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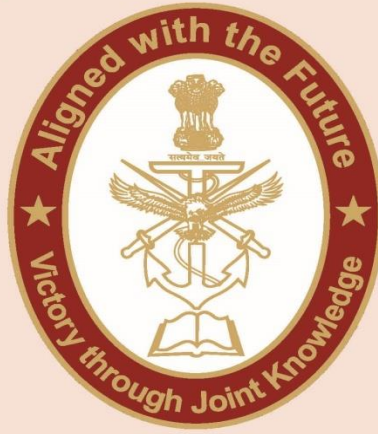
UNMANNED AUTONOMOUS SYSTEMS (UAS) – FUTURE IS HERE

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(UAS) – FUTURE IS HERE**



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India Plans to Induct Autonomous Surveillance and Armed Drone Swarm (ASAD-S) -26 Aug 22

Introduction

The UAS Threat Scenario. Army Day Parade on 15 Jan 2020 witnessed the drone defensive and offensive scenarios indicating the importance of UAS and it was just about time that Indian Armed Forces are UAS enabled. UAS is the next disruption and empower future scenarios not only for National defence but also in the civvy street. Consider a contingency of an unmanned system in a seeker shooter mode, totally autonomous, with a swarm of aerial and ground based vectors planning an operation in the hinterland or in the TBA or an unmanned recce in force troop of tanks or unmanned swarm on a surgical strike mission or a fleet of unmanned autonomous ships as a part of a mission. The future operations, are going to be a manifestation of human ideation, innovation and inventiveness- anytime anywhere. Over the past decade, technology has given shape to an age old product adage, **‘whatever can be defined can be designed’**, albeit in a shorter time frame, both in intent, context and content, given the unprecedented technological disruption. This UAS manifestation of the technology outreach whether obtrusively or unobtrusively, conventional or

unconventional, by kinetic and non-kinetic means, 3D printed or on an assembly line, deployed by state forces or non state actors, will remain instruments for quick deployment transcending time and space.

UAS – The Boom Trajectory. Unmanned Autonomous Systems, UAS, made a foray into our lives with the advent of robots during the second industrial revolution and have since proliferated into industrial smart additive manufacturing, logistics and supply chains, hazardous operations, nuclear power plants and precision surgery. The digital transformation, nano tech, and miniaturisation gave a new lease of innovation and today UAS have made huge forays into ground based systems, aerial platforms with outer space applications, sea based and under water based systems. Unmanned Ground Systems, Unmanned Ships and Unmanned Aerial Autonomous Systems or drones have disrupted every industry and most impactfully in defence applications. The Armenian Azerbaijan War, Russo-Ukraine War, the Aramco of Saudi, Jammu Airfield have been in news lately for the right reasons – these have demonstrated the combat capabilities of “seek and strike” with precision, both singularly and as a swarm, which has disrupted the tactical battle areas in an unequal man – unmanned combat. Together, the drones along with their twin the unmanned ground based systems or robots, have revolutionised supply chain, logistics support, robot based smart manufacturing and surgery among other commercial applications and disrupted military affairs - the bigger lesson is that UAS have arrived and are there to stay.

Prognosis of Unmanned Combat Autonomous Systems (UCAS)

Disruption in Military Affairs (DiMA). The Revolution in Military Affairs, so pronounced during the Gulf Wars, was driven by war scenes being witnessed in the living rooms relayed from the battlefield. But that was based on the technological revolution of 1990s through till Y2K. Both technology driving revolution and nature of warfare have undergone significant changes, since then, over the past two decades. Powered by digital transformation, the UAS based tech world order is defined by the robotic digital warrior, popularly known as robot humanoid, unmanned autonomous combat aerial systems, tethered drones as Quasi Satellites, and payloads defined by niche disruptive technologies which impact the entire bandwidth of military activities be it info gathering, intelligence, recce, surveillance, communication, weapons, defensive and offensive operations transcending space, time and endurance; logistics and supply chain, decision support, command and control systems. Further, the spectrum of conflict has enhanced from land, sea, air to cyber, space, psychological (Informational / mis-informational) and hybrid. In an overall analysis, the disruptive technologies, with or without man in the loop, is about enhancing velocity of OODA loop, as the driver of decisive proactive actions while suffering minimal human casualties. The DiMA has ushered an era with the concept that “Victory is measured by

Digital Unmanned Footprint”, for all those of us who would still like to believe that ‘Victory is measured by the Foot’.

UAS Driven Combat. Though by non-state actors, Yemen’s Iran-backed Houthi rebels attack on Aramco Refinery in the Saudi capital on 12 Apr 21 (and earlier on 14 Sep 19), using bombs and missiles laden drones, is an offensive act on the Kingdom’s energy and security installations. These drones reportedly flew more than 500 kms in an autonomous mode and hit their targets with precision. But an apt example of a decisive war through technology is the Armenian -Azerbaijan War. It is, in effect, the first war in the history of modern warfare that has been won almost entirely on the strength of drone warfare. The war between Armenia and Azerbaijan started on 27 September, over the disputed Nagorno-Karabakh Region. While Armenia only fought with tanks, artillery and air defence systems, Azerbaijan relied heavily on UAAS (drones), specifically the Turkish-made Bayraktar TB2 and the Israeli-made Kamikaze drones. The two drones carried bombs of up to 55 kg and 15 kg, respectively, and proved very useful when it comes to precise targeting of missile batteries, air defence radars and all equipment that emits radiation or has a sizeable radar or thermal signature. It is no brainer then, that Armenian forces and Nagorno-Karabakh, the ethnic Armenians, who had been living in the disputed region, lost approximately 185 tanks, 45 armoured fighting vehicles, 44 infantry fighting vehicles, 147 towed artillery guns, 19 self-propelled artillery, 72 multi-barrel rocket launchers and 12 radars while Azerbaijan’s losses were only one-sixth. The lethality of UAS is unparalleled in the man vs machine warfare.

The Russo-Ukrainian War. Drones have been deployed extensively by both Russia and Ukraine to locate targets, direct - guide artillery fire on them and deploy Kamikaze drones. These drones have been targeting ammunition dumps, logistics installations and ships, though the effect and impact has been localised. Ukraine has been using US switchblade kamikaze drones, Turkish Bayraktar TB2 and those supplied by other allies, these have been attacking Russian military bases in Crimea, on Russian Black Sea fleet ships at harbour and air bases in Sevastopol. Russian Forces have been deploying Orlan 10 drones for target tracking in depth areas and bringing down effective gun fire.

UAS & CHINA. China is a manufacturing hub of unmanned autonomous systems – commercial drones, military drones and humanoids (Robotised humans). Largest supplier of commercial drones, China has embarked on military drones from micro to mega High Altitude Long Endurance (HALE), MALE drones powered by AI for autonomous operations carrying lethal payloads, surveillance payloads as Quasi Satellites and logistics supply chain. In a recent event organised by PLA major logistics supply chain operations to include intelligent logistics drone for casualty evacuation, carrying ammunition vehicles and demonstrated air taxis transporting major stores efficiently. China is also

known to be developing robot humanoids for multiple employment and deployment scenarios.

GenNext - Lethal Autonomous Weapon Systems (LAWS)

Driven by nano technology, a new manifestation of UAS is palm top drone, like Black Hornett, and more importantly ORNITHOPTERS which are virtual birds which could be deployed in seeker shooter mode. This is the next threat which we need to prepare for- a swarm of quadcopters /hexa or octocopters/ mini helicopters / fixed wing UAAS or flock of ornithopters deployed in military operations in rear areas on sensitive installations and commanders as targets. In sync with the unmanned aerial arm is the unmanned ground systems (UGS) including robot mules powered by fuel engines / electric power / solar power /hybrid and robot humanoids which could work in isolation or synergy for effect. These systems could actually be an impressive combat force with the spectrum of combat abilities ranging from dummies, sleeper cells, depicting diversionary threat or augmenting the main and subsidiary thrust lines. China has deployed the unmanned aerial autonomous System as an eye in the sky as a Quasi Satellite. Turkey has earned a reputation of a formidable defence manufacturer, after their TB2 Bayraktar Unmanned Aerial Vehicles (UAVs) wreaked havoc on Russia and Armenia. Post the success of the autonomous aerial vehicle, it has recently Turkey showcased an unmanned combat patrol surface vessel Marlin SiDA with EW capabilities. Unmanned Autonomous Systems is an idea the time of which has long arrived and must form part of combat mission planning.

Swarms of Unmanned Systems. AI platforms are being used to configure ground based unmanned systems (robots), aerial unmanned systems and both sea based and under-water /submersible unmanned systems and hybrid systems like ground and aerial swarms and loiter ammunitions. These technologies are game changers in future warfare and a paradigm shift from automation (business intelligence) to autonomous systems, thereby graduating to LAWS.

C7ISR. Future operational paradigm would be driven by autonomous technology based action interspersed with military troops intervention depending on the criticality of the mission. Thus, man in the loop and man out of the loop missions can be generated as command, control, communication, computer, cyber, cognition, combat ISR (C7ISR) driven weapon platform systems. In effect, C7ISR based autonomous weapons systems are lethal devices that have been empowered by their human creators to survey their surroundings, identify potential enemy targets, and independently choose to attack those targets on the basis of sophisticated algorithms. These systems typically comprise a seek and respond system. Seek is an automated pivot which could be land, ship or aerial platform with computer based systems, real time data based multi platform-multi sensor data fusion for threat evaluation & assessment, application software based decision support, tightly integrated with the respond strike autonomous system

mobile manoeuvre arm comprising combat platforms both kinetic and non kinetic in automated system with man in the loop or autonomous systems with man out of the loop. Such systems require the integration of several core elements: a mobile combat platform, such as a drone aircraft, ship, or ground vehicle; sensors of various types to scrutinize the platform's surroundings; processing systems to classify objects as hostile or friendly discovered by the sensors; multi platform-multi sensor data fusion with IFF; and algorithms directing the platform to initiate attack when a hostile target is tracked. In effect a fully autonomous weapons system is one that 'once activated, can select (IFF), track, engage and destroy targets without intervention by a human operator'. Viewing LAWS from a technology lens, it comprises almost a host of niche disruptive technologies AI, sensor technologies and IOT, unmanned autonomous aerial and ground based platforms, AR /VR, secure communication, cyber, electronics warfare, directed energy weapons, quantum technologies, big data analytics, nanotechnologies and geo- spatial technologies. The ongoing conflict between Israel and Hamas is an apt example in the use of AI and precision in targeting. Imagine this technology in the hands of non-state actors /terrorists / militants, the results can be extremely disastrous.

UAS – Combat Scenario Building. How do we view Unmanned Combat Mission 2030? A realistic scenario building with a net assessment gives rise to the NextGen Tri Service Unmanned Autonomous Combat Force with man in or out of the loop to guide and mid-course correct Unmanned Combat Autonomous Systems (UCAS). A crystal gaze is given below. In fact, **strategic, operational and tactical sand model discussion with Unmanned Combat Autonomous Systems could be an interesting exercise for each Service and Tri Services with brilliant lessons for an action plan.**

- (a) **The Unmanned Army Footprint.** Robot humanoids, robots, robot mules, unmanned tanks/APCs and unmanned combat aerial systems with tethered drones deployed as a swarm in a tight autonomous or manned loop could operate in TBA and undertake surveillance and recce missions, recce in force, infiltrate - seek and destroy, shaping the battle field, mining, demining & creating safe lanes through minefields, unmanned minefield nests, unmanned posts and BoPs, loiter ammunitions, flank protection and a number of active combat offensive and defensive actions et all – the list is ongoing. The winter stocking could be augmented in support by robot mules and logistics drones and reduced in quantity for a just in time fresh supplies on posts and of course facilitate combat support of immediate reorg in offensive, ammunition and logistics support and supply chains could also be based on this unmanned combat support force.
- (b) **The Unmanned Combat Autonomous Aerial Systems (UCAAS).** For the Air Force, UCA Aerial S (UCAAS) with refuelling capabilities gives combat capabilities of deployed Combat Air Patrols, Close and Offensive

Air Support and a myriad of **beyond 8G** combat manoeuvres and combat support including recce and EW tasks. UCAAS is a poor man's potent air force, obviously with pilots only to meet the needs of man in the loop.

- (c) **The Unmanned Autonomous Naval Force (UANF)**. Unmanned ships and combat vessels, under water submarines, and seabed mine sweepers can augment the UANF, as a part of or independent fleet.
- (d) **Counter UAS Initiatives**. UAS is a reality of today. There is a dire need to evolve a UAS employment and deployment strategy and more importantly a counter UAS strategy. The first is stealth, adaptive camouflage and dispersion have to be part of future equipment profiling and battle drills and battle procedures. The next is the need to have integrated detection and interdiction systems for soft and hard kills. These strategies would need to be involved in the threat evaluation matrix and combat mission plans.

UAS - The Dual Usage

UAS has a huge utility bandwidth in enhancing the quality of life both defence and commercial applications. Aerial and ground based unmanned autonomous systems can work in supply chain and transportation of logistics, air taxis, air ambulances, precision agriculture, diagnostics and repair of equipment, smart manufacturing, critical medical surgeries requiring precision through robots, hazardous areas – sewage system maintenance to nuclear powered systems, etc. Given the 5G spectrum, the speed of communication can facilitate remote surgeries in real time is a future reality. Obviously a number of policies and UAS governance strategies on employment and deployment of unmanned autonomous systems including drones are being put into effect. The road highway space is finite but the aerial highways need to be defined with due regard to air space management to define drone travel safe lanes. The sky lanes have huge expanse.

Way Forward – A Thought Process

Unmanned Autonomous Systems have become a weapon of choice by state and non state actors, and that is where the threat scenario becomes a cause for absolute concern. While drones have their immense advantages as unmanned autonomous systems, counter drone systems are equally relevant. Other than a kinetic kill of UAAS which is a challenge, a potent counter measure is a non-kinetic neutralisation through jamming which triggers a return to home command, thus exposing the point of launch. With 5G communication technologies launched, the data handling capability is grossly enhanced and latency reduced, thereby facilitating UAS as a technology of most relevance. The following actions need to be institutionalised:

- (a) **Consortium Approach.** A consortium approach to attempt proliferation of UAS and counter UAS technologies is the need of the hour. Other than military use, these technologies have extensive applications in logistics, supply chain and optimum use of air space for move of humans and material. There is a dire need to create collaborative programs, structures, policies comprising academia, R &D Organisations, Start Ups, Tier 1,2 and 3 and Tri Service institutions for creating myriad of solutions to the myriad of problems. Light but strong carbon reinforced materials, batteries and efficient engines as power packs for high endurance, efficient motors, autopilots and control surfaces, inertial navigation systems, miniaturised surveillance payloads and hardening against cybertronics threats are salient specific areas of research. Application based creative problem solving will be a game changer. There is also a need to generate Start Ups Army /Navy / Air Force /Tri Service for UAS defence applications.
- (b) **Aatmanirbhar Bharat Impact.** UAS have huge bandwidth of dual use. There is a global awareness and need. Aatmanirbhar Bharat and Make in India Missions need to specialise and strategize use cases - prototype, mass produce and proliferated for military and civil use. The industry needs to scale up to the huge need Nation wide and the immense export potential.
- (c) **Non Kinetic Counter Measures.** Non kinetic measures like millimetric radars to detect and UAAS jammers to neutralise would need to be deployed in high security zones and available with QRTs / security forces to ward off the threat.
- (d) **Kinetic Counter Measures.** Counter measures both kinetic and non kinetic for swarm UAAS including ornithopter and UGS/robot based and hybrid threat need to be designed and developed as a cost effective solution. These would include EM spectrum based EMP and laser directed energy weapons.
- (e) **Data Integrity & Data Security.** Friendly Unmanned Autonomous Systems carry the risk of cyber and electronics counter measures. This cybertronics threats need to be warded off by building a defence in depth against cyber and electronics spectrum threats for UAS.

Conclusion

The Unmanned Autonomous Systems are there to stay, deploy, deter, dissuade, destroy and disrupt. There is a school which professes that military drones are the poor man's fighter aircrafts and as a swarm could prove to be as lethal, if not

more. This thought is gaining traction given the high spectrum of technologies packed in a small space at a low cost of acquisition with little training and high mission combat effectiveness. These have been deployed in tactical battle areas as tethered drones on tanks & stand alone systems, as an eye in the sky for beyond visual range recce coupled with armed drones to strike in a seek and respond (shooter) autonomous mode. There is a need to analyse and prepare for this threat scenario with all its contingencies. Let us make the right choices - UAS and anti UAS are no longer a choice it is a compulsion for future combat readiness and operational effectiveness.

CERTIFICATE

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