Improving the Tactical Employment of SUAS for Light Infantry Battalions in Decisive Action

LTC MICHAEL A. HAMILTON
CPT CHRISTOPHER J. EGAN

Authors' Note: *The purpose of this article is to describe the challenges of current small unmanned aircraft system (SUAS) capabilities and employment from the perspective of U.S. Army light infantry battalions executing decisive-action operations in restrictive terrain. It is heavily METT-TC (mission, enemy, terrain and weather, troops and support available, time available, civil considerations) influenced and not intended to speak definitively for all SUAS employment. The scope of this analysis is also limited to currently fielded "program of record" SUAS and makes no claim to fully know/understand the latest state-of-the-art SUAS capabilities, research and development efforts, or the conceptual direction of SUAS doctrine. Hopefully, the observations and lessons learned contained within this article can inform both on-going and future SUAS modernization efforts — both materiel and doctrinal — wherever they currently stand. As with all* Infantry *articles, the views expressed in this article are solely those of the authors and do not represent the official position of the Department of Defense, the U.S. Army, or any element of it.*

For the past two training rotations at the Joint Readiness Training Center (JRTC) at Fort Polk, LA, our light airborne infantry battalion has aimed to maximize the use of our SUAS systems to win on the battlefield. Unfortunately, what we have concluded over the past two years is achieving this is a lot harder than it should be. This is not due to a lack of effort or proficiency but because light infantry battalions are basically trying to "squeeze a square peg into a round hole" by employing the currently fielded SUAS to meet battalion-level decisive-action SUAS requirements in restrictive terrain. There are fundamental disparities between:
- The environmental challenges of restrictive terrain for SUAS employment;
- The light infantry battalion's SUAS requirements for decisive-action operations; and
- The current SUAS capabilities the Army has fielded infantry battalions.

Environmental Challenges of Restrictive Terrain for SUAS Employment

SUAS operations in restrictive terrain are significantly challenging for four reasons:
1) Suitable sites for launch and recovery are limited;
2) Favorable surface wind conditions to enable successful launch and recovery are negatively impacted;

Paratroopers in 2nd Battalion, 504th Parachute Infantry Regiment move in restrictive and severely restrictive terrain during training. (Photos courtesy of authors)

3) Communications ranges are substantially reduced; and
4) Positive visual identification of ground-level objects and terrain features requires direct overflight and takes longer due to increased concealment and dead space.

The consequence of having limited open areas and favorable surface winds in restrictive terrain is that successful SUAS launch and recovery depends heavily on short take-off and landing (STOL) capabilities. There are a number of ways to achieve this — from various types of launching devices to rotary-wing lift systems — but the preferred STOL solution is one that does not significantly reduce the range and endurance of the SUAS. Another consequence of having limited suitable launch and recovery sites (LRS) in restrictive terrain is that the selection of suitable LRS may require increased standoff from the named area of interest (NAI), thereby increasing the required range and endurance of the SUAS. The difficulty of increased concealment and dead space in restrictive terrain also increases the endurance (time of flight) required for the SUAS to positively identify ground-level threats, objects, and terrain features. Among all the challenges of SUAS operations in restrictive terrain, perhaps none are more difficult than reduced communications ranges due to decreased line-of-sight (LOS) and radio wave attenuation by dense vegetation and buildings. The combined result of these environmental constraints is that STOL capabilities, extended range, increased endurance, and resilient LOS communications links are critical to successful SUAS operations in restrictive terrain. (Note: Reduced SUAS communications ranges in restrictive terrain are also influenced by restrictions on flight altitude driven by common airspace management techniques. Proposed solutions for mitigating the loss of comms link that involve SUAS flights above 700-1,000 feet above ground level [AGL] are effectively infeasible solutions in the decisive-action operating environment.)

Light Infantry Battalion SUAS Requirements for Decisive-Action Operations

Army Techniques Publication (ATP) 3-21.20, *Infantry Battalion*, describes four operational activities relevant to SUAS employment for the infantry battalion:
- Reconnaissance,
- Surveillance,
- Screening as a security operation, and
- Observed fires, including target acquisition (TA) and battle damage assessment (BDA).

It is crucial to emphasize that light infantry battalions routinely execute all of these activities in restrictive terrain, which, independent of any other METT-TC considerations, inexorably drives the battalion-level SUAS requirements of STOL, resilient LOS communications, and increased range and endurance for all the aforementioned reasons. However, there are other METT-TC factors that drive these unique battalion-level SUAS requirements beyond the challenges of restrictive terrain.

The Operations Process, Army Operational Frame-work, and Distance. Army Doctrine Publication (ADP) 5-0 defines the operations process as "the major command and control (C2) activities performed during operations: planning, preparing, executing, and continuously assessing the operation."[1] The key idea here is that intelligence collection (IC) activities and SUAS requirements in support of the battalion's planning are different from the IC activities and SUAS requirements in support of execution. SUAS requirements during the planning phase may involve NAIs that are geographically farther away from friendly forces prior to initiating movement for execution. Short-range SUAS are better suited for IC activities during the execution phase and do not fully meet the SUAS requirements of battalion-level IC in support of planning.

The Army Operational Framework described in ADP 3-0, *Operations*, provides two additional concepts that are important for understanding the unique nature of battalion-level SUAS requirements: area of influence (AOI) and "deep" vs. "close" areas. An AOI is a geographical area wherein a commander is directly capable of influencing operations by maneuver or fire support systems normally under the commander's command or control.[2] The light infantry battalion's "pacing" asset within its AOI is the M120A1 120mm mortar system, with a maximum range of 7.2 kilometers. At present, currently fielded SUAS limit the battalion's ability to employ effective observed fires throughout the AOI due to the difficulty of maintaining reliable communications link in restrictive terrain. For the same reason, currently fielded SUAS systems fail to meet the battalion's requirements for SUAS activities in "deep areas" — the area where commanders "set conditions for future success in close combat," including "efforts to prevent uncommitted enemy forces from being committed in a coherent manner."[3] Battalion-level SUAS activities in deep areas require extended range and endurance in order to set conditions for companies during the execution

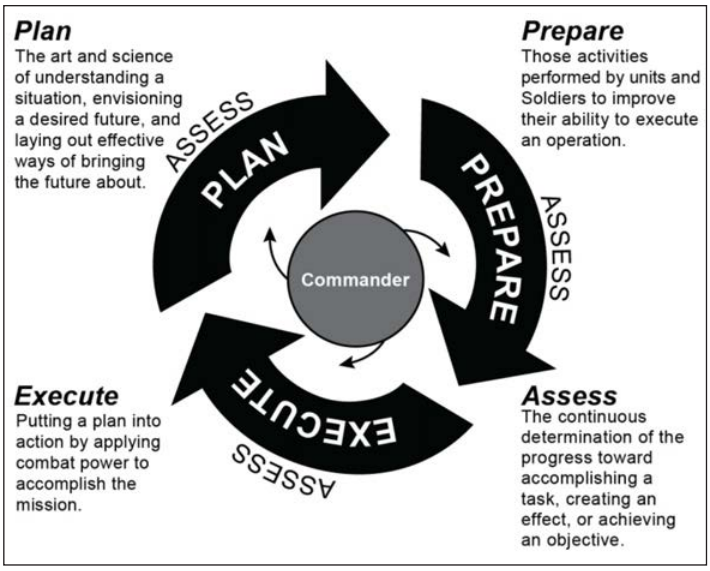

Figure 1 — The Operations Process

SUAS requirements during the planning phase may involve NAIs that are geographically farther away from friendly forces prior to initiating movement for the execution phase.

phase of the operations process. Short range/endurance SUAS are better suited to IC, security, and observed fires in the "close area" — "the portion of the AO where the majority of subordinate maneuver forces conduct close combat."[4] They are company enablers that do not meet battalion-level SUAS requirements.

Surveillance, Security, and Endurance. Field Manual (FM) 3-98, *Reconnaissance and Security Operations*, describes surveillance as distinct from reconnaissance in that surveillance is passive, continuous, and layered to provide "mixed, redundant, and overlapping coverage."[5] FM 3-98 also states that "employed together, UASs and manned or unmanned ground reconnaissance elements provide excellent surveillance capability."[6] Effective surveillance is critical to providing early warning for screening during security operations. At present, a lack of extended endurance SUAS systems in restrictive terrain limits the infantry battalion's ability to provide continuous and layered surveillance of NAIs, because of an inability to loiter for long periods of time, and rapidly cross-cue from ground-based assets and sensors. As stated in FM 3-98, reconnaissance efforts can absolutely complement surveillance, but short-duration capabilities cannot independently achieve effective surveillance — especially in restrictive terrain. In accordance with FM 3-98, surveillance should also be maximized, which is significantly hindered by decreased SUAS endurance and downtime in transitions to and from ground control station (GCS) and NAIs.[7]

Observed fires in restrictive terrain. Restrictive terrain poses a significant challenge to effective ground-based observation of indirect fires (IDF). Observation distances in restrictive terrain are typically limited to 150-300 meters or less. The result of this is an inability to effectively observe fires from the ground level — including target acquisition, adjustments, and BDAs — outside the risk estimated distances (RED) of IDF assets. Short-range/endurance UAS assist with this to some extent, but it is not uncommon for planned and unplanned IDF to take 10-30 minutes or longer to process and execute, limiting the ability for short-range/endurance SUAS to effectively adjust, conduct BDA, and re-execute as required. The ability to observe, adjust, and conduct BDA for IDF is directly tied to the observer's uninterrupted ability to observe the target.

Tactical Transitions and the Importance of Maximizing IC Capacity. As infantry battalions transition between offense and defense, it becomes imperative to maximize IC capacity to balance IC/security requirements for current operations and IC support to planning for future operations. The employment of all available reconnaissance and surveillance (R&S) capabilities to cover as many different NAIs as possible becomes very important during these tactical transitions. This inevitably motivates infantry battalions to delink scouts and infantry companies from SUAS capabilities that have the potential to meet battalion-level IC requirements while increasing IC capacity. Of course, without dedicated, modified table of organization and equipment (MTOE)-authorized personnel at the battalion level to accomplish this, trained SUAS operators must either be detached from subordinate units or be under the direct operational control of the battalion headquarters.

A Soldier with the 2nd Brigade Combat Team, 1st Cavalry Division launches an RQ-11B Raven during a live-fire exercise in Bemowo Piskie, Poland, on 30 March 2023. (Photo by SSG Matthew A. Foster)

Current SUAS Capabilities

The AeroVironment RQ-11 Raven SUAS has been the primary SUAS within the infantry battalion for over a decade. Originally fielded during the global war on terrorism (GWOT), this system is fielded at the company level, operated mainly from a stationary GCS by a minimum of two operators, and has an optimal endurance of one hour with a maximum range of 10 kilometers. The Raven is well-suited for operations in uncontested areas with relatively open terrain — in other words, environments with the benefit of unobstructed LOS and relatively secure LRS in rear areas.

Very similar to the RQ-11 Raven is the AeroVironment RQ-20 Puma SUAS. Although not officially authorized for the infantry battalion MTOE, the RQ-20 Puma is an Army program of record system, historically employed by special operations forces (SOF), that is often available to infantry battalions as excess equipment. Much like the Raven, the Puma is operated primarily from a stationary GCS by a minimum of two operators; however, it doubles the range and endurance of the Raven, boasting an impressive two hours of flight time and a maximum range of 20 kilometers. Like the Raven, the Puma is well-suited for operations in semi-permissive areas in relatively open terrain.

Finally, the FLIR Systems PD100 Black Hornet Nano UAS is the latest fielded SUAS capability within the infantry battalion. It has an optimal endurance of 25 minutes and a maximum range of 2 kilometers. Unlike the RQ-11 Raven and RQ-20 Puma, the PD100 Black Hornet is a vertical take-off and landing (VTOL) system that can be easily operated on-the-move by a single Soldier. The PD100 is well suited for short-range, company-level operations in contested areas in severely restricted terrain — in other words, environments with heavily vegetated areas and obstructed LOS and LRS in hostile areas.

For all the wide-ranging SUAS capabilities currently fielded to light infantry battalions, none of these systems fully meet the battalion's mission requirements for IC, target acquisition, and BDA in contested areas with restrictive terrain. Each of these systems falls short of meeting critical requirements in several ways – whether it be launch and recovery limitations in restrictive terrain, communications reliability in restrictive terrain, range, or endurance. As previously described, "the devil is in the details" of how and where light infantry battalions operate along with the technical capabilities and limitations of each of these systems to meet those requirements.

Above, a Soldier with the 2nd Infantry Brigade Combat Team, 34th Infantry Division performs pre-flight checks on an RQ-20 Puma during training in Kosovo on 21 January 2020. (Photo by SSG Tawny Schmit)

At right, an Infantryman assigned to the 1st Infantry Brigade Combat Team, 11th Airborne Division releases a Black Hornet during training at the Yukon Training Area in Alaska on 3 April 2023. (Photo by SrA Patrick Sullivan, USAF)

Understanding the Current Capability: What Are SUAS Really For? Since the initial fielding of the RQ-11 Raven SUAS circa 2006 during GWOT and its inclusion in the infantry battalion's MTOE under the scout platoon and infantry companies, two basic questions remain unanswered definitively by doctrine:

1) Are SUAS intended to be employed only as company-level enablers or as battalion-level IC assets as well?
2) Are SUAS intended to merely enhance existing IC capabilities or to increase overall IC capacity?

Fundamentally, these questions acknowledge and plead consideration for the distinction between SUAS employed as company enablers vs. SUAS employed as battalion-level IC assets. Although this distinction — and therefore these questions — are left uncontemplated by existing Army doctrine, three facts support the conclusion that the Army has, historically, only envisioned SUAS as company-level enablers that merely enhance existing ground R&S capabilities:

1) Within the infantry battalion, SUAS are MTOE-authorized equipment only for infantry companies and scout platoons, not for battalion-echelon elements;

2) Within the infantry battalion, units are not authorized any additional MTOE personnel to serve as dedicated SUAS operators; and

3) The trend of Army SUAS modernization seems to be increasingly smaller and shorter range capabilities that favor employment at the company and below level in the "close" area.

However, the contemporary shift from the counterinsurgency and stability operations of the GWOT to more decisive-action operations has revealed increasing evidence to support the argument that infantry battalion headquarters require dedicated SUAS assets that meet unique battalion-level requirements, and current SUAS capabilities — materiel, personnel, and doctrine — fall short of meeting these requirements. In other words, as far as SUAS capabilities are concerned, infantry battalions need both "apples" (man-packable, short-range/endurance systems) AND "oranges" (man-portable, extended-range/endurance systems), not just more apples trying to be oranges.

Doctrinal Gaps in SUAS Employment. ATP 3-21.10, *Infantry Rifle Company,* is full of vague, conceptual examples of how UAS could support battalion IC requirements for decisive-action operations but provides no specific tactics, techniques, or procedures (TTPs) for the employment of current SUAS capabilities in support of battalion IC. It doesn't even mention the currently-fielded MTOE SUAS by name, nor does it attempt to firmly solidify who should normally employ these systems within the battalion — companies, scouts, or headquarters elements. ATP 3-21.10 doesn't even mention SUAS employment of any kind, despite these systems being company MTOE equipment. ATP 3-04.64, *UAS Multi-Service Tactics, Techniques, and Procedures for the Employment of Unmanned Aircraft Systems*, ironically fails to offer specific TTPs relevant to small-unit transport, LRS establishment, launch, contingencies, or recovery for currently fielded SUAS, although it makes some attempt to conceptualize SUAS planning, flight operations, and environmental considerations.

The doctrinal publication for scout platoon operations, ATP 3-20.98, provides the best attempt to describe specific TTPs for SUAS employment in support of infantry battalion IC but falls woefully short of utility in two important ways. First, it fails to reconcile the fundamental problem of the wasted IC economy of relying on scouts to employ SUAS — because whenever scouts are operating Ravens or Pumas, they're not operating their own eyes and ears to conduct ground-based reconnaissance, surveillance, or security. This is likely a consequence of the RQ-11 Raven SUAS being included as authorized MTOE equipment for the scout platoon, but it lacks the detailed analysis of the technical capabilities and limitations of the RQ-11 Raven and the associated impacts for scout operations in restrictive terrain. Furthermore, if the METT-TC conditions were deemed best suited for SUAS employment within any given NAI, then arguably the battalion would rather commit scouts to other NAIs to maximize R&S capacity or utilize short-range, VTOL systems such as the PD100 — not long-range, fixed-wing SUAS like the RQ-11 Raven — to enable short-range scout reconnaissance or layered surveillance of an NAI.

Second, assuming scouts were the preferred operators for SUAS, ATP 3-20.98 makes no attempt to describe how they would deliver the bulky equipment of fixed-wing Raven/Puma SUAS to a given GCS/LRS under suboptimal METT-TC conditions: dismounted movement in severely restricted terrain. The technical considerations for RQ-11/RQ-20 transport, launch, flight, and recovery are not considered in detail in order to provide useful recommendations for how light infantry scouts would actually accomplish this. Perhaps MTOE vehicle transport is contemplated (if not specifically mentioned) in scout employment of Ravens/Pumas, but it absolutely cannot be assumed that METT-TC conditions will always accommodate mounted movement/transport during light infantry reconnaissance operations.

Recommendations

The following are specific recommendations to meet the minimum SUAS requirements for light infantry battalion IC, security, and observed fires in restrictive terrain during decisive-action operations:

1) Battalion-level SUAS should have an operating range of 10-12 kilometers. This allows infantry battalions to conduct IC in "deep" areas to enable deliberate planning and set conditions for companies prior to the "close" fight in decisive-action operations. This also allows the battalion to provide effective observed fires in restrictive terrain throughout its entire AOI covered by organic 120mm mortar fires out to its maximum range. Finally, this capability allows infantry battalions to mitigate a lack of suitable LRS with sufficient open areas for successful launch and recovery by allowing more standoff between suitable LRS and NAIs.

2) Battalion-level SUAS should have an operating endurance of 90-120 minutes. This gives infantry battalions the ability to provide continuous and layered surveillance of NAIs by reducing downtime in transitions to and from GCS and NAIs. Similarly, this increased endurance also enables a more effective ability to screen during security operations. It also provides battalions the ability to rapidly and more responsively cross-cue SUAS from ground-based assets and sensors. Finally, this capability allows infantry battalions to overcome increased aerial concealment and dead space in restrictive terrain by providing increased time of flight to positively identify ground-level threats, objects, and terrain features.

3) Battalion-level SUAS should have STOL capability. At present, the RQ-11 Raven and RQ-20 Puma are both very challenging to launch and recover in restrictive terrain because of the open area required to gain altitude above tree-top level, as well as the limited force/speed-of-hand launch methods for fixed-wing SUAS to generate lift under suboptimal surface wind conditions. This is unfortunate because, otherwise, both these fixed-wing SUAS possess the range and endurance desired for battalion-level SUAS operations… if they could only get up and stay up in the air in complex terrain. As previously mentioned, there are a number of ways to achieve STOL — from various types of launching devices to rotary-wing lift systems — but the preferred STOL solution is one that does not significantly reduce the range and endurance of the SUAS.

4) Battalion-level SUAS should have resilient LOS communications links for operations in restrictive terrain. There is a tremendous opportunity to accomplish this — and more — in the use of Mobile Ad-Hoc Network (MANET) solutions such as the TrellisWare TSM waveform as the primary communications link for the SUAS. Doing so would enable hundreds of other ground-based Integrated Tactical Network (ITN) radios within the MANET to serve as retransmission nodes between the GCS and the air vehicle (AV), improving the resiliency and reliability of the SUAS link. This solution could also (potentially) improve the ground tactical communications of infantry units by providing an aerial retransmission capability built into the SUAS. Finally, this solution could provide real-time AV position location information (PLI) into battalion common operational picture (COP) systems, which significantly increases situational awareness (SA) for intelligence collection, processing, exploitation, and dissemination (PED), while also providing integrated identify friend or foe (IFF) capabilities to prevent friendly counter-UAS fratricide.

Additionally, the following non-essential capabilities would significantly enhance the infantry battalion's SUAS employment efforts:

- Expanded access to full-motion video (FMV) beyond the GCS. During the execution phase of decisive-action operations, the rapid cross-cueing and dissemination of intelligence to ground units is imperative. Currently, the speed of this cross-cueing and dissemination is limited to direct communications (often voice) between the SUAS GCS, main command post, tactical command post, and ground force leaders. The ideal flattening of this critical information and SA would be direct access to the SUAS FMV by ground force leaders via receiver solutions, ideally compatible with existing ITN end-user devices (EUDs) to reduce additional equipment required on the assault.

- Integrated, real-time AV PLI and sensor data into battalion COP systems. The efficient cross-cueing and PED of imagery intelligence collected from SUAS is often hindered by a lack of real-time SA at battalion C2 nodes on the exact location of the AV and the center point and field of view of the SUAS FMV in relation to mission graphics. Programs such as the Unified Video Dissemination System (UVIDS) have been accomplishing this for Group 4-5 UAS for over a decade. This capability would significantly improve the infantry battalion's ability to make sense of what the SUAS is observing and quickly act on that information, both in planning and execution.

- GCS map compatibility with battalion COP graphics to enable SUAS flight planning and execution. Currently fielded SUAS GCS map software is not fully compatible with the digital COP systems battalions use to plan and C2 operations. This challenges SUAS mission planning and execution. The ideal GCS map system would be capable of receiving and building the same digital COP graphics as the battalion's C2 nodes and subordinate units.

- Low-power, beyond line-of-sight (BLOS) PLI reporting to enable downed aircraft recovery. SUAS operations in restrictive terrain will inevitably result in downed aircraft. The recovery of downed SUAS in these situations in complicated by the inability to pinpoint the exact location of the AV due to the loss of LOS communications, as well as the fact that the SUAS position can change significantly between loss of link at altitude and crashing. A low-power, BLOS PLI capability built into the SUAS would significantly increase the chances of successfully recovering the SUAS, or (at minimum) speed the recovery efforts or inform the decision not to attempt recovery based on confirmed information of the SUAS' location in denied areas.

- Integrated IFF capabilities to prevent friendly counter-UAS fratricide. The proliferation of friendly and enemy UAS capabilities increases the chances of misidentification and fratricide in counter-UAS efforts. Friendly forces would significantly benefit from increase SA on the real-time location and status of adjacent unit UAS to prevent counter-UAS fratricide. This would also make friendly counter-UAS efforts against enemy systems more effective in speeding the process of identifying enemy UAS.

A Final Plea for Dedicated SUAS Manning at the Battalion Level. Considering all the aforementioned recommendations for advanced materiel capabilities to support battalion-level SUAS employment, all would surely be undermined without highly proficient SUAS operators who deliberately train on SUAS employment in a variety of METT-TC conditions. This is not a proposition for all SUAS operators within the battalion to be MTOE authorized, just the ones responsible for the most complex mission with the most advanced SUAS capabilities for the widest tactical impact. Such important future capability "oranges" cannot be truly optimized with old "apple" manning solutions.

Notes

[1] Army Doctrine Publication (ADP) 5-0, *The Operations Process*, July 2019, Glossary 5.
[2] ADP 3-0, *Operations*, July 2019, 4-3.
[3] Ibid, 4-4.
[4] Ibid.
[5] Field Manual 3-98, *Reconnaissance and Security Operations*, January 2023, 4-8.
[6] Ibid, 4-7.
[7] Ibid, 4-8.

LTC Michael A. Hamilton is a 19-year Infantry officer with six deployments to Afghanistan and Iraq. His most recent assignment was battalion command of the 2nd Battalion, 504th Parachute Infantry Regiment (PIR), 1st Infantry Brigade Combat Team (IBCT), 82nd Airborne Division. His previous assignments also include serving with the 82nd Airborne Division, 1st Armored Division, 75th Ranger Regiment, and 1st Security Force Assistance Brigade. His operational experiences include a myriad of unmanned aircraft system (UAS) employment and integration activities in support of stability operations, special operations, and security force assistance. Over the past two years in battalion command, he has employed SUAS during two decisive-action Joint Readiness Training Center (JRTC) rotations and a deployment to Kabul, Afghanistan, in August 2021 in support of Operation Allies Refuge.

CPT Christopher J. Egan currently serves as the battalion intelligence officer for 2-504 PIR. He is a previous Infantry officer with a deployment to Syria and Iraq in support of Combined Joint Task Force - Operation Inherent Resolve. He previously served with the 1st Stryker Brigade Combat Team, 25th Infantry Division. For the past year as an Intelligence officer, he has managed the battalion SUAS program and executed numerous SUAS missions during home-station training and a decisive-action JRTC rotation.