SPOTLIGHT 20-5

The Chemical and Biological Attack Threat of Commercial Unmanned Aircraft Systems

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> *Some terrorist groups overseas are using battlefield experiences to pursue new technologies and tactics, such as unmanned aerial systems and chemical agents that could be used outside the conflict zones.*
>
> U.S. Department of Homeland Security[1]

In September 2013, at a political campaign rally in Dresden, Germany, a small unmanned aircraft system (UAS),[2] or "drone," flew within feet of German Chancellor Angela Merkel and Defense Minister Thomas de Maiziere, hovering briefly before crashing into the stage near Merkel's feet.[3] This harmless stunt by a political activist demonstrated that drones, especially those using autonomous navigation systems, could be stealthy, accurate and potentially deadly. Had this drone been armed with a chemical or biological warfare (CBW) agent, it may have incapacitated or killed this high-level delegation, garnering international attention and triggering profound concern regarding the government's inability to secure and defend vulnerable populations from any UAS capable of delivering CBW agents.

Recent Events

There have been other incidents involving commercial UAS and national security. In April 2015, a small UAS, possibly tainted with radioactive cesium, was discovered on the roof of the Japanese Prime Minister's office. The UAS was "carrying a camera and a bottle of unidentified liquid that bore a sticker with the universal symbol of radioactivity."[4] In January 2017, the Islamic State of Iraq and Syria (ISIS) started using commercial UAS to provide reconnaissance and targeting information against coalition forces[5] and began showing interest in conducting UAS-based CBW attacks.[6]

Some violent extremist organizations (VEO) are arming commercial UAS with small munitions to attack adversaries.[7] Likewise, UAS confrontations with military, law enforcement, pilots and citizens are increasing, as the Federal Aviation Administration (FAA) now receives over 100 adverse UAS reports each month.[8] These examples illustrate the intrusive,

ISSUE

The U.S. does not have a comprehensive national counter unmanned aircraft system (UAS) strategy to deal with the proliferation of intrusive, undetectable and potentially lethal commercial UAS.

SPOTLIGHT SCOPE

- outlines the rapid development and proliferation of commercial UAS and their potential dual-use capability to deliver chemical and biological warfare agents; and
- proposes recommendations on countering this likely persistent threat.

IMPLICATIONS

- A comprehensive approach that can be operationalized in conjunction with cost-effective counter-UAS technologies and capabilities is critical in defending against and defeating this emerging threat.

undetectable and potentially lethal nature of this emerging technology.[9]

This report briefly outlines the rapid development and proliferation of commercial UAS, their potential dual-use capability to deliver CBW agents and proposes recommendations on countering this likely persistent threat.

Advancements in UAS: Agricultural Spraying Drones and CBW Delivery

UAS have been around for years, evolving primarily for military use: The Flying Bomb (1918); Target Practice (1935); Surveillance (1964–1969); and Hunter-Predator (2001–Present).[10] Countries around the world are adopting UAS technology for domestic uses. Currently, there are 86 nations with UAS capabilities—both armed and unarmed.[11] The development and proliferation of UAS technology is driven by the commercial sector as drones become cheaper, lighter, easier to use and more sophisticated—penetrating nearly every sector of the economy.[12] Some fields benefiting from modern drone technology include: agriculture, construction, real estate, applied sciences, law enforcement, media, mining, private security, search and rescue and wildlife conservation.

A commercial drone sprays pesticides on crops. Such drones are readily available and could be used as a delivery system for chemical or biological attacks.

VEO'S USE OF UAS

- intrusive;
- undetectable; and
- potentially lethal.

EVOLUTION OF UAS

- 1918: Flying Bomb
- 1935: Target Practice
- 1964–1969: Surveillance
- 2001–Present: Hunter-Predator

The use of drones for agricultural crop spraying continues to increase, as do the available options for UAS platforms. In the 1990s, the Japanese developed one of the first UAS agricultural sprayers, the Yamaha R-50, and its successor, the Yamaha R-MAX, in response to demand for efficient, cost-effective aerial agricultural spraying.[13] Manned fixed-wing crop dusters had been in use in Japan for many years, but the small size of most Japanese farms meant that this method was inefficient and costly. The R-MAX allowed more precise small-scale spraying, at a lower cost and risk than manned aircraft.

People around the world are becoming more aware of how their food is grown; they want it to be cultivated with as few pesticides as possible, while at the same time, farms seek to maximize yields through efficiency and manageability in plant protection and fertilization. These factors contribute to the development of UAS agriculture technology that can apply precise pesticides, fertilizers and herbicides on agricultural land.

In addition to Japanese agriculture spraying UAS technology, **China is leading the field in commercial UAS**. In particular, China's Dà-Jiáng Innovations (DJI) is the market leader in easy-to-fly UAS.[14] DJI quadcopters have become the standard in commercial UAS technology, and its Agras MG-1S agriculture UAS model is no exception. The Agras MG-1S is an octocopter designed for precision variable rate application of liquid pesticides, fertilizers or herbicides. It carries up to 10kg of fluid and can cover 10 acres in a single flight—doing so approximately 60 times faster than manual spraying. Industry standard ceramic nozzles come pre-installed and can be changed out if necessary to accommodate different spraying requirements.[15] The Agras MG-1S was one of two models that the Spanish Military

Emergency Unit (UME) trialed for disinfecting large outdoor areas and the exterior of vehicles in the global fight to contain the Coronavirus Disease (COVID-19) pandemic.[16] Thus, significant advancements in UAS agriculture technology should give the joint counter weapons of mass destruction (CWMD) community pause.

The 11th Armored Cavalry Regiment and the Threat Systems Management Office operate a swarm of 40 drones to test the rotational units capabilities during the battle of Razish, National Training Center on 8 May 2019 (U.S. Army photo by Private Second Class James Newsome).

Capability Gaps and Their Implications

The proliferation in the research and development of commercial UAS for agriculture applications demonstrate that this is now an accessible dual-use technology that can realistically deliver CBW agents. A UAS CBW delivery platform is a definite possibility, especially for developing nations or VEOs that may not have the economic or technical means to acquire or employ more advanced delivery systems.[17] Technology has progressed to the point that commercial UAS are now much more capable in terms of operability, reliability, accuracy and range/payload capability than they were just a few years ago. Drone swarm technology, defined by Zachary Kallenborn and Philipp C. Bleek as "multiple UAS capable of coordinating their actions to accomplish shared objectives," is likely to encourage CBW proliferation and to improve the capabilities of states that already possess these weapons.[18]

Drone swarms may also aid in counter-proliferation, prevention, detection and response to a CBW attack, but those applications appear less significant than offensive uses.[19] Thus, the utility and flexibility of UAS make it a potential force multiplier. **UAS increase survivability, make attribution difficult and can be used as standoff weapon systems by states, small groups or individuals seeking to impose costs on a larger or more technologically advanced adversary.** However, the low payload capabilities of a UAS may reduce the direct losses sustained from an attack, but the propaganda value associated with a UAS CBW attack may increase the indirect costs (e.g. psychological, economic or political effects) associated with their use.[20]

Recommendations

The UAS epitomizes the difficulties with rapidly advancing dual-use commercial technology. The prospect of a UAS being used as a potential CBW delivery platform raises concerns that require constant situational awareness, coordination between the defense and law enforcement communities and employment of mitigation technologies. The recommendations below provide a starting point in developing a multi-purpose, synergistic approach in countering a commercial UAS CBW threat.

Develop a National Counter UAS Strategy

The United States does not have a comprehensive counter UAS strategy that includes all elements of the U.S. Government. In 2016, the U.S. Army drafted a counter UAS strategy "to develop and provide a comprehensive

set of capabilities that enable commanders to detect, identify and defeat UAS threats and enable strategic and tactical freedom of maneuver and action through all domains, including the electromagnetic spectrum."[21] In early January 2020, the Army was officially selected to serve as DoD's counter small unmanned aerial systems (C-sUAS) executive agent (EA).[22] The EA is chartered to find joint solutions to counter threats caused by small drones and to ensure that the services are not duplicating efforts.[23] One key deliverable that the joint C-sUAS office plans to complete by calendar year 2020 is a DoD counter-drone strategy. While this is a positive first step, it is likely that this strategy will be military-centric, will not address the spectrum of the CBW threat and will lack perspective on the specific capabilities and capacity that U.S. government agencies need to effectively counter any UAS armed with CBW. Thus, a national counter UAS strategy that understands and incorporates parallel counter UAS efforts across federal, state and local levels is key in developing an approach that can improve interoperability to defend and defeat a UAS CBW challenge, if one should arise.

Soldiers from 5th Armored Brigade, First Army Division West, developed a course of instruction to counter the threat of commercial, off-the-shelf unmanned aerial surveillance vehicles at McGregor Range Complex, New Mexico, 28 June 2019. Currently, there is no doctrine in place to train Soldiers how to deal with commercial off-the-shelf UAS (U.S. Army photo by Staff Sergeant Mylinda DuRousseau).

Explore Layered Defense Technological Solutions

In recent years, vast resources have been deployed to identify, track and intercept any UAS deemed a threat, but "drones continue to provide a significant challenge to special event security in the U.S."[24] There is no "magic bullet" in countering a UAS CBW threat—no single comprehensive material solution will completely eliminate the UAS problem. **Thus, a "soft kill" to "hard kill" chain is needed to detect, identify and defeat UAS threats.**[25] Kinetic methods, signal hijacking, radio frequency interference and directed energy are areas that can be explored to defeat UAS in a practical, cost-efficient manner. In late July 2019, the U.S. Marine Corps used a new portable jammer system to jam an Iranian UAS in the Strait of Hormuz. The Light Marine Air Defense Integrated System (LMADIS) is a recent example of an effective counter UAS electronic jamming technology.[26] Lastly, the military, law enforcement and commercial security sector should burden share—work closely with commercial industry and partner with the science and technology community to research emerging technologies and capabilities that may address gaps for threat UAS capable of delivering CBW agents.

Update CWMD Exercise and Training Concepts to Incorporate UAS CBW Delivery

The U.S. Army Chemical Corps and the Functional Area 52 Nuclear and Counter-Proliferation Officer Branch, in conjunction with the joint CWMD community, should update their training concepts and scenarios to better prepare the joint force in countering and defending against a UAS CBW threat. The Army and the joint force minimized chemical, biological, radiological and nuclear (CBRN) training during the wars in Iraq

RECOMMENDATIONS

- develop a national counter UAS strategy;
- explore layered defense technological solutions;
- update CWMD exercise and training concepts;
- ensure a sufficient stockpile of necessary CBRN protective equipment;
- account for CBW-capable UAS and swarming technology in the missile technology control regime (MTCR); and
- leverage world customs organization (WCO) operations, actions and activities.

and Afghanistan because U.S. adversaries lacked these weapons. Yet, as a result, the joint force now finds itself unprepared to confront a CBW threat.[27] **Commanders need to ensure that their formations understand how UAS-delivered CBW effects can affect personnel, equipment and the dynamics of combat power; they should train for and implement CBW survivability measures and techniques.** Additionally, updating lessons learned in countering ISIS's armed UAS tactics and techniques while incorporating the CBW delivery dimension in training concepts and exercise scenarios will assist commanders in preparing their forces for this threat.[28]

Staff Sergeant Warren Brewer (left), a member of the Virginia National Guard's 34th Civil Support Team (CST), examines a drone for evidence of weapons of mass destruction during a training exercise at H. Steven Blum Military Reservation in Glen Arm, Maryland, on 21 July 2020. Training exercises such as this ensure that the 34th CST is always ready to support civil authorities in a domestic chemical, biological, radiological or nuclear incident (U.S. National Guard photo by Sergeant Chazz Kibler).

Ensure a Sufficient Stockpile of Necessary CBRN Protective Equipment

Having enough CBRN protective equipment issued to the joint force and pre-positioned in the right locations is paramount when operating in a contaminated environment. Military units operating in a CBW environment require multiple sets of CBRN protective equipment to stay mission capable. Therefore, it is imperative that the Army's lead materiel integrator for CBRN protective equipment, the U.S. Army Tank-Automotive and Armaments Command (TACOM), ensure that sufficient amounts of CBRN protective equipment swing stock is built to prepare for the potentiality of a UAS CBW attack against the joint force.

Account for CBW-Capable UAS and Swarming Technology in the Missile Technology Control Regime (MTCR)

The U.S. State Department should evaluate whether and to what extent existing international treaties and multi-lateral control regimes are structured sufficiently to discourage proliferation of CBW-relevant UAS and swarming technology.[29] In particular, the State Department should advocate in the MTCR working group that CBW-capable UAS and swarming technology become export-controlled with export licenses on these technologies.

Fully Leverage World Customs Organization (WCO) Operations, Actions and Activities

The international community through the WCO should continue to fund international efforts to counter the diversion and trafficking of precursor chemicals used by VEOs and other criminal organizations for explosives development. The WCO should extend and expand *Programme Global Shield* (a law enforcement operation to combat the increasing illicit use of precursor chemicals to manufacture improvised explosive devices) to add specific Toxic Industrial Chemicals/Materials (TIC/TIM) and critical dual-use CBW components to their monitoring and reporting database.[30] Additionally, as part of the Strategic Trade Controls Enforcement Project (STCEP), it should fund and re-establish *Operation Cosmo* to focus industry and international efforts to disrupt the diversion of licit Chemical Warfare Agent precursors and dual-use components into illicit channels during importation, production, storage, transportation and sale.[31]

Conclusion

Although current commercial UAS technologies are sufficiently threatening, the industry is continuing to advance at a rapid pace that could potentially make these applications exponentially more deadly.[32] It is nearly assured that UAS will become smaller, cheaper and more capable as technology evolves. A UAS capable of delivering CBW agents makes the technology particularly difficult to defend against. One thing is for certain: **anyone willing to develop or acquire a CBW agent and deliver it via a UAS will likely not be able to be deterred.** Therefore, a comprehensive strategy that can be operationalized in conjunction with cost-effective counter UAS technologies and capabilities is critical in defending against and defeating this emerging threat.

A TALON tracked military robot picks up a downed unmanned aerial system at Al Asad Air Base, Iraq, 19 May 2020 (U.S. Army photo by Specialist Derek Mustard).

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Notes

[1] U.S. Department of Homeland Security, "National Terrorism Advisory Bulletin," 9 November 2017; Alexa Lardieri, "Homeland Security: Warns of Weaponized Drones as Terror Threat," *U.S News & World Report*, 10 November 2017.

[2] DoD and the Federal Aviation Administration (FAA) both use the term "unmanned aircraft system" (UAS), although "drone" is used colloquially when discussing unmanned systems. DoD defines UAS as "that system whose components include the necessary equipment, network, and personnel to control an unmanned aircraft." See "DoD Dictionary of Military and Associated Terms," January 2020, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/dictionary.pdf. Alternatively, the FAA does not have a specific definition of UAS, but due to its authorizing statutes it declares UAS an aircraft as it falls under the FAA's broad "aircraft" definition: "Any contrivance invented, used, or designed to navigate or fly in the air." See FAA "Unmanned Aircraft Systems (UAS)," https://www.faa.gov/uas/.

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[13] *DronesOnVideo*, "Top Agricultural Spraying Drone Systems for 2017," http://dronesonvideo.com/top-agriculture-crop-spraying-drones/.

[14] Dà-Jiáng Innovations (DJI), also known as Shenzhen DJI Sciences and Technologies Ltd. DJI is a Chinese technology company headquartered in Shenzhen, Guangdong, with factories throughout the world. See https://www.dji.com/.

[15] DJI Website, "Agriculture Spraying," https://enterprise.dji.com/agriculture?site=brandsite&from=nav.

[16] Many countries are exploring the viability of utilizing UAS to disinfect public areas (e.g. shopping centers, playgrounds, gyms, school campuses, etc.). See Che Pan, "Spain's military uses DJI agricultural drones to spray disinfectant in fight against COVID-19," *South China Morning Post*, 1 April 2020.

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[18] Zachary Kallenborn and Philipp C. Bleek, "Drones of Mass Destruction: Drone Swarms and the Future of Nuclear, Chemical, and Biological Weapons," *War on the Rocks*, 14 February 2019.

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[31] For the history of Operation Cosmo, see WCO, "Operation Cosmo's interdiction phase concludes," 31 October 2014, http://www.wcoomd.org/en/media/newsroom/2014/october/operation-cosmo.aspx.

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