capable of independent operations in high threat environment. UAVs can take on high risk mission, minimizing human exposure to threat. High precision kamikaze drones provide lethal hard kill measures. UAVs can extend operational reach of the fleet far beyond the radar horizon. They can be launched quickly to respond to time sensitive threats like piracy or surprise attacks. Further Manned-unmanned teaming (MUM-T) can improve commander's decision making at sea based on real-time data gathered from unmanned systems. Thus, UAVs are capable of executing multiple missions in multiple theatres with ease of redeployment based on emerging requirements.

10.2 The counter-UAS systems of Indian Navy are broadly classified into two categories, land-based and ship-based. While the land-based system focusses on laser and high-power microwave in addition to MANPADS and small arms, the same is not feasible at sea. Therefore, for ship-based counter-UAS, SAM systems, MR guns and close-range guns are utilized. Another emerging technology is swarm drone which can collectively exhibit a self-organizing behavior through interaction, time synchronization and cohesion among themselves as well as within the environment. There is a diverse spectrum in Indian Navy's RPA fleet in respect to both platforms as well as sensors wherein bulk of the technology has been imported from foreign oceans. Thus, significant challenges are faced by the RPA fleet with respect to operations and maintenance. Additionally, certain vulnerabilities have also been identified with respect to dependency on foreign OEMs which are required to be mitigated. Looking at those vulnerabilities from the operational aspects, the first point is with respect to reliance on foreign OEMs for mapping which leads to access to sensitive airfields to them. The survey process involves calibration of precise waypoints and location. The data gathered during such surveys is highly critical and could be used to map other high value assets located at those strategic locations. Secondly, RPS utilize software based electronic systems which require regular updates. The same is done by foreign OEM using a hardware which is plugged into the system. The update could last from minutes to hours during which the system is exposed to malware as well as data extraction. Beyond LOS, operations of RPAs require hiring of satellite services from foreign OEMs, which exposes confidential data of Indian Navy to foreign OEMs. IN released a roadmap for Atmanirbharta which was released by Hon'ble Raksha

Rajya Mantri during Aero India 25 wherein stringent requirements of naval aviation including all RPAs, whether land-based or ship-based, have been captured and the document is available on the Indian Navy's official website.

11. **User's Experience & Requirements: Coast Guard**. Speaking on User's Experience & Requirements in respect of Coast Guards, the speaker said that Indian Coast Guard has operational requirements, which is little off-center because of the nature of duty which it carries out. Indian Coast Guard is currently at a nascent stage in operational deployment of both UAVs and C-UASs. The wide ranging and multi-dimensional mandate of Indian Coast Guard includes maritime safety, enforcing law at sea, preserving marine environment, safeguarding artificial islands and installations, responding to distress calls from fishermen and mariners, and conducting vital search and rescue operations. This spectrum of responsibility demands dynamic and ever evolving capabilities, particularly in today's marine environment where challenges are becoming increasingly complex and time sensitive. To meet these challenges effectively it is critical that we integrate advanced aerial systems into our operations. In this regard, both UAVs and counter-UAS offer immense potential as force multipliers. These platforms provide persistent intelligence, surveillance and reconnaissance not just over our exclusive economic zone, but also around sensitive installations. In search and rescue missions, UAVs can cover large maritime areas quickly, detect survivors with on-board sensors and even act as first responders by delivering flotation devices and communication equipment. In our anti-smuggling and law enforcement operations, UAV allow real-time tracking and interception support. Looking to the future, Indian Coast Guard is pursuing a structured plan for inducting unmanned aerial systems tailored to our mission profile. These include procuring a blend of shore-based and ship-borne platforms.

12. **User's Experience & Requirements: SSB**. Brigadier R.S. Kang, DIG SSB said that in addition to our operations in Jammu and Kashmir and anti-national operations in Chhattisgarh, the focus of SSB as till now been on ISR, both on the borders and in internal security duties. SSB has felt the need for logistic drones, both in our border outposts on high-altitude areas and other inhospitable terrain. In recent times, there have been exponential increase in sightings of drones, especially on the Nepal border. However, there has been a massive void, in our counter- UAS capability, leading to hardly any detection capability and definitely not a single successful neutralisation. So, in addition to the discrete and high-tech drones, there is a requirement of developing an integrated AI-powered drone system which should be able to look after our borders. This needs to be based on a layered control architecture where there will be smart drones which are networked with the control centers at the border outposts. There's also a critical need to have cutting-edge indigenous counter-UAS. In addition, setting up of a lead agency at the apex level which should be able to lay down parameters, specifications, and also coordinate the development of drones and counter-drone systems to initiate and augment symbiotic work.

13. **Operation SINDOOR- Importance of Indigenisation & lessons.** Brig Anshuman Narang (Retd) while speaking on lesson learnt started by saying that the era of big drones is gone. During Operation Sindoor, whatever drones were shot, the drone forensics of that should be exchanged with all the counter-UAS Indian vendors. For drone operation, the satellite communication can only be facilitated by either Starlink or with Chinese Qianfan constellation. India needs to have its own satellite constellation for drone operations. The complete solution for UAV and C-UAS

operations include mobile network usage monitoring and detection, AI enablement, the cyber over RF or the latest in the buzzword, multi-tailed aerial interceptors.

SESSION 2: INDIGENISATION OF CRITICAL COMPONENTS CURRENTLY BEING IMPORTED FOR MANUFACTURING OF UAV & C-UAS

14. As moderator, Vice Admiral Sanjay Vatsayan, AVSM, NM, DCIDS (PP&FD), HQ IDS, said that its time to look ahead, not at 2026 but where do you want to be in 2029 or 2030 and start planning for it now so that we are able to catch up with what is happening in the industry as far as UAV and counter UAS systems are concerned. He argued the industry reps to whatever they are making today, it needs to NavIC compliant. With the launch of next two satellites by end of this year, the system which has already proven to be good, it will be much better. In addition, the drones that have been captured or downed during Ops Sindoor are available here in Delhi and have been shown to 15 companies. There will always be a fight between the drone and the counter drone systems. So let the drone companies design better features and let the counter UAS companies give us features which are going to be used to counter them. The armed forces will give their requirement in form of RFP for which Indian solutions are required. The most hopeful scenario will be that if we have to fight the next war, it will be in Indian conditions with Indian systems designed for Indian with Indian tactics, but made for the world. There is no terrain on this earth which is not available in our battlefield area which is going to be there in the future. Therefore, any system that is designed and developed not only needs to meet Indian requirements but the requirements of any and every country in the world.

15. **Indigenizing UAVs Technology Development Curve- Indian R&D**. Smt Veena Dixit, OS & Programme Dir, HALE RPAs, ADE said that the mission of Aeronautical Development Establishment is to design, develop and lead to production of unmanned aircraft systems, cruise weapon systems, flight control systems, flight simulators & associated ground operational systems**.**The ADE thrust area includes ISR/Weaponised UAVs (Short Range / MALE / HALE), cruise missiles, FCS for manned aircraft variants, simulators & advanced test stations, remotely piloted strike and NGMCS (Net Centric, MUMT, Swarm Operations). While talking about TAPAS MALE UAV which is an advanced indigenous surveillance platform for tri-services, it has pay loads including EOP, SAR/MPAR & AIS, ESM and SATCOM. It can achieve speed of 225 kmph with altitude of 30,000 ft. Its range is 250 km LOS/1000 km (SATCOM). Its 90% indigenous content include airframe, LG, avionics HW & SW, SBAS based ATOL w/o ground radar, LOS & SATCOM datalink, advanced GCS and payloads (Except EO & MPAR). For the Archer (Weaponized UAV), ten flight trials have been completed and two airframes realized. Its system integration is in progress. In aero-structures field, in-house design, development & testing for airframe and mechanical system design, composite fabrication and structural testing is available with ADE. In the TAPAS and other variants, ADE is flying with a multi-constellation using NavIC on board.

16. **Core Vulnerabilities and Threats in Indian Drone Ecosystem**. Maj Gen M Indrabalan (Retd) said that in the process of indigenization, we have to look at the components, subsystems, systems, platform level indigenization leading to indigenisation of entire ecosystem. As aircraft experience GPS spoofing regularly, we need to dispense with dependence on GPS and to migrate to NAVIC. But is NAVIC

ready to give us that ecosystem where our drones can be dependent? The drone components can be categorized into three types based on V for vulnerability, C for criticality and S for security. Today we are all speaking of vulnerability in the technology spectrum. But is the policy in place to address this challenge? Who implements the drone policy in India? The DGCA with its Rule 21 is not connected with the aircraft Rule 1934. The QCI (Quality Council of India), CEMILAC (Centre for Military Airworthiness & Certification),MAP (Military Airworthiness Procedures) and DGAQA needs to plug in critical gaps in the policy collectively.

17. **Indigenization of Optical & electro-optical instrumentation for UAV**. Dr. Ajay Kumar, OS & Director, IRDE said that IRDE handles all technologies with respect to design, fabrication, coating and develop a lot of instrumentations towards various cameras all falling in visible domain, near IR, SWIR, MWIR, LWR and terahertz. Besides that, IRDE provides solutions with respect to all laser instrumentations like laser range finder, laser target detection, seekers, fuse, voltimeters etc. Besides that, IRDE also works on the stabilized systems for various land-based airborne platforms and naval system. Recently, in last couple of years, IRDE has added new segments primarily for the airborne surveillance where various electro-optical surveillance suits for aerial platforms, for fighters and for helicopters. IRDE is making various payloads from three kilometers ranges up to 500 kilometers ranges and they have been integrated to various platforms with their production at various stages. The primary role of EO payloads for a mission is for reconnaissance and surveillance, situational awareness, border security, damage assessment, target acquisitions, detection and identification. EO payload can be categorized based on platform: it can be for air borne platforms, naval platforms or the ground-based EO platforms. For the airborne development, the prime motive is to go for the intelligent surveillance and reconnaissance. For ground-based development, it could be surveillance or tracking. A multispectral hyperspectral payload can work under all weather conditions. IRDE is striving towards the continuous improvement in the technology so that better features can be given. Another technology that IRDE is pursuing is the development of missile approach warning sensor because in a today's environment early detection and direction of a missile threat helps in initiating countermeasures in time. It's a completely automatic system where the six sensors are placed across the periphery of the aircraft to provide 360-degree spherical coverage. Some of the future technology which IRDE is working includes advanced ER sensor with larger field of view & super resolution, hyperspectral sensors, enhanced target tracking system, multi-sensor data fusion, and airborne directed energy weapon system. With respect to drone detection, the detection and classification of drone becomes very important and that is possible when we look for a completely novel technology. The current sensing technology which is being used worldwide is not applicable for classification of drone. IRDE has taken up a feasibility work with respect to neuromorphic imaging and event sensing for classification of drone, which coupled with the weaponry system, can discriminate between various drone systems.

18. **Indigenisation efforts for Quantum Proofing of Drones**. Capt (IN) Sunil Sud (Retd) of Q Nu Labs told that the company was a startup incubated in 2016 at IIT Madras, working in the field of quantum-based communication and data security, fully indigenous solutions from design, development, manufacturing, solutions tested. The company has been recognized by the National Quantum Mission and its customers include the Navy, Army, DRDO and other establishments. It has 10 patents including

three in the US, 10 more have been filed and company is building the world's largest commercial QKD network for NQM. Some of company's offerings include quantum random number generator and the quantum key distribution systems, both are in the field. A Quantum Shield which is a software-based platform allows post quantum cryptography-based solutions. The vision is to accelerate the world's transition towards a quantum secure future.

19. **Bharat's Own Quantum-Secure Drone Networks.** Air Mshl GS Bedi AVSM, VM, VSM (Retd) of Synergy Quantum said that Synergy Quantum is offering Bharat's own quantum secure drone network. The core expertise is post-quantum encryption, quantum key distribution and quantum communication infrastructure. The drones are going to be used for real-time intelligence gathering in remote, hazardous, or enemy-controlled environments. So, the security of communication and control system becomes critically important. The mission integrity, data security and operational trust, especially in national defence are prerequisite for success in a conflict. For this, there is a secure communication and real time link management and most important, zero trust network architecture. Ensuring zero trust protocol gives 100% trustworthiness, and mobile quantum secure key exchange is its offshoot. The Bharat Q Drone is an ultra-compact quantum communication payload weighing less than 5 kg, meeting the swap requirements and hybrid quantum cryptography. It is quantum secure and hack-proof.

20. **Indigenisation of Stratospheric & Optical Fibre Drones & Flight Ctrl.** Mr. Ahmad Faraaz of Kalam Labs Ltd told that hia company is a stratospheric aerial laboratory and has made the world's highest UAV capable of being deployed at around 30,000 meters of altitude using high-altitude polyethylene balloons. It does not start off from a runway, but from an extreme peak of the edge of space and once at that particular altitude, it goes off deep into the enemy territory, around 100, 200 kilometres inside, evading all the anti-drone systems to carry forward its kamikaze or ISR missions. The company has made cheap swarms of nano-drones with their own flight controller costing just around USD 3. These nano drones can be flown up in huge amounts of swarms, saturate the entire enemy creating confusion behind the enemy lines. And this flight controller can be configured on bigger UAVs as well.

21. **Indigensing and Integrating Multidisciplinary Systems for C-UAS**. Dr. Jagannath Nayak, DS & Director CHESS, DRDO started his talk by saying that instead of kinetic energy weapon, we require a directed energy weapon to achieve cost parity between target and weapon used. The cost of one shot of DEW is less than a litre of petrol. Presently the counter drone systems are named IDD & IS (Integrated drone detection and interdiction system) and we have already developed the IDD & IS Mark 1 and Mark 2, already undergoing trials. The drone detection is going to be different and it took two years to develop a drone detection radar and a tracking system. Hard kill by directed energy weapon uses a laser as a beam weapon. In all the cases the requirement is of laser with wavelength from 0.1 micrometre to 10 micrometre and the microwave is 1 millimetre to some few meters. And because of this, the laser is focused very tightly which can neutralise a target. The laser weapon is fully utilized in most of the country and it now has potential to be used against drones, missiles and aircraft. In case of particle beam, it is going to be much more powerful in the future. There are powerful particle accelerators available but are bulky. But in future, these

are going to be very lethal weapon. In case of hypersonic missiles, detection is becoming very difficult. But for hypersonic missiles laser is the only solution.

SESSION 3: STRATEGY FOR INDIGENOUS DEVELOPMENT OF CRITICAL COMPONENTS CURRENTLY BEING IMPORTED FOR MANUFACTURING OF UAV & C-UAS

22. As Moderator cum Speaker**, Dr. Chandrika Kaushik, DS & DG (PC&SI)** invited Prof Abhishek from Department of Aerospace Engineering, IIT Kanpur. While speaking on **Strategising Innovation: Systems Approach to UAS & C-UAS,** Prof Abhishek started by saying that we cannot become a successful nation in UAV or counter UAS system unless and until we build a really solid ecosystem. Some of the key areas for this include structural systems, propulsion systems, avionics systems. In some, we are very good and in some a lot of path needs to be covered. We are so dependent on carbon fibre composites but do not make composites readily in the country. So as an alternative why reed-grass be used to build drones. if someone is looking for one time use kamikaze drone, reed grass is a solution, very cheap, readily available, free. It's a patented technology from IIT Kanpur. We are not making radars ourselves; we are not making your RF jammers and spoofers. So as long as reliance is on certain kind of radars, we will not be able to detect those things. Phased array radars are actually one of the key areas. The key thing is that we are not planning properly for long term as a nation together. We have to be at the top level of the technology. We always want to do incremental stuff but unless and until we think like DARPA kind of model, success will elude us.

23. **"*Atmanirbharta*' in C-UAS Critical Technology**. Dr. Hari Babu Srivastava, Former DG (TM), DRDO, Professor of Practice, IIT Delhi spoke that challenges coming our way are serious not only from the technological point of view, but also from the geo-security point of view, because we already see three countries have aligned together – China, Pakistan, and Turkey. Whether it is two-and-a-half front war, three-front war, three-and-a-half front war, we need to be prepared for all. Someone observed that we may be single alone in the ring when the time of adversity comes, so we have to be actually prepared for that kind of thing. The whole thing is that we need to plan holistically is overall technology ecosystem, not only drone but also other technologies as well. The requirement is that we should not only match the other countries, we must outpace them. As the challenges become bigger, the decisions also have to be bolder. We cannot work in the same way that we have been working. If the challenge is bigger, we have to take bold and disruptive decisions. The government must fund not only the new developments but also re-engineering, successive enhancements to indigenous technologies so that there are no Chinese or no foreign components.

24. **Industry Solution.** In this part of session 3, following companies gave an overview of their capabilities: -

24.1 Mr. Sameer Joshi, CEO New Space Pvt. Ltd. On Indigenised Next Generation Intelligent Cyber-Physical systems.

24.2 Mr. Tanmay Bunkar from Botlab Dynamics on Indigenous solutions for autonomous UAVs.

24.3 Mr. Harsh Bhardwaj of 80L Robotics on Indigenisation of Embedded Electronics.

24.4 Mr. Venkatesh Sai from Zuppa Geo Nav Tech on Indigenous Cyber Physical Stack The Autopilot / Flight Controller.

24.5 Mr Pawan Kakkar from Jugapro India Private Limited on Indigenised solutions for C-UAS grid.

24.6 Lt Cdr Tarun Budhrani (Retd) from Motionmatics Private Limited on Indigenising Surveillance Payloads & Cameras.

24.7 Dr Apurva Joshi from Indrones Solution on Indigenised solutions for Countering Swarm Drones.

25. **MRO of UAV and C-UAS**. Lieutenant General J.S. Mataru, AVSM, VSM, retired said that in a conflict, as we maintain aircraft, tanks, guns, communication equipment, radars etc., same needs to be done in respect of UAVs and counter UAS systems. The technicians are trained and drilled so that they can work in a battlefield environment with shells falling near them and still do the repairs. Military training is extremely important for an MRO person to be able to work in that environment. While operating certain UAVs of foreign made and maintained under AMC, how much time is it going to take to get it back into action is a point to ponder? So that's where the MRO ecosystem comes to fore.

26. **Strategies for Development of Indigenous Tech for UAV & C-UAS.** Mr. Arjun Kumar, Associate Director from Technology Development Fund (TDF) said that the self-reliance avenues or the push towards India going global, whether it is a DRDO developed, given the TOT to the DPSUs, or the developed technology through the IDEX or the TDF or the other avenues is tangible. This is our responsibility to reach to the appropriate stakeholders. DRDO is doing a lot of things in terms of the technology, whether it's about the ToTs, tech support or test facilities. Everybody is contributing and pushing for self-reliance and indigenization effort. Under technology development fund, a lot of support is extended for the import substitution or the indigenization effort. Till date, DRDO has around 15 academic institutions in different premier academic institutions, and these are working continuously in support of indigenization of the technology to a level 4, 5, and sometimes 6. And once the technology is proven, then hand-holding is done from the startup for the production of those items. All the information is available on DRDO portal. DRDO is continuously taking the inputs from the different stakeholders on: how it's going on and what the improvement you want. But it’s the responsibility of the stakeholders to make it more successful. TDF till date sanctioned around 81 projects costing roughly around ₹ 350 Crore. However, continuously the effort is on to push for more and more projects. Ecosystem has already been created and is working in sync.

27. **Open Discussion**. The open discussion was conducted, moderated and curated by Maj Gen (Dr) Ashok Kumar, VSM (Retd), Director General CENJOWS. During the open discussion, the following points emerged: -

10.1 Need for enunciation of doctrinal framework for UAV and C-UAS operations.

10.2 Need for functional organizational structure for UAV and C-UAS operations with a clear chain of command, defined roles and responsibilities.

10.3 Identification of types of UAVs and C-UAS systems needed by the three services and paramilitary forces.

10.4 Establishing a mechanism for identification and proscription and banning of Chinese components/ systems.

10.5 Nomination of a designated central agency to address various associated licensing and integration challenges.

10.6 Industrial licensing policy to be tailored for innovation and growth. Cumbersome industrial licensing policy acts as a roadblock for *growth* beyond a certain point.

10.7 Lack of adequate number of ranges with basic facilities for testing/ trials by the manufacturers. More number of the testing facilities in high-altitude area.

10.8 The DAPP 2025 to address acquisition challenges. Despite policy initiatives, private entities remain underleveraged owing to limited funding, commercial viability of products and positive handholding.

10.9 The Cyclic process of development and procurement to be accelerated. Lack of incentivisation for indigenous components vis-a-vis imported component is underpinning the bottlenecks.

10.10 The NCNC (No Cost No Guarantee) clause is hindering development.

10.11 Handholding of small industries by large manufacturers.

10.12 The support to industry from DRDO needs to be more forthcoming.

10.13 Financial autonomy of local Commanders for seeking specific solutions from industry tailor made to local conditions.

10.14 The evaluation process to be reformed and evaluation to be carried out through a Weighted Matrix Evaluation model. The acquisition strategies and processes need to be tailored to engender innovation, boost creativity and harness capabilities.

10.15 To strengthen the collaborative efforts for capability determination, gap identification, and policy formulation among stakeholders commensurate with envisaged capacity building goals.

10.16 Challenges in complying with current Drone Rules 2021 of the DGCA making it mandatory for users of Drones to get clearances on their intended usage and flight paths besides many other aspects, thereby limiting innovation and testing.

28. **Closing address by Air Mshl Ashutosh Dixit AVSM, VM, VSM, CISC**. In his closing address, Air Mshl Ashutosh Dixit said that the UAVs are unmanned and autonomous, free from the physical and psychological limitations of human-piloted systems. The modern warfare no longer hinges on human courage and a well-placed drone strike or even just drone surveillance can alter the tactical equation dramatically. Recent India-Pakistan conflict is the witness of the changing scenario and the capability demonstration of the UAVs systems. Operation SINDOOR is not just a story of tactical success, it is a validation of India's defence indigenization policies. From air defence systems to drones, from counter-UAS capabilities to net-centric warfare platforms, Indigenous technologies have delivered, when it mattered the most. The fusion of efforts made by all the stakeholders and military vision has enabled India to not only defend its people and territory but also assert its role as a hi-tech military power in the 21st century. Still, India relies heavily on imports from foreign OEMs for crucial/critical components, many of which are essential for drone manufacturing. India is actively working towards indigenizing UAV (Unmanned Aerial Vehicle) and Counter-UAS technologies. This involves promoting domestic manufacturing of critical components, developing advanced systems with AI and automation, and fostering innovation in both drone and counter-drone technologies. This workshop and exhibition on UAV and Counter-UAS would act as a catalyst for innovation, collaboration, and strategic development, contributing to a safer, more secure, and technologically advanced future in the realm of unmanned aerial systems. All stakeholders present to assimilate and act upon the views, issues, challenges, suggestions and feedbacks emerged during the course of event and prepare viable and workable strategies for indigenisation of critical components being used in manufacture of UAV & C-UAS.

29. **Key Takeaways/ Recommendations**.

10.1 **<u>Doctrinal Employment Norms</u>**. Need to enunciate doctrinal framework for UAV and C-UAS operations for addressing the current tactical, operational and strategic imperatives as well as those envisaged for future with new technologies and newer systems.

10.2 **<u>Organzational Structures</u>**. An organizational structure for UAV and C-UAS operations with a clear chain of command, defined roles and responsibilities, and established communication channels.

10.3 Identifying types of UAVs and C-UAS systems needed by the three services and paramilitary forces and based on inputs, galvanize the defence innovation ecosystem to fulfil the demands through indigenous production.

10.4 Objective policy for enforcing proscription and banning of Chinese components/ systems or components/ systems manufactured/ procured from countries inimical to our national interests.

10.5 Army Design Bureau (ADB) to be nominated as lead agency for UAVs and C-UAS to address the challenges like simplifying industrial licensing policy, explosive licensing and availability for mating/ integration with platforms.

10.6 Simplifying industrial licensing policy will engender innovation and growth.

10.7 Ensure availability of adequate number of ranges with basic facilities for testing/ trials by the manufacturers including ranges with testing facilities in high-altitude area as that is our conflict zone.

10.8 MoD to factor acquisition challenges related to procurement of UAVs and C-UAS to ensure that the products with new technology are available with users without any time lag. The DAPP 2025 must factor this.

10.9 The Cyclic process of development and procurement in respect of UAV and C-UAS needs to be strengthened further.

10.10 The cost of trials need to be borne by the user to keep the innovation landscape sustainable and tenable: doing away from NCNC (No Cost No Guarantee) clauses.

10.11 Confirmed orders to be awarded to industry partners when their products meet the user's requirements.

10.12 To fostering indigenous manufacturing by creating consortia of large manufacturers.

10.13 Ensure availability of adequate number of ranges including in high-altitude area with basic facilities for testing/ trials of UAVs by the manufacturers.

10.14 Lack of adequate number of ranges with basic facilities for testing/ trials by the manufacturers. More number of the facilities in high-altitude area as that is our conflict zone.

10.15 **Envisaged Support from DRDO**.

29.1.1 Identify local capacity and competition in respect of UAV and C-UAS and include them in Public Procurement Order to be notified by

Department for Promotion of Industry and Internal Trade (DPIIT) for ensuring their procurement from local suppliers only.

29.1.2 Encourage Indian industries to use DRDO patents (access is free under DRDO new patent policy) to further boost up their R&D and develop new technologies.

29.1.3 Seeking financial assistance for promising and innovative technology under Technology Development Fund (TDF) scheme of DRDO.

29.1.4 DRDO to identify systems and subsystems in respect of UAV and C-UAS, which would be designed, developed and manufactured by industry only and will not be taken up by DRDO itself for development.

29.1.5 DRDO to identify potential Indian industry stakeholders and seek their partnership for Development cum Production for its projects in respect of UAV and C-UAS right from inception.

29.1.6 The critical components in respect of UAV and C-UAS to be included as part of the 'Aatmanirbhar Bharat Package' and notified in 'Positive (Erstwhile Negative) List' leading to an embargo on the import beyond a recommended timeline.

29.1.7 Encourage Indian Industry partners to approach Defence Investor Cell in MoD to access information related to investment opportunities, procedures and regulatory requirements for investment.

29.1.8 To review 'Policy for Indigenisation of Components and Spares used in Defence Platforms' issued on March 2019 to support development of technological capabilities and testing of components being indigenised at No-Cost, No-Commitment basis to make it commercially viable and sustainable for Indian Industry.

29.1.9 To leverage Innovations for Defence Excellence (iDEX) for strengthening innovation-based ecosystem in respect of UAV and C-UAS.

10.16 A unified, whole-of-nation approach to bolster India's defence production ecosystem for indigenous development UAV and Counter-UAS.

10.17 Enhance Discretionary Powers and financial autonomy of Commanders to seek indigenous and field-tested solutions in respect of UAV and Counter-UAS -especially in high-threat zones- and procure them expeditiously.

10.18 **Evaluation Metrics**. Replace the out-dated LI (Lowest Cost) model with a Weighted Matrix Evaluation model to holistically assess products across parameters such as technical innovation, lifecycle cost, strategic relevance and indigenous content usage.

10.19 To put in concerted collaborative efforts for capability determination, gap identification, and policy formulation among stakeholders commensurate with envisaged capacity building goals.

10.20 The current Drone Rules 2021 of the DGCA to be modified for ease of innovation and testing.

CONCLUSION

30. The Operation SINDOOR, while demonstrating the resolve of national leadership and its people to punish the perpetrators of terrorist attack also underscored the importance of "Strategic Autonomy" and a thriving indigenous defence ecosystem. The fusion of efforts made by all the stakeholders and military vision has enabled India to not only defend its people and territory but also assert its role as a hi-tech military power in the 21st century. Still, India relies heavily on imports from foreign OEMs for crucial/critical components, many of which are essential for drone manufacturing. India is actively working towards indigenizing UAV (Unmanned Aerial Vehicle) and Counter-UAS technologies. This involves promoting domestic manufacturing of critical components, developing advanced systems with AI and automation, and fostering innovation in both drone and counter-drone technologies.