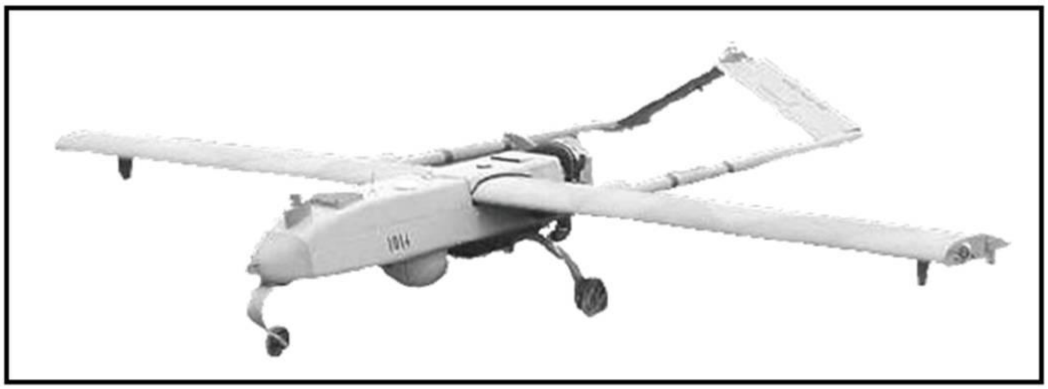
2011

Shadow Troop Handbook



-A doctrinal approach to the employment of the RQ7-B Shadow Tactical Unmanned Aircraft System (TUAS) in the Armed Reconnaissance Squadron (ARS)

-Adapted from *Army UAS Operations FM 3-04.155*

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Combat Aviation Brigade, 1st Infantry Division

Shadow Troop Handbook

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FORWARD

In an age where the changes in equipment are starting to outrun the changes in doctrine, this manual was created to provide a centralized starting point for doctrinal and Tactics, Techniques, and Procedures (TTP) research for the Full Spectrum Armed Reconnaissance Squadron (ARS) and Shadow Troop Commanders. We took the informative Army UAS Operations Manual and revised it to fit the needs of the Shadow Troop key leadership. Mostly, we used this manual as a means to fuse our lessons learned into the future development of the Shadow Troop operations.

The troop creating this manual, Falcon Troop, 1-6 Cavalry, was created by the 1st Infantry Division Commander and Combat Aviation Brigade (CAB) Commander to provide an aviation standardization program to the division's Unmanned Aerial Systems (UAS). Falcon Troop trained up at Fort Riley, working with the division's Shadow platoons and Kansas State University's UAS program. They deployed to OIF and maintained an Aircrew Training Program (ATP) command relationship with four separate Shadow platoons from 3rd ID, 10th MTN, 25th ID, and 1st ID. Additionally, they established a Scan-Eagle tactical UAS program in USD-C, manning the program with Soldiers of all Military Occupational Specialties (MOS) from across the CAB. Their work resulted in a 67% reduction in aviation accidents and incidents and an increase in cross-training between manned and unmanned aviation.

This manual was tailored towards the key leadership in the Full Spectrum ARS. With the audience as the primary staff, commanders, and senior leadership, this manual does not reinvent the wheel for any doctrine already implemented at the OH-58D Squadron level. We took much of our information from *FM 3-04.155 Army Unmanned Operations Manual*, which provides a wealth of information for a general Unmanned Aerial System leader. With this manual, we deleted information that was not needed for the Shadow TUAS key leadership and infused our lessons learned. In many instances, I either replaced the wording to address a specific point or simply replaced the section. My intent was not to delete key information, but to focus the most relevant information for a future Shadow Troop commander.

In a standard military field manual, the ability to portray lessons learned and successful Tactics, Techniques, and Procedures becomes difficult. I addressed this problem by maintaining, as close as possible, a military manual approach, but created text boxes to portray our lessons learned. This manual is meant to be a working document and will continue to grow and change with the dawn of a new reconnaissance era. On the back page I have placed a disc loaded with key information which is normally given to UAS leadership in courses at Fort Huachuca, AZ.

As scout pilots, our sights will no longer slow our aircraft to sub-100 knots airspeeds and four kilometers viewing capability. Our sight will be autonomously searching at times, and at other times will be in our direct control extending our engagement distance to the limits of the hellfire. This concept of the Shadow being an extension of the scout pilot's system is the first concept that needs to be internalized by the modern-day air cavalrymen. They should know the limits of the Shadow like they know the limits of their current Mast Mounted Sight. This manual does not discuss the specific limitations of the Shadow aerial vehicle, but rather emphasizes the doctrine that will need the OH-58D Air Mission Commander's expertise on both types of aircraft in his combined team.

Finally, the last page of this manual has a disc containing multiple publications, TTP briefs, and school-house briefs. This is our additional attempt at pushing lessons learned out to the field. Falcon Troop managed to build and implement an emergency re-trans capability for 2-1 Advise and Assist Brigade's (AAB) operational area during Operation Iraqi Freedom. We were also successful at building TTPs for hasty remote Hellfire engagements between the Shadow TUAS and manned platforms. These tactics exercised other processes, including laser designation operations, communications relay, and airspace coordination. Also on this disc, I put a copy of this manual, the Shadow Troop Handbook. My intent is for you to take this manual, update it, re-print at your local Defense Logistics Agency print shop, and pass on to the next Shadow Troop. It is a small step now, but by the time the third or fourth Combat Aviation Brigades receive their Full Spectrum Shadow Troops, I hope the lessons learned will be spilling over on the pages of this manual.

WILLIAM L. KOCH
CPT, AV
Commanding

Chapter 1

Missions and Organization

The RQ-7B Shadow Tactical Unmanned Aerial System (TUAS) fielded organically in the Attack Reconnaissance Squadron (ARS) is organized and equipped to provide a combat enabler to the Combat Aviation Brigade.

> *UAS significantly increase situational awareness (SA) and the ability to decisively influence current and future operations when employed as a tactical reconnaissance, surveillance, and target acquisition (RSTA) platform. UAS provide near real time (NRT) battlefield information, precision engagement, and increased C2 capability to prosecute the fight and shape the battlefield for future operations. UAS capabilities are maximized when employed as part of an integrated and synchronized effort.*
>
> **FM 3-04.155 Army Unmanned Aerial Systems Operations**

When properly employed, **the Shadow TUAS will serve the ARS Commander as an extension to the scout-attack manned platforms**, **an autonomous, continuous-coverage asset, and a search-and-designate platform**.

SECTION 1 - OVERVIEW

FUNDAMENTALS

1-1. The Shadow TUAS extends the ARS Commander's ability to support the full spectrum of conflict through reconnaissance, security, aerial surveillance, communications relay, and laser designation.

1-2. The UAS supports the full spectrum capability through augmenting all warfighting functions:

a. Movement and Maneuver: Provides the full depth of the reconnaissance and security missions in order to aid the ground commander in movement of friendly forces and provide the ground forces with freedom to maneuver.

b. Intelligence: The Shadow Troop provides Near Real Time (NRT) intelligence, surveillance, and reconnaissance (ISR) and extends the capability through flexible RSTA platforms as an organic asset to the ARS and CAB commanders. They greatly improve the situational awareness of the ARS and aid in employing the Scout Weapons Team (SWT) in high threat environments.

c. Fires: Coupling the Communication Relay Package (CRP) with the Laser-Designating (LD) payload, the Shadow aids in all levels of the Decide, Detect, Deliver, and Asses cycle.

d. Protection: Through continuous reconnaissance, the Shadow Troop can significantly increase the force protection in and around secure operational bases.

e. Sustainment: The Shadow provides reconnaissance and security along supply routes and logistics support areas. Using the CRP, the Shadow can talk directly to the convoy commander for immediate reaction.

f. Command and Control: The Shadow greatly increases the ARS commander's ability to control the fight. The CRP package extends radio transmission ranges to 240 kilometers. With proper TTPs, the Shadow can serve as an emergency re-transmitting capability to isolated personnel.

FULL SPECTRUM OPERATIONS

1-3. The Shadow Troop aids the ARS and CAB commanders through the full spectrum of operations from stable peace to general war:

a. Peacetime Military Engagement: The Shadow Troop provides counterdrug activities, recovery operations, security assistance, and multinational training events and exercises.

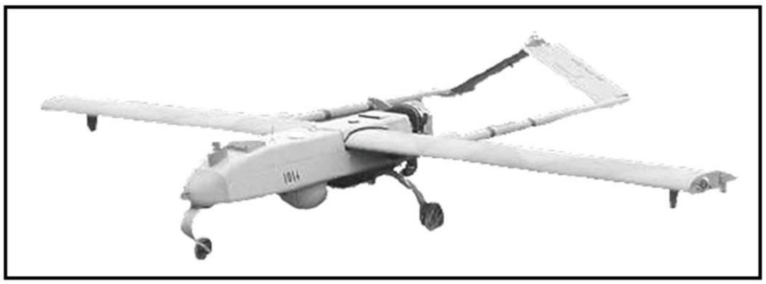
b. Limited Intervention: Provides search for evacuation operations, security for strike and raid operations, foreign humanitarian assistance (search of survivors during disaster relief), and searching for weapons of mass destruction.

c. Peace operations: Provides peacekeeping through surveillance and security for peace enforcement operations.

d. Irregular Warfare: Assists in tracking enemy personnel while combating terrorism and unconventional warfare.

e. Major Combat Operations: Provides the capability to extend the communication of friendly units, emergency retransmitting capability to isolated personnel, target acquisition, and laser designation.

SECTION II – RQ-7B SHADOW AERIAL RECONNAISSANCE TROOP



ORGANIZATION

1-4. The Shadow Troop will be organic to the Attack Reconnaissance Squadron employed at the Squadron, Aviation Brigade, or Infantry Division level. Additionally, the Shadow Troop commander should maintain an Aircrew Training Program commander relationship with the IBCT Shadow platoons.

1-5. The **Troop leadership will be comprised of Aviation Officers from across the ARS**. This Troop should be considered as a second command, in order to ensure the subject matter expertise for employing the OH-58D in conjunction with the Shadow UAV. Further, the Shadow Troop commander is the officer responsible for maintaining a strong relationship between the manned and unmanned assets.

1-6. Similar to an aerial reconnaissance troop of OH-58Ds, the Shadow Troop will be comprised of two aerial reconnaissance Shadow platoons, and a headquarters section which includes an exploitation cell. Each platoon will be comprised of a flight operations section and a maintenance section.

1-7. The aerial reconnaissance platoon consists of—
- Flight operations section.
- Maintenance section.
- Four UA.
- Four OSRVTs.
- Two vehicle-mounted OSGCS.
- Two ground data terminals (GDTs).
- Two personnel/equipment transport vehicles with one equipment trailer.

- Two tactical automated landing systems (TALSs).
- One vehicle-mounted air vehicle transport (AVT) with launcher trailer.
- One vehicle-mounted mobile maintenance facility (MMF) with maintenance trailer.
- One portable ground data terminal (PGDT).
- One portable ground control station (PGCS).

1-8. The Shadow platoons will move the Technical Inspectors and Certified Field Support Representatives into the Aviation Unit Maintenance Troop to prevent conflict of interest and maintain aviation standards of maintenance. The Troop's breakdown should mirror the chart below:

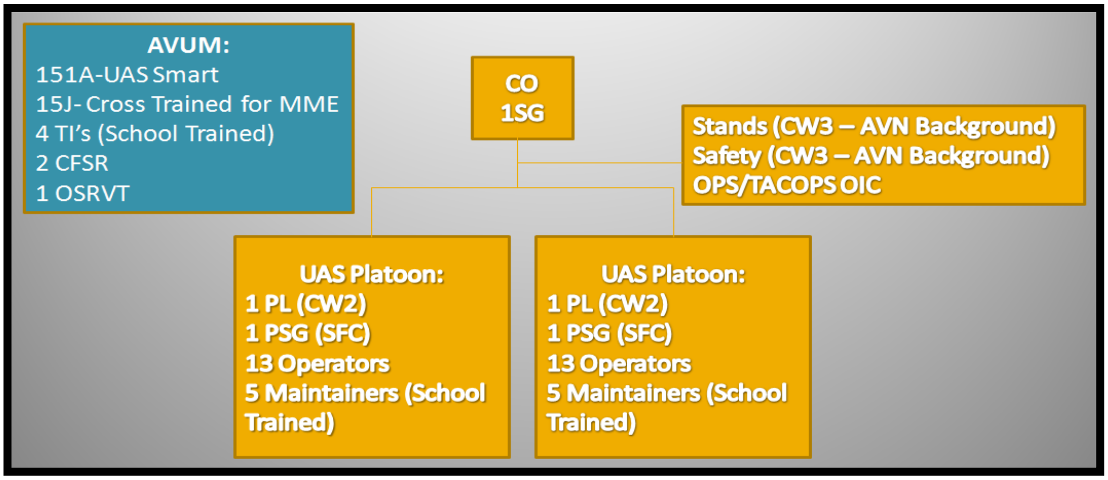


Figure 1-1. Suggested MTOE

LESSONS FROM THE FIELD

We manned our Safety and Standardization program with OH-58D senior aviators. After being separated from aviation brigades since the birth of the Shadow UAS, the Shadow technical personnel have never received aviation specific training. They taught the Shadow maintainers and operators very detailed aviation specific information which resulted in a 67% reduction in accidents.

Programs that needed specific attention in the platoons we worked with are below:

Standardization:

- Flight Records maintenance
- Airspace management and understanding
- Radio communication and crew coordination
- No-notice and evaluation program

Safety:

- FOD prevention program
- Trust in the Emergency Procedures
- Quality Control and Maintenance records procedures

1-9. The Squadron should also consider manning an exploitation cell within the headquarters section of the Shadow Troop. The benefits of the exploitation cell will be discussed throughout this manual.

1-10. The Troop will be fielded with four Ground Control Stations (GCSs) which will allow the ability to provide two GCSs for launch and recovery and two GCSs in forward locations where they best support the operational mission.

SECTION III – DUTIES AND RESPONSIBILITIES

1-11. The duties and responsibilities of the personnel inside of the Shadow Troop will mirror those positions in the peer OH-58D Kiowa Aeroscout Troops. The following is a list of duties and responsibilities to expect in the Shadow Troop.

COMPANY LEADERSHIP

1-12. The company commander, first sergeant, platoon leaders, and platoon sergeants are responsible for the integration, training and development, and line maintenance of the UAS organization. Their principal concern is integration of the unit into the combined arms fight. Company leadership should be proficient in UAS and OH-58D Scout Weapons Team (SWT) employment and have an in-depth knowledge of enemy forces and how they fight. Company leadership is responsible for—

- Aircraft and system maintenance, ensuring availability to meet the supported commander's intent.
- Training leaders and evaluating crews and individuals. Assessing training according to the commander's task list (CTL).
- The unit safety program.
- Assigning individuals to perform specific duties required for safe flight operations not designated in the modified table of organization and equipment.
- Maintaining familiarity with all aspects of UAS.
- Assisting in management and enforcement of the Army's Shadow TUAS standardization program throughout the Infantry Division.

1-13. As an extension of company leadership, additional responsibilities for the operation of UAS are detailed below.

STANDARDIZATION OFFICER

1-14. The standardization officer (SO) works directly for the commander and assists the platoon leader in developing and implementing the unit aircrew training program (ATP). He assists in crew selection and normally performs as a member of the company operations planning cell. The SO provides quality control for the ATP through the commander's standardization program (refer to training circular [TC] 1-600 and TC 1-611). He is also a principal advisor to the subordinate unit instructor operators (IOs). The SO is tasked to provide expertise on unit, individual, crew, and collective training to the commander. He also—

- Serves as a member of the ARS standardization committee.
- Advises the commander on development of the CTL.
- Monitors unit standardization and ATP.
- Maintains unit individual aircrew training folders (IATFs).
- Monitors unit no-notice programs.
- Assists the master gunner in development and execution of realistic company gunnery tables.
- Develops company situational training exercises (STXs).
- Attends training meetings.

INSTRUCTOR OPERATOR

1-15. The IO is responsible for assisting the platoon leader in properly training combat-ready crews. He provides quality control for the ATP via the commander's standardization program. Although the IO works directly for the platoon leader, he receives guidance and delegated tasks from the company SO. This ensures training is standardized throughout the company. The IO—

- Conducts no-notice evaluations.
- Assists the company SO in maintaining IATF.
- Assists in development of company STX.
- Assists in development and execution of company gunnery tables.
- Assists the company SO in development of the CTL.

UNIT TRAINER

1-16. The unit trainer (UT) is an operator designated to instruct in areas of specialized training (TC 1-600). He assists the IO/SO in unit training programs and the achievement of established training goals.

SAFETY OFFICER

1-17. The safety officer, military occupational specialty (MOS) 150UB, assists the commander in developing and implementing all unit safety programs. Commanders rely on their safety officers to monitor all safety aspects of the unit and provide feedback and advice to the commander. He serves as the commander's advisor on risk management. The safety officer is the commander's primary trainer for annual safety training requirements and composite risk management, including—

- Safety meetings (quarterly and monthly).
- Individual risk assessment.
- Crew risk assessment and mitigation.
- L/R site surveys.
- Class III/V and assembly area site surveys.
- Convoy risk assessment and safety briefs.
- UA accident and incident investigations in accordance with (IAW) Army regulation (AR) 385-40.

UNMANNED AIRCRAFT SYSTEM OPERATIONS TECHNICIAN

1-18. The UAS operations technician (MOS 150U) analyzes UAS mission requirements and determines necessary payloads. The operations technician maintains detailed knowledge of airspace requirements to plan missions. MOS 150U applies to all UAS warrant officers regardless of aircraft training/qualifications. Additional duties/responsibilities include—

- Integrating UAS into collection plans.
- Conducting detailed analysis of UAS information for integration into all-source intelligence products.
- Analyzing information to cue other collection assets.
- Coordinating dynamic retasking of UAS.
- Coordinating dissemination of UAS products.
- Coordinating UAS airspace and frequency requirements.
- Developing, implementing, and supervising the UAS standardization, maintenance, and safety programs.
- Establishing and maintaining an ATP.
- Conducting tactical mission planning and air-to-ground integration.
- Acting as a liaison at all command levels for UAS missions.

MISSION COMMANDER

1-19. The MC is a leadership position and not a crew duty assignment. MC responsibilities include, but are not limited to,—

- Mission planning, briefing, and execution.
- Ensuring all ground and flight operations are safely conducted.
- Coordinating airspace and frequency deconfliction.
- Coordination with the crew and all supported units.

1-20. The MC must be prepared to make critical decisions throughout mission planning, briefing, and execution. The MC must possess a thorough understanding of UAS operations, capabilities, and the process in which a mission is executed while coordinating with unit, battalion, brigade and division staffs. The MC must also know the ground tactical plan and possible mission contingencies.

UNMANNED AIRCRAFT OPERATOR

1-21. The unmanned aircraft operator is responsible for the safe operation of the UA. He must be tactically and technically proficient in the unit mission essential task list. The unmanned aircraft operator pre-flights, launches, recovers, post-flights, and performs operator-level maintenance actions on the UAS. He is responsible for both the UA and sensor. The unmanned aircraft operator controls and/or monitors the actual flight of the UA from a GCS, PGCS, or similar device. This is normally done through the use of a monitor and not by direct visual contact with the UA.

MISSION PAYLOAD OPERATOR

1-22. The mission Payload Operator (PO) is responsible for the operation of the payload to include weapons and sensors. The POs employing weapons systems will be qualified and current according to U.S. Army directives.

CREW CHIEF

1-23. The crew chief is a ground crewmember who is required to perform duties essential to the flight operations of a UAS. The crew chief is responsible for coordinating the actions of all ground crewmembers in the manner directed by the commander of the aircraft.

LESSONS FROM THE FIELD

Currently fielded Shadow platoons have conflict of interest in the manning of Technical Inspectors (TIs) in the line platoons. After fielding to the Aviation Brigade, we would suggest keeping all TIs in the Aviation Unit Maintenance (AVUM) QC section. As Infantry Brigades deploy, the TIs can work out who goes with which IBCT and maintain their rating schemes with the AVUM. This will greatly alleviate the current existing conflict of interest.

EXPLOITATION CELL

1-24. The exploitation cell should consist of two imagery analysts for immediate exploitation of imagery. This team would provide the following benefits:

- Timely effort of Analyzing, Assessing, Disseminating, Planning, Preparing, Collecting, and Producing products to supplement the war-fighter.
- Ability to collect, record, and store intelligence to prevent contamination and ensure strict chain of custody from point of capture.
- Provide crucial information related to mission requirements and Soldier safety through imagery and video analysis.

ADDITIONAL CONSIDERATIONS

1-25. Additional Considerations: The following should be considered in building the Shadow Troop manning package:

a. **Aviation Integration and Officer Professional Development**: The Platoon Leaders approved for a Shadow platoon are Chief Warrant Officer Three (CW3) officers. The unit should consider placing the CW3s in the Troop Standardization and Safety positions and fielding the Platoon Leader positions to OH-58D Lieutenants and junior Captains. This will aid in growing mature officers with a strong awareness of UAS operations, as well as further integrate the aviation mentality into the Shadow program.

c. **Aircrew Training Program (ATP) Relationship**: The Troop leadership maintains a standardization and safety relationship with all Shadow platoons in the Division. The Shadow Troop commander is the ATP Commander for all Shadow operators in the division. The Troop Safety and Standardization officers will help maintain the Aviation Safety program and individual flight records for all Shadow operators. They will conduct flight record and safety inspections as well as mentor the Shadow platoon leadership.

Chapter 2

Command, Control, and Communication

Efficient command and control of an organic ARS Shadow Troop will rely heavily on knowledge of the Shadow's full capability and the ability for the Shadow operator to communicate directly with commanders at all levels. As an extension to the OH-58D, the Shadow will aid in clearing enemy territory prior to reconnaissance and security missions only if the manned aviation assets can communicate directly with the UAS operator. Additionally, the commander must set a clear priority for the UAS effort and ensure command, control, and communication of the UAS supports their effort.

> *UAS on the battlefield are significant combat multipliers that enhance our situational awareness, improve combat effectiveness, and save Soldiers lives.*
>
> **GEN Richard H. Cody**
> **Vice Chief of Staff of the Army, July 2008**

The UAS extends the sensor to shooter link and provides NRT battlefield information. This chapter pulls heavily from FM 3-04.155 Army UAS Operations. Minor changes were made to specifically address the Shadow UAS employed in the ARS squadron.

SECTION I – COMMAND

2-1. The commander provides his staff with a clear intent for employing all available UAS, to include:

- Priority of support.
- Weapons release authority.
- Dynamic re-tasking criteria.
- Priority of UA access to OSRVT-equipped units.
- C2 support priorities.

COMBAT AVIATION BRIGADE

2-2. The CAB commander is the division commander's senior advisor for employment of aviation assets. The CAB commander and staff are the primary integrators of manned and unmanned aviation operations. They provide expertise, technical knowledge, and aviation experience integrating aviation operations into the division commander's scheme of maneuver. The CAB plans and executes UAS operations in coordination with the division staff, Fires Brigade, BFSB, and BCT.

2-3. Recent operations have led to the consolidation of IBCT TUAS platoons under CAB C2. This task organization has resulted in increased efficiencies in mission support, maintenance, and safety. A clear understanding of mission support and tasking authority for IBCT TUAS consolidated under the CAB must be achieved to enable effective UAS operations. This consolidation will be a minimum of ATP relationship between the Shadow Troop commander and the IBCT Shadows.

ATTACK RECONNAISSANCE SQUADRON

2-4. The ARS commander is the subject matter expert and the brigade commander's senior advisor for the employment of the Shadow TUAS. They provide expertise and technical knowledge in the employment of the RQ-7B Shadow TUAS. The ARS plans and executes mixed SWT/Shadow teams and autonomous Shadow reconnaissance missions in coordination with the aviation brigade to support the Ground Force Commander's scheme of maneuver. This will be a

combination of direct support missions, general support missions, and organically tailored reconnaissance missions.

> **LESSONS FROM THE FIELD**
>
> We maintained a Scan-Eagle program that conducted missions directly for the Division Intelligence, Surveillance, and Reconnaissance (ISR) team. When not specifically employed or when target decks were completed early, we organically chose targets for observation and reconnaissance. The key take away from this program: the operator is the primary observer and needs to maintain the reconnaissance mind-set throughout the entire mission set, regardless of mission origin.

DIVISION AREA OF OPERATIONS

2-5. A large division area of operation, complex terrain operations, and a noncontiguous environment place greater demands on organic RSTA/ISR assets. UAS employment in this environment requires careful synchronization. All activities must be orchestrated and fused at the division current operations integration cell (COIC) to maximize UAS capabilities.

ONE SYSTEM GROUND CONTROL STATION POSITIONING

2-6. OSGCS positioning is critical to successful employment of UAS. The OSGCS provides the technical means to receive UA sensor data. The unmanned aircraft operator, PO, and MC assigned to the OSGCS provide tactical and technical expertise to facilitate UAS operations. The CAB commander advises the division commander on placement of this critical UAS component to maximize its effectiveness. The CAB, BFSB, Fires brigade, and BCT conduct disparate missions simultaneously across the division area of operation, with different TTP, focus, and skill sets required. This requires integration of overall aviation operations at division-level to avoid redundancy of effort. An additional consideration is the Shadow platoons in the IBCT BSTBs and the OSGCSs that remain in their control. With a cohesive ATP relationship built between the IBCT Shadow platoons and the ARS Shadow Troop, direct support missions to the IBCT in an extended range environment can be controlled by the IBCT Shadow operators, POs, and MCs.

Single-Site Operations

2-7. In single-site operations, the entire UAS unit is co-located. Single-site operations allow for easier unit command, control, communication, and logistics. Coordination with the supported unit may be more difficult due to distance from and communications with the supported unit. In addition, single-site operations emit a greater electronic and physical signature.

Split-Site Operations

2-8. In split-site operations, the UAS element is typically split into two distinct sites: the mission planning control site (MPCS) and the L/R site. The MPCS is normally located at the supported unit's main or tactical CP location. The L/R site is normally located in more secure area, positioned to best support operations.

2-9. The IBCT Shadow platoons should also consider consolidating launch-recovery with the ARS Shadow Troop in order to receive the additional benefits of the ARSs large logistical footprint. The IBCT Shadow platoons can focus directly on the MPCS with forward-staged GCSs.

> **LESSONS FROM THE FIELD**
>
> In Camp Taji, Iraq, a single launch and recovery site was developed to launch four Shadow TUAS platoons during the surge in Baghdad. The platoons were able to share assets which resulted in significant increases in the amount coverage, playtime for the ground commander, and surge capabilities. We suggest even considering consolidating with the IBCT Shadows to allow these capabilities to the entire division.

Mission Planning and Control Site

2-10. The MPCS consists of the OSGCS, OSGCS personnel, and supporting equipment. The MPCS receives the tasking, plans the mission, takes control of the Shadow UA after launch for mission execution, and reports information. The MPCS releases control of the UA for recovery.

Launch and Recovery Site

2-11. The L/R site consists of UA, L/R systems, OSGCS, maintenance equipment, GSE, and supporting personnel. The L/R site receives the mission from the MPCS, then prepares and launches the UA. After the UA has reached a predetermined altitude, the OSGCS operator at the MPCS assumes control of the Shadow UA. For recovery of the UA, this process is reversed. When selecting the L/R site, units should consider—

- Distance and LOS to possible target areas.
- Adequate space for system L/R or engineer support.
- Sufficient obstacle clearance to conduct takeoffs and landings.
- Avoiding areas with high population densities, multiple high power lines, and high concentrations of communications equipment and transmitters, as these may interfere with UA control.
- Proximity to the MPCS to support effective communications and UAS control.
- Site selection incorporating operations security considerations to reduce the possibility of detection and destruction by enemy forces.
- Impact of local manned aircraft operations.
- Positioning of GSE to accommodate network and power cables while considering noise abatement and security.

2-12. One primary limitation of the IBCT Shadow platoons is the MTOE of only one launcher system. Consolidating IBCT Shadow platoons within the Shadow Troop footprint allows platoons to share low-density pieces of equipment as well as manning to cover 24-hour operations.

LESSONS FROM THE FIELD

Facilities planning: A detailed effort is required to "download" all of the electronics equipment to a more suitable Ground Control Station environment. Therefore, most facilities tailor specifically to keeping the GCS operating as built. Generally, this means backing up a HMMWV up to a building that houses the mission coordinator and exploitation cell. This keeps the team centrally located and in constant communication with one another, but precludes the requirement to download all of the equipment.

SECTION II – CONTROL

2-13. Control of forces and functions helps commanders and staff compute requirements, allocate means, and integrate efforts. Control permits commanders to acquire and apply means to accomplish their intent and develop specific instructions from general guidance.

2-14. The critical aspect of TUAS control is the requirement for ARS battle staff officers and NCOs to integrate TUAS with maneuver and/or intelligence efforts for both current and future operations. Communications between the battle staff and TUAS MC must be open and frequent, particularly during dynamic retasking and weapons employment.

2-15. To support tactical RSTA operations in NRT, information must flow rapidly between UAS and the supported unit. Locating an OSGCS near the CP, or employing an OSRVT at the point of decision, facilitates this rapid information flow. For example, OSGCS information distributed to the all source analysis system (ASAS) remote workstation meets the intelligence analyst's requirements for immediate battlefield intelligence and transmission of data for long-term analysis and exploitation. The advanced field artillery tactical data system (AFATDS) operator may use this information for immediate target engagement or future target development. The OSRVT supports decision making at the point of decision, and facilitates coordination between the OSRVT operator and CP to ensure synchronized operations.

SHADOW TUAS CONTROL METHOD

DIRECT UNMANNED AIRCRAFT CONTROL

2-16. Direct UA control involves an OSGCS controlling a UA with a LOS downlink to the UAS LOS limit (figure 2-1). The limit for the Shadow UAS is 120 km. The UAS OSGCS conducts all operations; from take-off, through mission execution, to landing; or receives the UA from another OSGCS responsible for L/R of the UA.

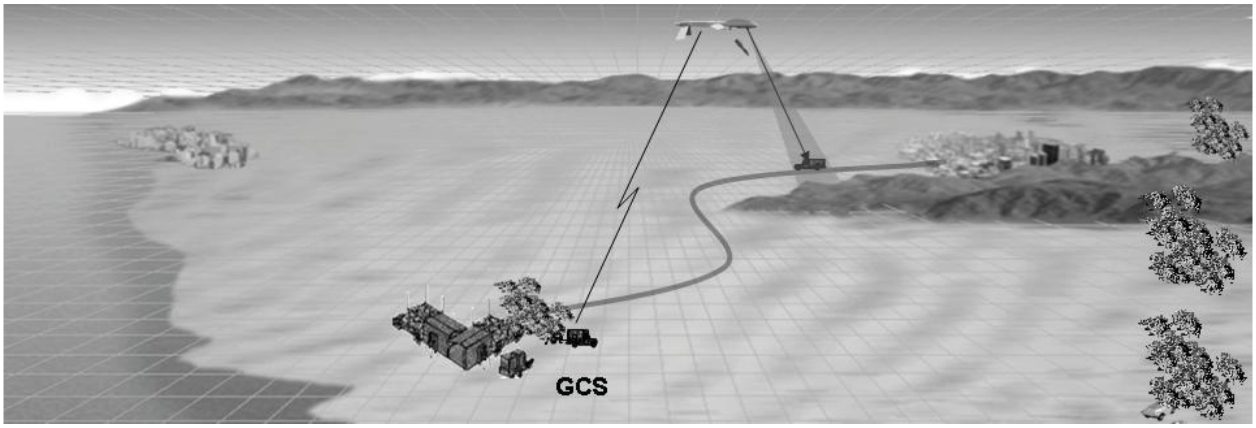


Figure 2-1. Direct unmanned aircraft control

AERIAL DATA RELAY

2-16. Aerial data relay does not apply to the Shadow UAS.

SATELLITE UPLINK CONTROL OF UNMANNED AIRCRAFT

2-17. Satellite uplink control does not apply to the Shadow UAS.

LEVELS OF INTEROPERABILITY

2-18. Levels of interoperability (LOIs) define how UAS interface with supported units during operations. Familiarity and application of LOIs, during mission planning, prepare units to integrate UAS into future operations. Army units interact with the UAS using one of the LOI. Current hardware/software constraints preclude the ability to fully utilize all levels. The AH-64D upgrade (Block III) is scheduled to provide LOI 4 capability. OSRVT currently provides units with LOI 2 capability; LOI 3-5 are not currently available for the Shadow TUAS.

LEVEL 1

2-19. LOI 1(figure 2-4, page 2-6) is the receipt and display of UAS derived imagery or data without direct interaction with the UA. Imagery and data is received through established communications channels, most often from the OSGCS controlling the UA. LOI 1 requires OSGCS connectivity with the global broadcast system (GBS), digital video broadcasting-return channel via satellite FMV, common ground station, ABCS, or other similar systems.

- In figure 2-4 the troops in contact (TIC) cannot receive video from UAS.
- The OSGCS receives video or SAR/GMTI imagery. The information is then distributed to the CP through a network for further distribution, development, and exploitation.
- UA data passes from one CP to another for increased SA.

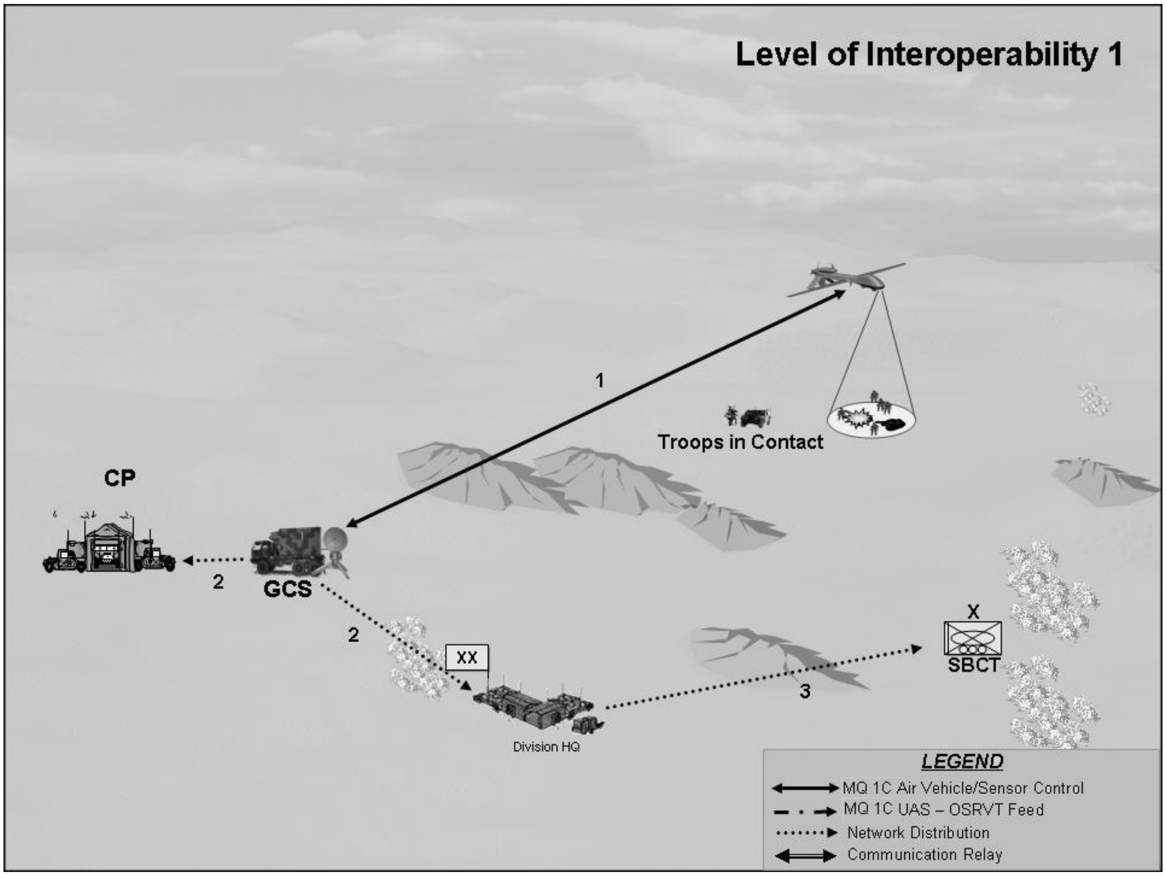


Figure 2-4. Level of interoperability-1

LEVEL 2

2-20. LOI 2 (figure 2-5, page 2-8) is the receipt and display of imagery and data received directly from the UA to the supported element. The Shadow's CRP enables the supported unit to communicate sensor movement and adjustment requirements to the OSGCS operator during operations. LOI 2 requires that a system (OSGCS or OSRVT) directly receive video or other data from the UA for use by the support unit. At a minimum, LOI 2 operations require a UA-specific data link and compatible LOS antenna to receive imagery and telemetry directly from the UA.

- TIC, with an OSRVT, can receive video imagery from UAS. Shadow CRP enables direct coordination between TIC and OSGCS operators.
- The OSGCS receives video or SAR/GMTI imagery. The information is then distributed to CP through a network for further development/exploitation.
- The adjacent CP receives video from UAS through the OSRVT and/or network for increased SA.

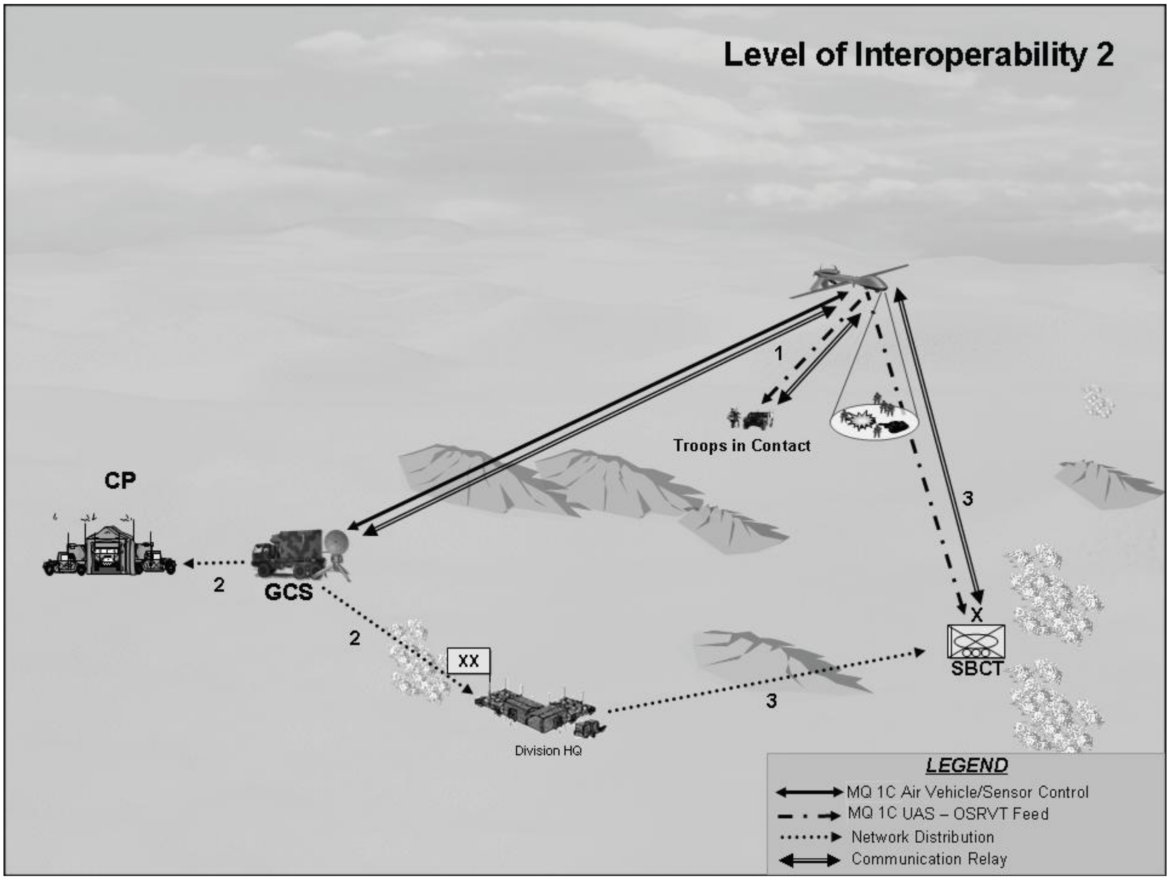


Figure 2-5. Level of interoperability-2

LEVEL 3-5

2-21. The Shadow UAS does not currently support LOI 3, 4, or 5 (for more information on these levels see TM 3-04.155 Army UAS Operations).

MISSION PLANNING

2-22. UAS mission planning is the same as manned aviation. However, the mission planning for the UAS pure teams begins in the S2 Intelligence Shop on the Squadron Staff before going to the S3 Operations section. Following Squadron staff planning, the mission is pushed to the Troop for continued planning.

MISSION

2-23. UAS capabilities and limitations determine which system (Shadow or OH-58D) is used for mission accomplishment. The supported unit, division G-3/COIC, or ARS S3/S2 section provides mission requirements to the Shadow Troop. Providing only target lists or "target decks" to sequence UAS operations does not provide the supporting unit the necessary amount of information required to integrate UAS effectively. Essential mission planning information for Shadow operations is listed below. Adequate pre-planning, synchronization, and coordination of UAS operations reduces the amount of no-notice, unplanned, dynamic retaskings and results in more effective utilization of the UAS with greater endurance of the UA. Preplanned UAS operations should be included in the ATO/ACO cycle.

2-24. The UAS mission order includes—

- UAS unit AO.
- Mission statement/commander's intent.
- Mission time window.
- Task organization.
- Reconnaissance objective.
- PIR/intelligence requirements.
- NAI/tactical areas of interest (TAIs).
- Routes.
- Fire support coordinating measures (FSCMs)/ACMs.
- Communications and logistics support.
- Restricted operations area (ROA)/restricted operations zone (ROZ).
- Altitudes.
- Weapons release authority.
- Laser codes.

ENEMY

2-25. UAS will operate in close proximity to heavily defended areas. They will be subject to hostile air defenses that may include full range of anti-aircraft systems (conventional small arms, automatic antiaircraft weapons, man-portable air defense [AD], and crew-served systems) using radar, optics, and electro-optics for detection, tracking, and engagement. The threat includes launcher-mounted surface-to-air missiles; air-to-air weapons launched by fixed-wing (FW) aircraft, helicopters, and counter-UAS UA; anti-radiation missiles; and directed energy weapons. Long-range acquisition systems provide early warning and cueing for shorter-range kill systems. UAS may be subjected to offensive EW, computer network attacks, computer network exploitation, and signal intelligence exploitation.

TERRAIN AND WEATHER

2-26. Both natural and man-made features limit sensor effectiveness and C2. Flat terrain eases LOS issues; while mountainous terrain may reduce UA range.

2-27. AR 95-23 and unit standing operating procedures (SOPs) set minimum weather conditions stated as ceiling and visibility, for UAS operations. Weather conditions must be at or above these minimums while the aircraft is flying and over the entire mission area in which they are operating, unless the appropriate approval authority waives or approves deviation due to criticality of a specific combat operation.

2-28. Weather effects on UA platforms include take-off and landing limitations, en route considerations, and weather impact within the proposed mission area. Additional consideration must be given to the impact weather will have on the planned sensor operations. Commands anticipating UAS support for wartime contingencies or exercises must research the AO for data on meteorological trends. This information provides a method for anticipating UAS coverage.

Temperature, Precipitation, and Winds

2-29. Temperature, precipitation, and winds reduce the operating parameters of the Shadow; however, icing conditions present a major dilemma. When the Shadow is operating in temperatures within five degrees Celsius of freezing and in visible moisture, ice develops on the wings and fuselage, increasing drag and weight. When the operator notes the first effects of icing, he will maneuver the UA out of the icing environment.

2-30. The Shadow can operate in light rain (.2 inches/hour). Depending on mission payload, light rain may degrade the quality of Shadow imagery. Precipitation does not drastically degrade operations at an OSGCS; however, protection of portable systems exposed to the elements may be required. Commanders must closely monitor the L/R site to confirm runways/landing areas are suitable for Shadow operations. Other considerations include—

- Crosswinds in excess Shadow limitations create dangerous conditions for takeoff and landing.
- High winds at operating altitudes may create dangerous flying conditions.

Fog and Low Clouds

2-31. Fog and low cloud ceilings reduce the effectiveness of visual mission payloads. The IR camera image is degraded by thin obscurations (dust and light fog), but cannot penetrate heavy fog or clouds. To collect needed exploitable imagery, the Shadow must fly lower, increasing potential for detection and exposure to enemy AD systems. In addition, fog at the L/R site reduces visual cues necessary to execute a safe landing. This could impact the Shadow's ability to respond to mission requirements if an alternate landing site is not available.

LESSONS FROM THE FIELD

Many of the limitations that deal with moisture apply most noticeably to take off. At the same time every evening, the humidity in the air caused us to cancel our launches. By adjusting our take-off slightly earlier, we were able to take-off and fly the entire mission while still remaining within aircraft limits.

Lightning and Thunderstorms

2-32. The presence of lightning and thunderstorms at the L/R site or within the flight area pose significant risks to both the operators and the Shadow. Wind, heavy precipitation, icing, and lightning within thunderstorms significantly reduce the combat effectiveness of UAS. The Shadow should not be intentionally flown into thunderstorms.

TROOPS AND SUPPORT AVAILABLE

2-33. As with all aviation assets, early and detailed Shadow employment planning is critical to mission success. Cross-echelon integration of all UAS supporting tactical operations maximizes the effectiveness of this limited asset.

TIME AVAILABLE

2-34. Time considerations are critical when planning for longer range Shadow missions, such as—

- Positioning L/R site to reduce en route times.
- Early planning for OSGCS positioning.

CIVIL CONSIDERATIONS

2-35. Tactical-level civil considerations focus on the immediate impact of civilians on current operations; however, they also consider larger, long-term diplomatic, economic, and information issues. Civilian air traffic may become a central consideration of planning.

KEY PLANNING PARTICIPANTS

2-36. UAS mission planning requires multi-echelon participation. Key planners include—

- **G-3/Operations staff officer (S-3)**. Integrates overall division and brigade-level UAS assets to meet the commander's scheme of maneuver.
- **G-2/Intelligence staff officer (S-2)**. Develops and coordinates PIR. Integrates intelligence requirements with the G-3/S-3 to ensure maximized UAS employment.
- **CAB commander and staff**. Serves as the division commander's UAS subject matter expert (SME).
- **ARS commander and staff**. Serves as the brigade commander's UAS SME. Conducts UAS Mission planning for division and organic missions.

- **Shadow Troop commander and platoon leader**. Conducts UAS mission planning and provides tactical and technical input to commanders at all echelons.
- **Shadow MC/technician**. Provides technical and tactical UAS expertise, and conducts troop leading procedures (TLP) and missions.
- **ADAM/BAE cell**. Plans, coordinates, and executes brigade airspace requirements.
- **AC2 cell**. Plans, coordinates, and executes division airspace requirements.

BRIGADE AND BELOW TASKING AND PLANNING

2-37. For most operations, the Shadow unit will integrate with a higher command echelon. The CAB S-3 synchronizes aviation operations into the scheme of maneuver. The Shadow Troop will frequently team with manned systems during ground maneuver and fire support (FS) operations. UAS mission planners must be familiar with operations across the brigade AO to effectively anticipate mission requirements.

2-38. The S-2, in conjunction with the S-3, develops NAI/TAI to focus collection efforts. UAS' inherent range and endurance expands the brigade's footprint for targeting and early warning.

SHADOW TROOP PLANNING PROCESS

2-39. The company commander receives valid requirements from the supported unit, usually in the form of a warning order (WARNO) or operation order (OPORD). He begins initial planning according to TLP (table 2-2).

Tasking Management Responsibilities Matrix		
	Troop Commander	***Mission Coordinator***
Receive and Analyze the Mission	Receive WARNO or OPORD. Analyze the mission. Determine payload requirement. Determine crew availability and fighter management. Determine aircraft availability.	N/A
Issue the WARNO	Issue DA Form 5484, Mission/Schedule Brief. Request ACMs, as necessary. Submit schedule for ATO, as necessary.	N/A
Make a Tentative Plan	Macro-plan mission (transit flight time for split-site or split-base, set-up time for communication relay mission).	N/A
Initiate Movement	Issue fragmentary order (FRAGO) to MC.	Initiate preflight of aircraft.
Conduct Reconnaissance (Receive and Analyze the Mission Revisited)	Receive and validate NAI/TAI of the ISR plan. Attend targeting workgroup, as necessary. Attend combined arms brief, as necessary. Attend supported unit OPORD, as necessary.	Receive validated NAI/TAI of the ISR plan. Receive operational graphics, as necessary. Download ATO and ACO (weekly master, daily, and changes), as necessary. Review notices to airman (NOTAMs), as necessary.
Complete the Plan	Develop prioritized target list. Develop operations schedule. Direct mission planning.	Complete mission planning.
Issue the Order	Brief MC and crew. Assign risk assessment value (RAV).	Conduct air mission brief.
Supervise and Refine	Update mission tasking status. Coordinate changes with supported unit(s)/agency(ies). Verify mission objectives are accomplished.	Update system tasking status. Conduct direct coordination with supported unit.

2-40. NAI/TAI List. The list is compiled by the exploitation cell with the aid of the Shadow operators. The components include—

- Name.

- Physical description to aid in acquisition.
- Location in eight-digit military grid reference system (MGRS).
- Mission statement.
- Desired endstate/effect.
- Reporting instructions.

LESSONS FROM THE FIELD

The Shadow can be employed autonomously or employed as part of a Manned-Unmanned Reconnaissance Team (MURT). When employed autonomously, the missions should be fully integrated into the S2 section for mission planning and control. This is the most common current TTP as a result of limited integration of the Shadow into the OH-58D teams. We suggest the Shadows that are employed entirely as a member of a MURT should be fully integrated into the S3 section with standard S2 briefings before the mission. The MURT Shadow operators will prepare for the mission the same as the OH-58D pilots.

FLIGHT PREPARATION

2-41. The MC receives a mission briefing and FRAGO from the commander or platoon leader, and prepares a tactical flight plan. The MC builds a flight plan around mission requirements and coordinates airspace through the ADAM/BAE cell or other AC2 organization.

POST MISSION ACTIONS

2-42. Accurate BDA is a key factor in determining mission success. BDA assessment focuses on target effects, intelligence gathered, and what was/was not successful during the mission.

2-43. An after-action review (AAR) enables units to identify for themselves what happened, why it happened, and how to sustain strengths and improve on weaknesses. The AAR—

- Reviews the mission as briefed.
- Determines what happened.
- Identifies actions to sustain and improve.
- Determines what should be done differently.

SUSTAINED OPERATIONS (FIGHTER MANAGEMENT)

2-44. AR 95-23 and local policy establish limits on crew duty days. The commander establishes an SOP governing fighter management.

LESSONS FROM THE FIELD

The Shadow operators will fall under the CAB fighter management policy. The fighter management is a program tailored specifically to preventing accidents due to chronic and acute fatigue for aviation operations. We also suggest that heavy consideration should be made to applying this same fighter management policy to the IBCT Shadow platoons as a means of prolonging combat power and decreasing the mission downtime due to human error.

RULES OF ENGAGEMENT

2-45. Rules of engagement (ROE) specify circumstances and limitations under which forces initiate and/or continue combat engagement with other forces encountered. U.S. forces comply with command established ROE. Many factors influence ROE; including national command policy, mission, operational environment, commander’s intent, and international agreements regulating conduct. ROE recognize the inherent right of unit and individual self-defense. Properly developed ROE are clear, situation dependent, reviewed for legal sufficiency, and included in training.

2-46. The Shadow Troop commander ensures that the IBCT Shadow Platoons receive the ROE training from the ARS. The ROE training should be incorporated into the academic standardization training.

SUPPORTING FIRES

2-47. The supported unit frequently has access to indirect fires from a coordinated fires network. These complementary fires may facilitate movement to the objective area through joint suppression of enemy air defenses, engage targets bypassed by UA, or provide indirect fires on the objective. Knowing what and when FS is available are important considerations during UAS mission planning and engagement area development. Efforts to coordinate joint fires for actions on the objective could be critical toward success for interdiction operations. With the application of a laser rangefinder/designator (LRF/D) on UAS mission equipment packages, coordination of supporting fires will become a routine part of UAS pre-mission planning.

ADDITIONAL UNMANNED AIRCRAFT CONSIDERATIONS

ALTITUDE

2-49. Assignment of the UA operating altitude should balance the need for adequate sensor resolution, detection avoidance, threat avoidance, and aircraft de-confliction. During winter months, the humidity and freezing level play a large factor in choosing higher altitudes. Typically, the Shadow UAS looks for an altitude between 3,500' and 7,000' to balance noise reduction, sensor resolution, and aircraft de-confliction.

AIRSPEED

2-50. UAS planners must consider the impact of UAS low airspeeds. Low airspeeds result in increased loiter time, but limit the commander's flexibility to dynamically re-task the system across long distances. The Shadow can increase speed to 100 KIAS in order to reach a target area in shorter time, but caution must be used in regards to decreased station time and increased engine temperatures.

UNMANNED AIRCRAFT SYSTEM SURVIVABILITY

2-51. TUAS internal combustion propulsion systems create a distinctive noise signature. TUAS operating at mission altitude may be detected from the ground. Mission planners must consider this aural signature when deciding which UAS conducts a mission.

2-52. TUAS create a limited visual signature when operating at mission altitude. They have a relatively small IR signature, making them less vulnerable to surface-to-air and air-to-air defense systems engagement. They are susceptible to radar-guided anti-aircraft artillery, man-portable systems, and small-arms fire. Their vulnerability is decreased by tactics that recognize these limitations (loitering for short periods over a particular location).

PRECISION TARGETING

2-53. The Shadow POP-300 L/D provides 10-digit UTM grid coordinates for use by the ground commander. The L/D also provides coded-laser energy for remote Hellfire engagements fired from other aircraft.

ONE SYSTEM REMOTE VIDEO TERMINAL

2-54. OSRVT is a small, portable receiver and display system integrating live video and telemetry data from an array of UAS (MQ-1C, Shadow, Predator, Raven, Pioneer, and Hunter) and manned aircraft using Lightning Pod. The Shadow video feed to the OSRVT includes embedded geo-location information. This data provides map-referenced icons and symbology to the user. The OSRVT receives only LOS feed from the UA. It does not receive SAR/GMTI imagery. Projected OSRVT fielding includes units at all echelons, from corps to company level. The OSRVT provides targeting information directly to the unit's organic and direct support heavy weapons, as well as supporting artillery and close air support (CAS) assets. Current OSRVT capabilities are limited to video downlink from the supporting UA. Planned improvements to OSRVT include software upgrades that support LOI 1 through LOI 3.

2-55. Future OSRVT capability will provide supported units with the ability to directly control the UA sensor. The Shadow communications relay package provides a direct link between the supported unit and the OSGCS operator significantly improving "sensor to shooter" response time.

UNMANNED AIRCRAFT SYSTEM REQUEST PROCEDURES

PREPLANNED

2-56. Pre-planned requests are received prior to the new ATO execution cycle. UAS support should be requested in the same manner as manned aviation (figure 2-10). TUAS support appears on the ATO/ACO. Unfilled UAS requests are forwarded to the next echelon for consideration and tasking. Airspace coordination parallels the request process to ensure a comprehensive air picture. After the ATO is published (typically 12 hours prior to its execution), UAS requests are processed as immediate requests.

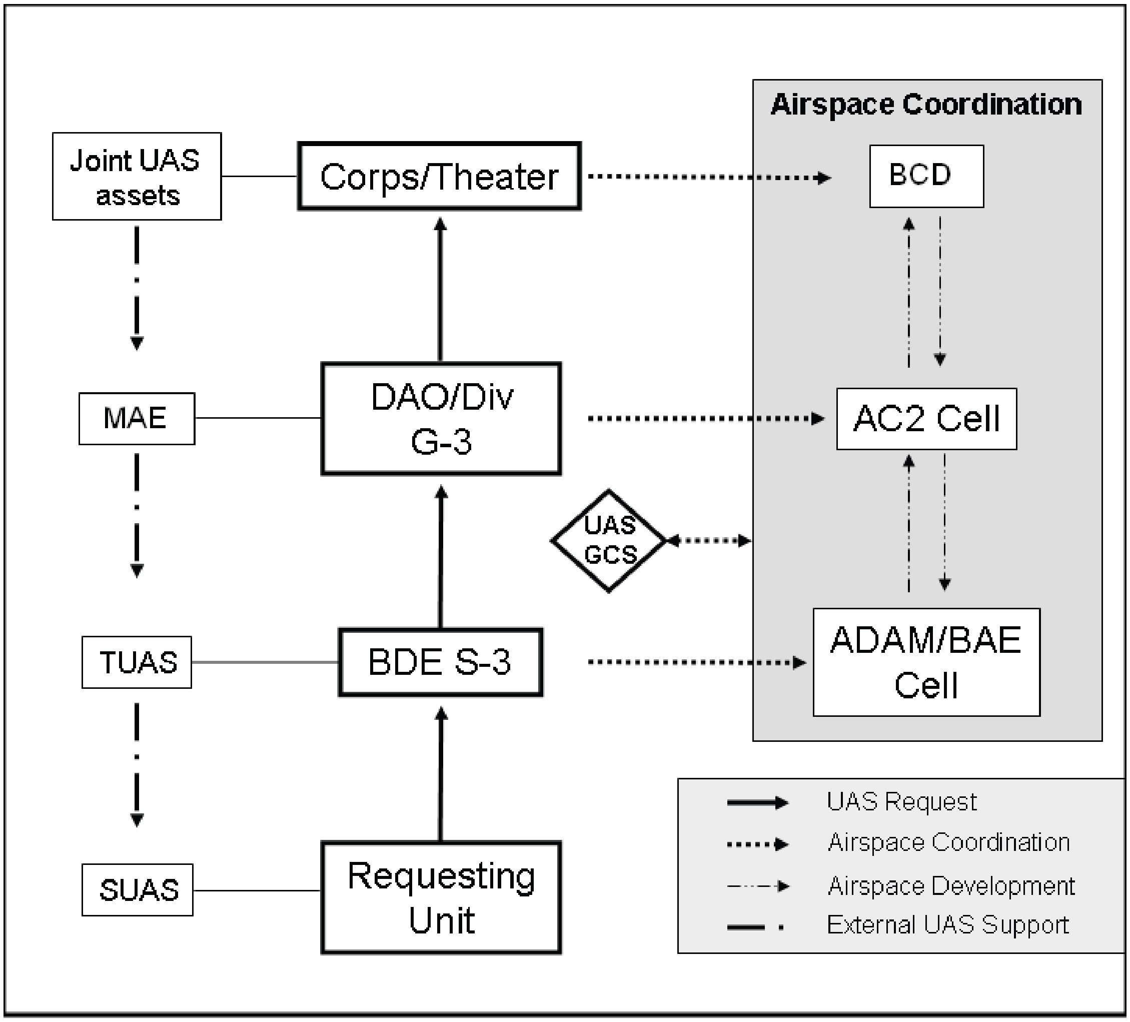


Figure 2-10. Pre-planned request procedures

IMMEDIATE

2-57. Typically, immediate requests are submitted outside the normal ATO cycle. Immediate requests are expedited through multiple-use internet relay chat, email, telephone, or radio, as required. The G-3 forwards unfilled requests if organic assets are not available.

DYNAMIC RETASKING

2-58. Dynamic retaskings divert a UA from an existing mission to a new target. Dynamic retasking requires a rapid decision based on previously published criteria. Clearly defined priorities must be published to facilitate effective coordination of an emerging tactical situation (TIC or high pay-off target [HPT]). The re-tasking authority will be the same as a re-tasking for an SWT in the ARS. Depending on the operation, the ARS Battle Staff Officer will request immediate re-tasking for Shadow TUAS through the Brigade and supported units based on pre-briefed criteria. Upon completion of dynamic retasking, the UA resumes the preplanned mission. The minimum information required to begin dynamic re-task planning includes—

- Priority of use.
- Call sign.
- Routing.

- ACMs.
- Required altitude.
- Weapons considerations.

IMMEDIATE CRP REQUEST

2-59. Units can push the Shadow internal frequency and communicate directly to the Shadow operator for use of the communications relay package. The limiting factor is the loaded frequency list. The Harris radios have no method of changing channel in flight. Therefore, all Battalion TOC frequencies should be loaded on a common mission set. Units will have the ability at any time to relay through the Shadow's Harris radios back to their battalion headquarters.

Mission Change Contingency Planning

2-60. Mission change after launch is possible with TUAS, due to their long duration flight characteristics and the nature of RSTA operations. UAS planners and supported units should prepare by creating contingency plans and ensuring appropriate airspace, mission, and operational coordination is considered. Contingency planning may be necessary due to:

- Changes in the AO or dynamics of the operation.
- Changes to commander's scheme of maneuver or timeline.
- L/R area or mission-area weather.
- Airspace deconfliction.

2-61. A mission change during flight requires the UAS MC to validate the request/requirement based on:

- Asset availability and capability (remaining station time and/or on-board munitions).
- Time sensitive/criticality (En route time).
- Impact on current mission (Current mission priority).
- Airspace coordination/deconfliction.
- C2 support available.

2-62. The Shadow Troop briefs the supported commander/staff on the mission and considerations, and then presents a tentative plan detailing the change.

AIRSPACE CONTROL

2-63. Airspace deconfliction is a major consideration during any UAS operation. Airspace control prevents mutual interference for all users of the airspace; facilitates AD identification; and accommodates the safe flow of all air traffic. Airspace control increases combat effectiveness by promoting safe, efficient, and flexible use of airspace with a minimum of restraint placed on friendly airspace users. Airspace control includes coordinating, integrating, and regulating airspace through positive and procedural controls to increase effectiveness at all levels of war. UAS pose a significant challenge due to their small size, agility, and increasing density, as well as their limited ability to detect, see, and avoid other aircraft. Detailed airspace C2 considerations are addressed in appendix B of FM 3-04.155.

2-64. Basic techniques for deconflicting UAS operations are—

- Altitude separation.
- Geographical separation, typically by keeping the UA to one side of a feature such as a road or river.
- Time separation or moving the UA out of the objective area before aircraft or ordnance arrives.
- A ROZ or track that confines the UA to a specific region of the airspace.
- Separation through the use of a common grid reference system (CGRS) and key pads.
- Kill boxes.

2-65. The number of UAS in the operational environment will grow each year. Planned airspace for UAS must be included in the ACO, and UAS requirements should be part of the theater airspace control plan. All UAS missions must be coordinated with the appropriate C2 agency prior to launch, ensuring effective integration and deconfliction with other airspace users. UAS missions should be coordinated with the Airspace Control Authority (ACA), area air defense commander, and joint force air component commander (JFACC) to separate UA safely from manned aircraft and to prevent engagement by friendly AD systems.

2-66. Some UAS are equipped with a CRP that enables direct communication between the UAS operator and the controlling airspace agency. For UAS not equipped with this direct communication capability, procedural ACMs are a critical planning consideration. UAS missions; changes in L/R site locations; UA altitudes; operating areas; identification, friend, or foe (IFF) squawks; and check-in frequencies are reflected in the daily ATO, ACO, or special instructions (SPINS) and disseminated to appropriate aviation and ground units.

2-67. Planners monitor current UAS airspace requirements to anticipate future airspace requirements based on the emerging tactical situation. Changes in allocation of CAS, artillery, Army aviation, and the dynamic retasking of UAS will cause conflicts in airspace use. To address these changes, the supported unit should have a periodic AC2 meeting with all key personnel involved (BAE, S-3, fire support coordinator, air liaison officer) to address these issues.

> **LESSONS FROM THE FIELD**
>
> The differences between types of control may allow much more freedom to the Shadow operators in a combat environment. Generally, they stay under positive control above the coordinating altitude. However, a MURT may be able to maintain positive control of all three aircraft (two OH-58Ds and one Shadow) while maintaining one set of radio transmissions to flight following. Additionally, the Shadow would be able to descend below the coordinating altitude for better target acquisition in this scenario.

SECTION III – COMMUNICATION

2-68. Fundamental to combat operations is combat information reporting and exploiting. This information and the opportunities it presents are of interest to other maneuver units and higher headquarters staffs. Combat information reporting requires wide and rapid dissemination. Battalion elements frequently operate over long distances, wide fronts, and extended depths from their controlling headquarters. The Army communication system consists of three layers; terrestrial, aerial, and space-based systems.

2-69. The terrestrial layer includes the effects of terrain and environment. When LOS is interrupted between individual systems and units, terrestrial relays are used. Terrestrial relays are limited in their application due to their pre-planning requirements, immobility, need for physical security, and inability to be rapidly shifted in dynamic situations. In addition, these relays are LOS systems, and are limited in complex terrain and at extended distances. There are operational situations in which additional terrestrial relays are at increased risk, especially well forward in the area of operations. As unit areas of operation increase, the terrestrial layer becomes increasingly fragmented and both connectivity and capacity suffer.

2-70. The aerial layer is intended to be very responsive and can reduce the workload otherwise placed on the other layers. On-station or on-call aerial relays provide the commander tremendous flexibility to respond to the tactical situation. Aerial relays can transcend LOS challenges except in the most complex terrain. Even then, aerial relays provide enhanced connectivity over other options. Weather and enemy air defenses can limit aerial relay capability, and complicate flight safety and AC2.

2-71. The Shadow Troop plays an integral role in supporting the aerial communication at the tactical level. While other assets manage the complex operational and strategic communication through space-based communication, the Shadow has the ability to provide platoon and company level operations the ability to support communications over increased distances. Through the standard Shadow request procedures, units have the ability to augment their terrestrial communication network with aerial capabilities for limited duration during key operations.

> **LESSONS FROM THE FIELD**
>
> We maintained the communications relay net during any mission, regardless of routine ISR target decks conducted over mIRC or specific ground liaison missions. We did this to force the Shadow operators more practice in radio communications, as well as to provide a consistent emergency communications relay network in the event of isolated personnel.

COMMUNICATION INTEGRATION

2-72. OSGCS receive, process, and prepare imagery information from UA conducting operations. Dissemination of the sensor data and other payloads relies on a variety of systems. The specific dissemination method for UAS sensor data is contingent upon the UAS being employed, supported unit capabilities, and other theater considerations. For example, the flow of UAS data may be significantly limited due to network constraints during initial entry operations when compared to the networks in a mature theater. Additionally, the wide spread introduction of OSRVT will increase the availability of UAS sensor data across the force. Although voice communications systems are handy for quick coordination, the secret internet protocol router network has proven to be the system of choice for passing mission requests, targets, and mission summaries. OSGCS use local area network (LAN) cable for internal ground communications and SINCGARS, and mobile subscriber equipment (MSE) for external communications on the battlefield.

Decisions regarding methods used to pass mission payload data should reflect the quality required, distances, availability and priority of communication assets, and capabilities and locations of transmitter and receiver systems. The options may include—

- Microwave.
- OSRVT (must remain within UA distance parameters).
- T-1 line.
- Secret internet protocol router/non-secure internet protocol router LAN lines (high band width).
- Cable from second UAS control station.
- SATCOM (GBS).

STANDARDIZED COMMUNICATION

2-73. Clear, standardized communications procedures are critical to mission success and safety of ground forces operating in the vicinity of UAS operations. Table 2-3 lists terms that help standardize communication with the OSGCS operators.

LESSONS FROM THE FIELD

Standardized communication is a point of friction in the Shadow community, which results from lack of voice communication with the ground assets or manned aviation to date. As mentioned, to combat this, we maintained the communications relay throughout the breadth of their mission. In addition, our standardization officer worked with the operators to practice standard communications and "target talk-on"s. Beyond this, we suggest the integration of the Shadow operators fully into aviator academics to continue the unit specific communications standards.

Table 2-3. Terminology ***Term***	***Meaning***
Zoom (in/out)	Change the sensor's field of view (FOV).
Switch polarity	Change the IR camera from white hot to black hot or vice versa.
Capture	The object of interest has been located and is being tracked.
Terms to change the sensor orientation, leave the UA flight path unchanged	
Pan (left/right/up/down)	Move the sensor as indicated relative to the current image.
Slew (to position)	Move the sensor to the indicated position.
Reverse (to object)	Reverse the panning direction to an object previously seen.
Monitor (object)	Keep the indicated object in the sensor's FOV.
Terms to change the UA flight path, leave the sensor unchanged	
Move (to location)	Reposition the UA to the indicated location.
Terms to change both the UA flight path and the sensor	
Look (at location)	Reposition the UA and sensor as necessary to provide coverage of the indicated location.
Track (object)	Reposition the UA and sensor as necessary to keep the indicated object in the sensor's FOV.

FREQUENCY MANAGEMENT

2-74. UAS employment requires frequency management and coordination specific to the AO. TUAS operations are susceptible to interference from military and civilian communications systems. Terrestrial microwave systems using high energy directional antennas (MSE and tropospheric systems employed by Army and Marine units) may cause significant frequency interference problems and should be avoided.

2-75. Requesting frequencies through the division staff will assist in proper frequency management.

IMPROVISED EXPLOSIVE DEVICE JAMMERS

2-76. IED jammers are designed to interfere with radio devices commonly used to detonate IED. Certain IED jammers may interfere with the UAS uplink. These jammers can be tuned to deconflict with UAS frequencies. The following are guidelines for UAS operations in an IED jamming environment:

- See the signal officer regarding active IED jammers in the AO.
- Do not fly within a 300 meter radius or over a known IED jammer.
- Ask unit frequency managers (S-6) for assistance in reporting IED jammers that interfere with the UAS.

DATA LINK INTERFERENCE AND JAMMING

2-77. UAS data links are susceptible to both interference and jamming. Interference can occur when two or more UAS are operating in close proximity on the same frequency (one unit may inadvertently control another unit's UA if operating on or near the same frequency).

2-78. High power transmitters or jammers in a UAS data link frequency range can jam the data link and cause lost link with the UA. Frequency managers can eliminate these problems by providing a sufficient buffer between frequencies and appropriate distances between terminals.

UNMANNED AIRCRAFT LOST LINK

2-79. Improper planning, overlapping OSGCS or GCS coverage, or poor frequency management can result in a UA experiencing lost link with the controlling station. This mode causes the UA to follow a preplanned route at a programmed altitude and proceed to a lost link point where control may be established or the UA returns to its home base.

2-80. The UA "lost link" flight plan defines the route the UA will travel if communications are lost between the UA and controlling OSGCS.

RADIO LINKS AND NETS

2-81. The unit operates and transmits or receives information on the following external nets:

- **Brigade/battalion intelligence net.** Used primarily to share threat and friendly information. All routine and recurring reports are transmitted on this net.
- **Brigade/battalion command net.** Used to pass C2 information from one commander to another.
- **Administrative and logistics net.** Used to exchange logistical information and unit status reports, as required.
- **Company command net.** Used to pass C2 information and critical reports within the company.

TACTICAL COMMON DATA LINK

2-82. The TCDL is a lightweight, low-cost common data link designed to be jam resistant and provide a high-bandwidth (10.71 megabits-per-second [Mbps] and above) pipe for transmitting sensor data from UA to their associated ground terminals.

2-83. TCDL will support air-to-surface transmission of radar, imagery, video, and other sensor information at data rates of up to 274 Mbps at ranges of up to 200 kilometers. The programmable features of the TCDL design will enable maximum flexibility in the data, while still allowing the system to interface with legacy systems already in use by Department of Defense (DOD).

COMMUNICATION RELAY

2-84. A large battlefield area typically strains communications systems overextended by lost LOS, lack of nodes, jamming, or inadequate range due to friendly force dispersion. The TUAS' CRP helps maintain communications between commanders and subordinate units by providing an aerial capability to extend communications.

Chapter 3

Employment

The teaming of an OH-58D scout helicopter with an RQ-7B Shadow TUAS in the Attack Reconnaissance Squadron is the next level of scout reconnaissance operations. Historically, the OH-58D was fielded with a "Mast Mounted Sight" in order to clear enemy territory without fully unmasking the aircraft. With the use of the Shadow TUAS, the OH-58D pilot can remain one or more terrain features from the enemy territory prior to bounding forward.

The Shadow will effectively replace the Mast Mounted Sight on the legacy scout helicopter. The OH-58F teamed with an RQ-7B Shadow TUAS will be the most lethal combination of aero-scout capabilities to date.

SECTION I – MISSIONS

OVERVIEW

3-1. The Shadow TUAS is employed as a tactical RSTA platform supporting the ARS commander's scheme of maneuver and intelligence requirements. TUAS missions are reconnaissance, surveillance, security, attack (close combat and interdiction attack [IA]), and C2 support (communications relay). UAS support the achievement of information dominance by providing the capability to collect, process, and disseminate relevant information.

3-2. The ARS Battle Staff keep the following list as a basic guideline in employment of the Shadow TUAS:
- Autonomous
  - Reconnaissance Operations
  - Security Operations
  - NAI/TAI Development
  - Continuous Coverage during troop and squadron attack mission
- MURT Operations
  - Reconnaissance Operations
  - Security Operations
- General
  - Emergency Communications Relay for the ground commander
  - Laser Designation for engagements

TEAMING OF MANNED AND UNMANNED AIRCRAFT

3-3. Teaming the Shadows with SWTs will provide enhanced operational fires and maneuver efforts while extending C2 and intelligence capabilities of the commander. With the operators organically assigned to the Attack Reconnaissance Squadron, the relationship will continue to grow into an easily teamed effort. Operators should be viewed and expected to perform the same as manned-aviation pilots. This synchronizes the different types of communication across the Squadron.

3-4. The flexible nature of the Shadow offers commanders and staffs a wide range of options to integrate UAS capabilities into the operations plan and fulfill collection requirements. Effective units will build a cohesive relationship between the manned and unmanned assets. On a broader scope, cooperative operations encompass all aspects of manned-unmanned teaming and LOI, and extend beyond targeting and engagement aspects.

3-5. Scout Weapons Teams equipped with the L2MUM will be able to view the feed directly while directing the battle. Having this teamed capability will provide:
- Risk reduction to manned aircraft when in an environment where the enemy can effectively employ anti-aircraft measures.

- Extended range of observation and detection deeper into the operational environment, providing better situational understanding.
- Early detection of threats along flight routes and verification of pre-mission intelligence data.
- Immediate feedback, real time video of specified areas of interest and target verification to the SWT/AWT.
- Remote laser designation of targets to provide a stand-off capability and increased survivability to manned aircraft.
- The SWT/AWT to observe, designate, and engage targets outside of visual range.

3-6. Techniques and procedures for teaming are applied through direct communications with the UAS crew or through indirect means (CP). With direct communications C2 is implied. This approach is best selected when the likelihood of preplanned missions includes the relay or repositioning of assets to facilitate communication. Immediate Shadow/SWT teaming can be accomplished through ensuring the Shadow has an "internal" frequency. This frequency will be monitored by the Shadow operators throughout the mission and if needed for a teaming scenario, the SWT can push the internal to contact the Shadow operator directly.

Manned Unmanned Reconnaissance Team (MURT)

3-7. Whether hasty or pre-planned, the Manned Unmanned Reconnaissance Team (MURT) consists of one or two OH-58D Kiowas and one RQ-7B Shadow. The Shadow can support a single SWT for the duration of the SWTs mission, or it can support multiple SWTs though out the duration of its mission.

3.8. The SWT Air Mission Commander (AMC) is the overall responsible officer for the conduct of the mission. Similar to standard SWT operations, the Shadow will take guidance from the AMC. The AMC decides on location of the Shadow based on:
- Type of mission
- Location of enemy/threat
- Location of friendly element
- Terrain otherwise masked from the SWTs direct line of sight

3.9. With a clear task and purpose, the AMC can employ the Shadow to effectively augment the SWTs mission. The following information should be considered when providing task and purpose to the Shadow operators:
- Primary/Secondary Objectives
- Limits of Advance / Key areas of interest
- Reporting / Bypass criteria
- Method of airspace deconfliction
- Engagement criteria (if fielded with the POP-300 LD)

RECONNAISSANCE

3-10. The Shadow Troop performs reconnaissance throughout the entire spectrum of combat operations. They employ their assets for the specific mission assigned but, regardless of mission type, Shadow operators always perform reconnaissance.

3-11. With the Shadow Operators fully integrated into the Squadron's training program, they will learn, train, and employ reconnaissance operations from FM 17-95 "Cavalry Operations" and FM 3-04.126 "Attack Reconnaissance Helicopter Operations."

3-12. Information derived from UAS assets facilitates maneuver by assisting the supported unit in determining suitable terrain and detecting possible threats influencing the terrain. In-cockpit Shadow feeds and OSRVT in or near the CP permit direct access to NRT UAS video during reconnaissance.

3-13. Multiple levels of manned and unmanned reconnaissance systems are part of a larger reconnaissance effort occurring jointly and within the Army from theater to squad. In most mission profiles, integration of ground and air reconnaissance provides mutual reinforcement. For example, ground units may reinforce air units if the terrain offers concealment from aerial observation. UAS augment aero-scout operations as well as ground reconnaissance efforts throughout the AO.

FUNDAMENTALS

3-14. The fundamentals of reconnaissance are trained thoroughly in the most effective Attack Reconnaissance Squadrons. This training should fully include the Shadow troop in order to instill the aero-scout mentality.

- **Gain and Maintain Enemy Contact**
  - Capabilities to gain and maintain contact autonomously, or provide continuous coverage while SWT/AWTs cycle through the FARP.
- **Orient on the Objective**
  - Orientation on the objective may be a consideration of METT-TC, look-down angle, or detection avoidance.
- **Report All Information Rapidly and Accurately**
  - Every effort should be made to report all information as widely as possible and especially to the lowest customer possible. CRP and OSRVT provide great capabilities to disseminate the information down to the lowest ground commander for immediate reporting.
- **Retain Freedom to Maneuver**
  - UAS concerns freedom to maneuver for both the UA as well as the maneuver element. The UA operators should have a constant awareness of surface-to-air threat and air-to-air threat. At a minimum, the Shadow operator should avoid placing the UA between the enemy and the aviation threat. The exploitation cell should have a constant awareness of retaining the ground elements freedom to maneuver.
- **Develop the Situation**
  - The Shadow develops the situation through information reporting and dissemination. The exploitation cell aids in intelligence collection and recommending enemy threats for possible courses of action.
- **Ensure Maximum Reconnaissance Force Forward**
  - The Shadow Troop has the ability to provide significant surge efforts for intelligence gathering operations. The Shadow Troop gives the ARS commander, CAB commander, and the ground maneuver commander significant leverage in providing maximum reconnaissance.
- **Ensure Continuous Reconnaissance**
  - The Shadow Troop also provides the commander with the ability to cover 24 hour operations. This gives the commander an ability to watch a specific area where known enemy activity will occur. Additionally, during combined arms operations, the Shadow can provide reconnaissance before, during, and after a significant key event or decision point.

PRINCIPLES

3-15. UAS reconnaissance may occur well forward, just forward, or "over-the-top" of friendly forces. UAS units expand the area covered by ground and air reconnaissance assets. UAS reconnaissance principles include—

- Areas/objectives where terrain or threat can hinder ground or manned air reconnaissance.
- Extended distances or extended durations, or both.
- Maximizing standoff distance to retain the element of surprise and increase force security. Effective gathering and dissemination of UAS mission payload data.

FORMS OF RECONNAISSANCE

3-16. UAS aid in four forms of reconnaissance: route, zone, area, and aerial surveillance.

ROUTE RECONNAISSANCE

3-17. The Shadow conducts a route reconnaissance either autonomously or as part of a MURT. The Shadow operators receive the standard information about the route prior to the conduct of the reconnaissance.

3-18. Autonomous Route Reconnaissance. The autonomous route reconnaissance provides the ground commander the ability to maintain vigilance well in front of their vehicle. Through the use of the OSRVT, the convoy commander receives near real time surveillance and the ability to modify, adjust, or abort the mission based on information gathered. Additionally, with the aid of the CRP, the convoy commander can specifically lay down the task and purpose to the Mission Commander and direct the use of the payload.

3-19. MURT Route Reconnaissance. Working as an extension to the SWT, the Shadow operator receives tasks and purposes from the Air Mission Commander (AMC). The AMC focuses his assets based on METT-TC. As a general rule of thumb, the Shadow is extended further into the enemy territory and ahead of the SWT, while the SWT focuses reconnaissance efforts closer to the main friendly element. Generally speaking, during a route reconnaissance, the Shadow will operate ahead of the SWT calling significant activity and objects through the CRP back to the AMC.

ZONE RECONNAISSANCE

3-20. Zone reconnaissance is conducted to find any significant signs of positions of enemy activity within a given area defined by boundaries. It is conducted only in conjunction with a larger reconnaissance element and is an extremely detailed reconnaissance effort. For this reason, the zone reconnaissance will normally be conducted in a MURT, which will also be a part of a larger task force.

3-21. Similar to the route reconnaissance, the Shadow will extend further towards enemy activity and work further ahead of the Forward Line of Own Troops (FLOT). The Shadow will clear territory for any major threats one phase line ahead of the SWT and report any significant activity. The primary goal of the Shadow during a zone reconnaissance is to ensure the freedom of maneuver for the SWT. The SWT is focused primarily on the freedom of maneuver of the larger friendly reconnaissance element.

AREA RECONNAISSANCE

3-22. Area reconnaissance gathers intelligence or conducts surveillance of a specified area. This area may be key terrain or other features critical to an operation. Similar to a route reconnaissance, the TUAS may conduct an area reconnaissance autonomously or in a MURT.

3-23. The autonomous area reconnaissance will focus outwards and move into the objective area. The flanks of the overall objective area are secured; then, reconnaissance efforts are focused inward. UAS may establish a screen on the flank to provide security for ground forces, if used.

3-24. The MURT will use the Shadow to continue reconnaissance efforts on any terrain that can influence the given objective area while the SWT moves inward towards the main objective area. This provides NRT intelligence on any changes or significant activities during the conduct of the reconnaissance.

AERIAL SURVEILLANCE

3-25. Aerial surveillance is the systematic observation of aerospace, surface or subsurface areas, places, persons, or things by visual, aural, electronic, photographic, or other means to collect information. Aerial surveillance is usually passive and may be continuous.

3-26. UAS surveillance of base camps, airfields, and key logistic sites in lesser-contested areas may free combat forces to perform other missions and help prevent surprise.

3-27. The TUAS provides easily maintained and lower detectable aerial surveillance to the ARS and CAB commander to help develop the commander's intent and concept of the operation. The Shadow Troop provides 24 hour coverage for an NAI in order to:

- Track pattern of life VIA Full Motion Video (FMV)
- Observe a specific area for enemy activity
- Provide early warning and detection on a specific high speed avenue of approach

3-28. The difference between an aerial surveillance and standard reconnaissance is the amount of movement for the Shadow payload. During an aerial surveillance, the payload should remain generally stabilized to gather information on an extremely specific area of the battlefield.

LESSONS FROM THE FIELD

> Selecting aerial surveillance techniques need to balance time on station, noise reduction, and image clarity in order to ensure the greatest success for observing enemy activity. For instance, we chose IED hot-spots, assumed a minimum 10 minute emplacement time, and planned our surveillance pattern to sweep the hot-spot every 10 minutes. This gave the ground commander insurance that no IEDs had been emplaced. This technique also prevented "chasing our tail through a soda straw sight" scenario.

SECURITY OPERATIONS

3-29. Security operations provide reaction time, maneuver space, and protection to air-ground maneuver. Security operations orient on the force, area, or facility being protected.

3-30. Security includes all measures taken by a command to protect itself from surprise, provocation, espionage, sabotage, or observation by the threat. Security operations provide the protected force with early and accurate warning of threat operations. They develop the situation to provide time and maneuver space, enabling the protected force to exploit or react to the threat.

3-31. Security operations characteristics are—

- Conducting reconnaissance to reduce terrain and threat unknowns.
- Gaining and maintaining contact with the threat to ensure continuous information flow.
- Providing early and accurate reporting of information to the protected force.

3-32. Security operations include screen, guard, and cover; convoy security and aerial security (for air operations); and area security that focuses on a geographically defined location. They are conducted in all types of terrain, to include natural or manmade features and urban environments. Security operation considerations include—

- Orchestrating sensors to develop the situation.
- Maneuvering to positions of advantage.
- Developing and sharing the COP with all members of the air-ground team.
- Applying principles of reconnaissance through gaining and maintaining contact.
- Conducting actions to fix, isolate, or destroy threat forces and provide reinforcing fires.
- Synchronizing fires, maneuver, and tactical assault as required.
- Maintaining communications with all members of the air-ground team.

3-33. Again, the Shadow conducts security operations autonomously or as a part of a MURT. As the size of the security operation increases (screen, guard, cover in order of increasing friendly element size), the Shadow works autonomously, as a part of a MURT, or as a part of an entire task force.

FUNDAMENTALS

3-34. Security operations preserve friendly force combat power and freedom of maneuver, while providing information about the threat and terrain. UAS support security operations by providing information regarding the threat; and deny this threat the ability to observe and execute direct fire engagements on the protected force. Successful security operations are planned and executed by applying the following five fundamentals:

- Maintain contact.
- Orient on the force or facility to be secured.
- Provide early and accurate warning.
- Provide reaction time and maneuver space.
- Perform continuous reconnaissance.

ATTACK

3-35. Attack operations destroy or defeat enemy forces in order to seize, retain, or exploit the initiative. UAS conduct two basic types of attack: close combat attack (CCA) and IA.

CLOSE COMBAT ATTACK

3-36. CCA is a hasty or deliberate attack by Army aircraft providing air-to-ground fires for friendly units engaged in close combat. Due to the close proximity of friendly forces, detailed integration is required. CCA is an action in support of maneuver BCT as they close with and destroy the enemy. UAS support CCA by operating as part of the combined arms team when conducting, integrated, air-ground operations through fire and maneuver. The OSRVT enables rapid dissemination of UAS information and increased SA between air and ground forces. The Shadow takes advantage of its altitude and mobility to provide laser designation for munitions fired by joint and Army ground/air platforms.

3-37. During MURT CCA operations, the Shadow provides target identification, grid locations, and laser designation for Hellfire engagements. With the fielding of the L2MUM, the SWT's CPGs will be able to maintain Positive Identification (PID) through the Shadow feed while pushing off the objective area to observe additional enemy activity.

INTERDICTION ATTACK

3-38. IA is a hasty or deliberate attack by Army aircraft that diverts, disrupts, delays, degrades, or destroys the enemy before they can be effective against friendly forces. IA is conducted at such a distance from friendly forces that detailed integration with ground forces is not required. IA combines ground-based fires, attack aviation, unmanned systems, and joint assets to mass effects. This isolates and destroys key enemy forces and their capabilities, and shields friendly forces. The CAB is normally responsible for planning and executing interdiction missions. It has the inherent staff planning expertise to support maneuver, synchronization, and integration of joint effects.

3-39. UAS, when coupled with Army and joint fires, provides the division with the ability to extend the battle to the maximum range of organic and supporting sensors.

3-40. UAS have the capability to destroy an HVT/HPT by employing indirect or direct fires. This Shadow can conduct high risk and high payoff attack operations with minimal exposure of manned systems. In strike missions, the Fires brigade employs precision Army fires, reinforced by joint fires, and complemented by attack aviation (including selected UAS). Strike missions require a continuous capability to immediately locate, strike, and conduct physical damage assessments of targets throughout the AO. The Shadow aids the CAB throughout all levels of locate, strike, and BDA operations.

SECTION II – EMPLOYMENT CONSIDERATIONS

3-41. The Shadow will be a unique addition to the capabilities of the Attack Reconnaissance Squadron. Effective leaders will know the implications of employing a Shadow autonomously with a clear task and purpose versus employing the Shadow as an extension to the Scout Weapons Team in MURT operations, as well as enforcing the team to know when to change between the two.

SHADOW PRODUCT DISTRIBUTION

3-42. The most important factor regarding UAS employment is the effective, timely, and focused dissemination and exploitation of UAS information. Current UAS and Army network limitations require judicious management of information flow (video, text, and images). Typically, voice communications or internet relay chat (instant messaging) is the standard methods for integrating UAS. It is critical the decision maker is included in the flow of mission information. Commanders and staff personnel must maintain awareness of UAS operating in the vicinity of their AO.

3-43. Time-sensitive operations require a C2 architecture that allows—

- The OSGCS and the supported element to communicate through an intermediary, such as a battle captain with the ability to watch the UAS video. He or she interprets the UA video feed for the supported element and communicates their requirements to the OSGCS operator.
- The supported element can watch the UAS video directly on an OSRVT and has tactical control of the UAS through voice communication with the OSGCS.
- A representative from the supported element can be located at the OSGCS and control the mission from there.

3-44. The Shadow Troop commander also needs to maintain a constant awareness of task overload to the Shadow operators. With the wide and immediate distribution of the Shadow video feed, personnel may have the urge to call directly to the Shadow's MC or operators. However, all information needs to be funneled through a single source that is tied directly into the Shadow GCS. The Exploitation Cell is also a good use of funneling information towards the Shadow operator (if co-located).

LESSONS FROM THE FIELD

Exploitation cells are employed for the Scan-Eagle, Hunter, and Grey-Eagle programs, but have not been utilized in the Shadow IBCT platoons. The benefits of the exploitation cell are in the immediate analysis of video feed, analysis of aerial imagery, and the immediate access to the Shadow operators. The cell should be physically located in the same office as the mission coordinator for immediate access to the key players in the TUAS.

CUEING UNMANNED AIRCRAFT SYSTEMS

3-45. Cross-cueing with other assets makes target detection easier. Cueing the UAS with generalized grid coordinates will help verify the target. A collection system that offers exact coordinates is even faster. The key to successful cross-cueing is the timeliness of information from the primary cueing source. Information on troops and vehicles must be provided to the UAS operator as soon as possible. Once the primary cueing source and UAS confirm a target, the sensor-to-shooter time should be minimal. Cross-cueing may be accomplished with a variety of sources.

LASER DESIGNATOR

LASER SAFETY

Non-Eye Safe laser energy is hazardous to a Soldier's eyes. Safety considerations for friendly forces are paramount.

BORE SIGHT REQUIREMENTS

3-46. The laser must be bore-sighted according to the Shadow TM. Six basic requirements are needed to effectively employ laser designators with Laser Guided Weapon (LGW).

- The direction of attack must allow the LGW to sense sufficient laser energy reflecting from the designated target.
- The laser designator must designate the target at the correct time and for the proper duration.
- An LOS must exist.
- The pulse repetition frequency and pulse internal modulation code of the laser designator and the LGW must be compatible.
- The delivery system must release the weapon within the specific weapon's delivery envelope.
- Atmospheric conditions must be suitable for laser operations.

LESSONS FROM THE FIELD

Remote laser designation should be kept simple in order to minimize delay for weapons employment. To alleviate this, the Shadow operator asks for Gun Target Line (GTL) when requesting remote engagement and automatically stacks 30 degrees off one side or the other. Once stacked, the operator stands by for the other aircraft to call within maximum engagement range. Our operators simply held a small orbit approximately 4 kilometers off the target. Once the manned asset was within maximum effective range, our operators turned inbound and had several minutes to work through the entire sequence of remote designation.

SUCCESSFUL LASER EMPLOYMENT

3-47. In addition to knowing the basic fundamentals of laser employment, the operators should be fully integrated into the Squadron's standardization program and aviator academics. The following conditions impact successful employment of lasers.

- Backscatter applies to a portion of the laser beam energy reflected off atmospheric particles in the laser path back toward the designator while the remainder of the laser energy penetrates toward the target. Backscatter energy competes with the reflected energy from the target, allowing the seeker to lock onto the backscatter rather than the target. One method for defeating backscatter is to conduct a lock-on after launch (LOAL) engagement to allow the missile to fly past the false laser signal.

- Obscurants (fog, haze, rain, snow, smoke, dust) in the laser-to-target LOS will also produce strong backscatter pulse returns. To reduce the effects of obscurants the designator could wait for clearer atmospheric conditions, reposition the aircraft, or switch the role of laser designator and missile launch platform (in a cooperative engagement).
- Attenuation is a portion of the laser beam energy that is "scattered" by obscurants along the laser-to-target LOS and the missile-to-target LOS, resulting in reduced laser energy to the seeker. If attenuation is severe, the seeker will not detect the laser energy from the target. The pilot or UA operator can confirm range to target to detect significant attenuation. To avoid attenuation, reposition the UA or manned aircraft and switch roles or wait for improved atmospheric conditions.
- Beam divergence (figure 3-19, page 3-20). The farther the laser designator is from the target, the wider the spot will be upon the target with a resultant increase in the chance for overspill or under spill to occur. If practicable, reposition laser designating platform closer to the intended target.

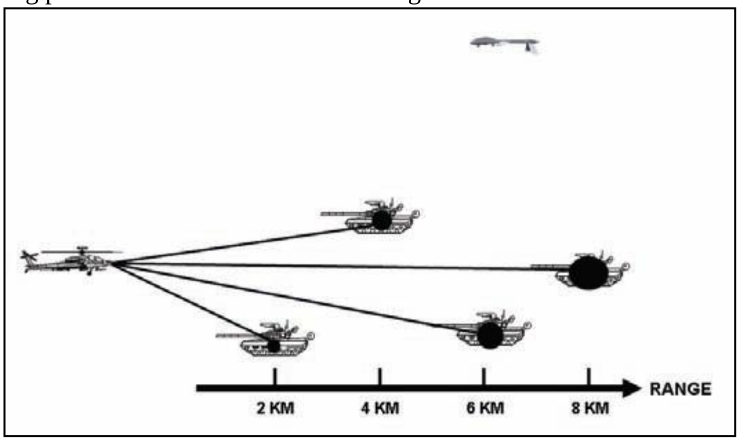


Figure 3-19. Beam divergence

- Spot jitter is the result of motion of the designator or the beam developed by the designator around the intended aim point. This can give the laser spot a bouncing movement on the target that increases with designator distance from the target. To reduce spot jitter, if available, use the system’s target lock-on feature to maintain proper target lock.
- Overspill (figure 3-20) is caused by placing the laser spot too high on the target so that beam divergence and jitter cause the spot or a portion of the spot to spill over onto the terrain behind the target. This can cause intermittent background false targets, becoming more severe at longer designation ranges. If available, use the system’s target lock-on feature to maintain proper target lock.

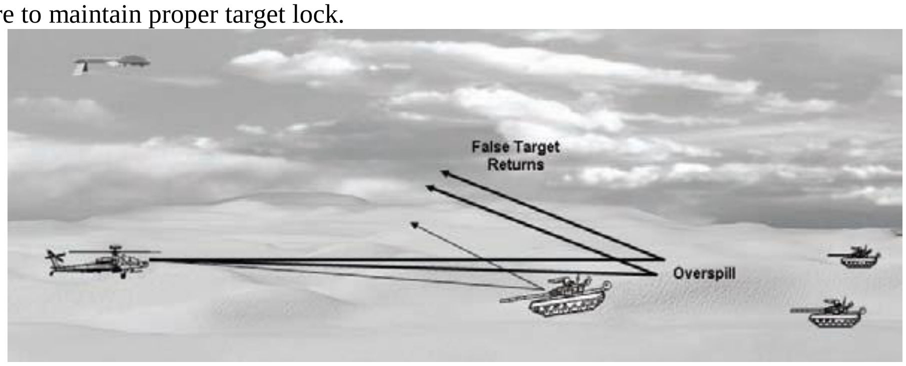


Figure 3-20. Overspill

- Under spill (figure 3-21, page 3-21) occurs by placing the laser spot too low on the target so that the spot, or a portion of the spot, spills onto the foreground. This can cause foreground false targets, becoming more severe at long designation ranges. Even a small amount of under spill can cause the missile to follow false returns. If this occurs just before missile impact, the probability of hit is seriously degraded. Use the systems target lock-on feature if available.

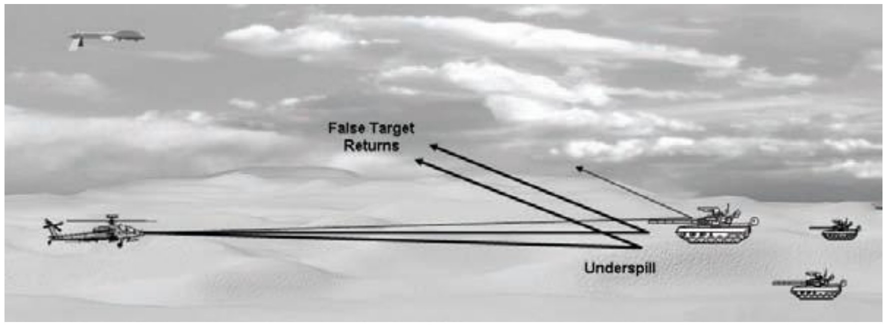


Figure 3-21. Under spill

- Podium effect. When the seeker is looking for scattered laser energy, it must be able to "see" the reflecting surface. When a laser designates a surface that the seeker can't see the reflections are blocked or reflected away from the seeker head, also known as podium effect (figure 3-22). Personnel must be aware of the laser-target and missile-target line to ensure adequate laser energy is presented to the missile seeker head.

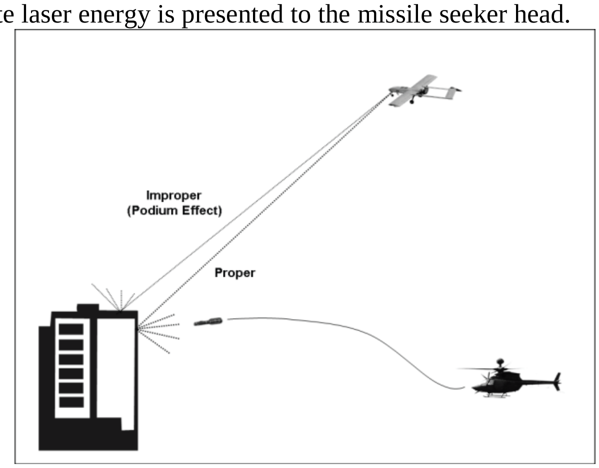


Figure 3-22. Podium effect

- Mirror-like reflections. When firing the laser at mirrors or reflective surfaces, the guided munitions may track unintended targets due to strong reflection. To prevent this, avoid designating reflective surfaces.

PAYLOADS

3-48. Currently the Shadow has two types of payloads. Every effort should be made to launch with laser designation and CRP capability. Weather conditions, temperature, and time of day are but a few of the variables considered in selecting the best MEP option. Table 3-1 is a matrix of sensor advantages and disadvantages for the types of sensors currently available.

Table 3-1. Sensor matrix

Advantages	***Disadvantages***
Electro-Optical	
Affords a familiar view of a scene.	Employment of camouflage and concealment techniques can deceive the sensor.
Offers system resolution unachievable in other optical systems or in thermal images and radars.	Restricted by weather conditions; visible light cannot penetrate clouds or fog.
Preferred for detailed analysis and measurement.	Restricted by terrain and vegetation.
Offers stereoscopic viewing.	Limited to lighted areas during nighttime.
Infrared	
A passive sensor, impossible to jam.	Not as effective during thermal crossover (1 to 1.5 hours after sunrise or sunset).
Offers camouflage penetration.	Tactical platforms threatened by threat air defenses.
Provides good resolution.	Bad weather degrades quality.
Nighttime imaging capability.	

FIELDS OF VIEW

3-49. The Shadow payload has specific limitations imposed by weight capacity and space limitations. The selected FOV (figure 3-24) significantly impacts the quality of the image depending on altitude of the UA, atmospheric conditions, type of sensor and intended target. A narrow field of view provides a significantly reduced breadth of image commonly referred to as a "soda straw" view, while a wide field of view provides a larger area with reduced fidelity. The Shadow employment should take into consideration the limitations of its field of view, even in the most ideal conditions.

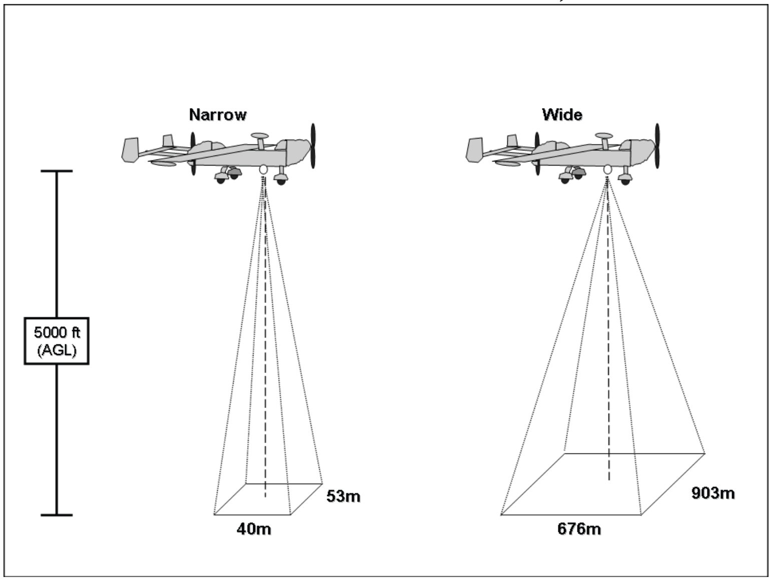


Figure 3-24. Comparison of narrow and wide field of view

> **LESSONS FROM THE FIELD**
>
> Integrating the Shadow operators into the Squadron aviator academics immediately begins instilling the basics of visual cues. Previous units have had great success taking Shadow operators and placing them in the AVCATT simulator. Talking them through the different methods of target identification between wide field of view and narrow field of view, the operators realize the importance of different visual cues for different fields of view. For instance, while the narrow field of view is best for detecting specific objects, texture, and detailed imagery, the greatest visual cue for detecting enemy activity in wide field of view is motion.

3-50. UAS are able to compute the sensor aim point's coordinates and depict them as an overlay on video display. The precision of these computed coordinates depends on the distance between the UA and aim point, and the depression angle of the sensor. If the distances are equal, a small depression angle (B) may result in coordinates less precise than coordinates from a greater angle (A) as shown in figure 3-25. General guidance shows that the depression angle should be between 60 and 90 degrees for best precision. UA equipped with an LRF have the capability to provide more accurate targeting data.

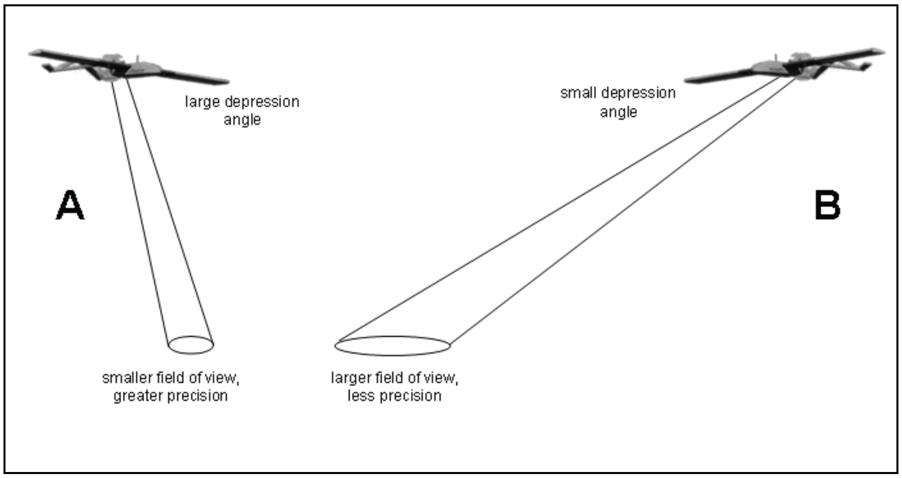


Figure 3-25. Coordinate accuracy

TARGETING

COMBAT IDENTIFICATION

3-51. Combat identification is the process of attaining an accurate characterization of detected objects in an operational environment sufficient to support an engagement decision. The role of reconnaissance vehicles in the combat identification process is to report all information rapidly and accurately.

3-52. The combat identification process is a series of progressive and interdependent steps (or actions): target search, detection, identification, locating, and reporting that leads to the decision process to engage or not engage. The Detect, Identify, Locate, and Report is the scout pilot/operators systematic approach to handling reconnaissance and security operations. The scout pilot/operator provides the information necessary for the ground commander to decide whether an engagement is necessary.

Table 3-4. Detect, identify, decide, engage, and assess process

Detect	The Shadow TUAS generally detects suspect activity in wide FOV. In wide, the operator looks for obvious sightings, heat, trails, smoke, and most of all, movement.
Identify	Identification depends heavily on METT-TC, but is generally conducted in the narrow FOV. In narrow, the operator is able to determine size, shape, texture, and other specific details. The operators may consider adjusting altitude and distance to target to aid in identification.
Locate	Immediately, the Shadow operators should start to consider the location and how it affects the friendly scheme of maneuver. The higher the impact on friendly maneuver, the faster the initial spot report needs to be submitted. Regardless, location can be as simple as “2 o’clock, 500 meters” in a time constrained situation, or a 10 digit UTM grid when time permits.
Report	Reporting depends heavily on size of threat, type of enemy weapon, and distance to friendly elements. All reports should be submitted as soon as possible utilizing the standard “Size, Activity, Location, Time, What you are doing about it” (SALT-W) format.

TIME-SENSITIVE TARGETS

3-53. Time-sensitive targets (TSTs) are defined as those air-, land-, or sea-based targets of such high priority to friendly forces that the JFC designates them as requiring immediate response because they pose (or will soon pose) a danger to friendly forces or targets of opportunity. The JFC will provide specific guidance and prioritization for TSTs within his or her joint operational area.

Support to Time-Sensitive Operations

3-54. UAS can support time-sensitive operations with the following:

- Surveillance of ingress and egress routes, and possible enemy avenues of approach.

- Continuous observation of specific objects of interest.
- Positive target identification.
- Verbal talk-on of attack aircraft pilots to targets.
- Target coordinates.
- Target marking with laser designation.
- Terminal guidance of laser-guided ordnance.
- Immediate bomb hit assessment and BDA.
- Long-range relay of radio transmissions.

HIGH PAYOFF TARGETS

3-55. During war-gaming, the battle staff identifies HPTs. The staff also develops a method to locate and track those HPTs for engagement and BDA. During planning, the ARS battle staff prioritizes HPTs, that if found, will cause Shadow operators to track and engage with on-call fires. The Shadow Troop provides the ability to focus ISR platforms on aviation threat specific HPTs.

3-56. An alternate method is the commander specifying a time or event during the battle when a transition in UAS priorities occurs. For example, transitioning the Shadow from security in depth to targeting in support of decisive operations. If the HPT list identifies enemy artillery, the Shadow may dynamically re-task to laser designate for counter fire and eliminate identified artillery systems that threaten advancing friendly elements.

COOPERATIVE OPERATIONS AND ENGAGEMENTS

3-57. Cooperative engagements are an extension of cooperative operations presented earlier within this chapter. Cooperative operations enable the aviation or ground commander to develop the situation; and conduct decisive, integrated air-ground operations to close with and destroy the enemy through fire and maneuver. Cooperative engagements extend the tactical reach of maneuver forces while furnishing the commander with immediate reinforcing fires. During close combat operations, cooperative engagements enable precision direct and indirect fires integrated into the ground scheme of maneuver.

3-58. Cooperative operations and engagements focus individual platform capabilities and provide:
- Increased lethality, endurance, agility, and survivability.
- Persistent surveillance.
- Reliable, NRT battlefield information to the on-scene commander.

3-59. Cooperative engagement (figure 3-40) rules must be followed to ensure safety of the remote designator and increase likelihood of a successful engagement.

COOPERATIVE ENGAGEMENTS

Do not allow the seeker to see the remote designator's laser aperture.

Do not allow the remote designator to be within the seeker's FOV.

The operator of the remote designator must be knowledgeable of the missile's flight path and ensure LOS between the laser spot and missile seeker.

The remote designator requires a safety zone in order to minimize backscatter and preclude errors in missile engagement (Figure 345, page 3-38).

3-60. Aerial target designation guidelines are:
- During flight, the Shadow aircrew detects and recognizes a target that meets preexisting criteria.
- The ground commander (with the appropriate level of release authority) directs target engagement.
- The Shadow operator confirms the target before engagement.
- The designating platform operator passes the necessary laser code to the supporting weapons platform while the UA maneuvers into the best position for target designation.
- The ground commander clears and authorizes fire.
- After engagement, the UAS provides BDA (completing the 4-step targeting process: detect, decide, deliver, and assess).

3-61. The Shadow MC and SWT must understand the method used to locate the target, the execution sequence, and post-attack requirements. Airspace deconfliction must be mutually agreed upon, understood, and well executed. Standardized elements for target handover are—

- Alert voice cues and target description. This alerts the SWT a target handover is about to occur. It identifies the sender and describes the target.
- Target location. The Shadow MC gives target location with a reference from a known point or use grid coordinates.
- Method of attack. The Shadow MC or SWT lead describes the planned scheme of maneuver, fire distribution, and maneuver for the attack (for example, "Attack targets west of north-south road.").
- Execution. The command to initiate the attack is given using two methods to control the engagement.
  - **At my command**-The SWT engages when the UAS MC says "fire."
  - **When ready**-The SWT fires when ready. Assume "When ready" when no other command of execution is given.
- Post attack method. The Shadow operators conduct BDA and coordinate future actions with the SWT.
- The minimum information for a target handover includes identification, target, and location; for example, "B16, this is B45, armored vehicles, 270 degrees, 2,000 meters, over."

LESSONS FROM THE FIELD

Shadow operators benefit greatly from field artillery simulation and training exercises. Most garrison posts have well designed simulation facilities. Scheduling the Shadow operators for "call-for-fire" training gives them the target-handover / voice communication mind-set. While in the field environment, our standardization team simply work through practice drills with them. Practicing call for fire battle drills while in the AVCATT will also benefit this battle drill.

BATTLE DAMAGE ASSESSMENT

3-62. BDA is the timely and accurate estimate of damage resulting from the application of military force (lethal or nonlethal) against a predetermined objective. BDA collection and reporting helps commanders determine when or if their targeting effort is accomplishing their objectives. See FM 6-99.2 for the BDA report format.

3-63. After enemy engagement, Shadow imagery is used to evaluate the extent of damage and necessity for re-attack. Figure 3-47 is an example of BDA imagery. The exploitation cell can provide immediate intelligence feedback and a detailed BDA to the maneuver force commander.

Figure 3-47. Battle damage assessment

3-64. Ground maneuver planners should be familiar with the unique capabilities of Army aviation. Army aviation requires unique planning and coordination considerations. It must be fully integrated into the military decision-making process to ensure effective combined arms employment. See FM 3-06.11 for additional information.

LESSONS FROM THE FIELD

With the relative new capabilities of the Shadow and other air platforms, Aviation battalions have had great success in sending Air-Ground-Integration teams to ground maneuver battalions to brief the unique capabilities and planning considerations.

SECTION III – GROUND UNIT AND AVIATION COORDINATION

GROUND MANEUVER UNIT SUPPORT

3-65. Ground units may receive support from a variety of manned and unmanned systems. Shadow TUAS provide the ability for medium duration tactical RSTA, precision fires, adjustment of indirect fires, and C2 support.

GROUND MANEUVER UNIT PLANNING REQUIREMENTS

3-66. The initial planning and information passed to the ARS Battle Staff includes the mission statement, commander's intent, scheme of maneuver, and initial AC2 planning. Other planning requirements may include—

- The command relationship between the supported unit and supporting UAS.
- The initial task and purpose to aircrews.
- The current situation estimate (intelligence and operations).
- Any updates to the joint AC2 structure.
- A call sign and frequencies for ground elements.
- Any control measures necessary for initial planning.
- The engagement criteria and available weapon systems.

ACTIONS EN ROUTE TO THE OBJECTIVE

3-67. The ground maneuver headquarters informs its units when Shadows are inbound. The Shadow MC contacts the ground maneuver element on the designated net for a SITREP when en route to the AO.

3-68. A SITREP may include—

- The enemy situation.
- The friendly situation (including AC2 considerations).
- Changes to briefed mission.
- Restrictions or constraints.

SHADOW OPERATOR CHECK-IN

3-69. It is essential to positively identify locations of friendly units and supporting aircraft. The BCT staff confirms the positive locations of friendly forces and provides the operators with updated information.

3-70. Traditionally, the Shadow operators have checked-in VIA MIRC. However, with the fielding of the CRP, the operators will begin checking in over the established FM net. Upon initial radio contact, the MC executes a check-in, providing the following information:

- Identification. *(Ground commander, this is the MC)*.
- Type of UAS, the location, and estimated time of arrival.
- Station time/special capabilities (such as IR, LRF/D).
- A request for ground SITREP, which includes other air activity and advisories.

3-71. The UAS selects an orbit area within communications range until required coordination is complete.

3-72. The MC provides his concept for the operation based upon the ground commander's scheme of maneuver. Upon completion of coordination, the UAS conducts the mission.

POSITIVE LOCATION AND TARGET IDENTIFICATION

COMMAND AND CONTROL TECHNIQUES

3-73. C2 techniques effective during air-ground operations with UAS are—

- Reference point technique–uses a known target reference point or an easily recognizable terrain feature.
- Grid technique–uses grid coordinates to define the point.
- Sector/terrain technique–uses terrain and graphics available to both air and ground units.
- Phase line technique–uses graphics available to both air and ground units.
- Key pad designations through a common grid reference system.

MARKING

3-74. During daylight hours, the EO and IR systems allow accurate target identification. During periods of reduced visibility, the IR system alone provides adequate target resolution, but may require additional methods of verification prior to engagement.

Friendly Positions

3-75. Friendly forces can mark their positions with IR strobes or tape, night vision goggle lights, smoke, signal panels, body position, meal ready-to-eat heaters, chemical lights, and mirrors. Marking friendly positions can be a more time-consuming process than directly marking a target and can reveal friendly positions to the enemy. Aviation units require the positive identification of all friendly elements before an attack is authorized during CCA.

> **LESSONS FROM THE FIELD**
>
> Integration of the Shadow operators into the Squadron aviator academics will include CBAT/ROC-V training to aid in target identification. Additionally, the exploitation cell should receive similar training in order to aid in imagery analysis.

Enemy Positions

3-76. Target marking aids UAS target identification and engagement. The target mark must be timely, accurate, and easily identifiable to avoid confusion with other fires on the battlefield. Methods to mark an enemy position include:

- Direct fire weapons (missiles, tank rounds and tracer).
- Indirect fire weapons (smoke and airborne rockets).
- Other methods (laser designator, laser illuminator, and IR spotlight).

FRATRICIDE

FUNDAMENTALS

3-77. Fratricide is the employment of friendly weapons and munitions, used with the intent to kill enemy forces or destroy its equipment or facilities, which results in unforeseen and unintentional death or injury to friendly, neutral, or noncombatant personnel.

CONTRIBUTING FACTORS OF FRATRICIDE

3-78. Contributing factors of fratricide include—

- Fatigue.
- Incorrect target identification.
- Incomplete planning and coordination.
- Improper clearance of fires.
- Equipment failure or improper procedures.
- Inadequate graphic control measures.
- Poor land navigation.
- Loss of communications.

- Position-reporting errors.

FRATRICIDE RISK CONSIDERATIONS

3-79. Fratricide risk is reduced by─

- Understanding the capabilities and limitations of units and components.
- Understanding the task, purpose, and scheme of maneuver for ground units.
- Understanding the enemy, identifying weaknesses, and creating opportunities to exploit enemy weaknesses.
- Proper training in vehicle identification.
- Planning for a mission or unit training.
- Training with supporting branches (joint and combined arms).
- Participating, supervising, and observing unit training.
- Allowing the maneuver force commander the ability to personally view NRT FMV and personally decide

SECTION IV – COMMAND AND CONTROL SUPPORT

OVERVIEW

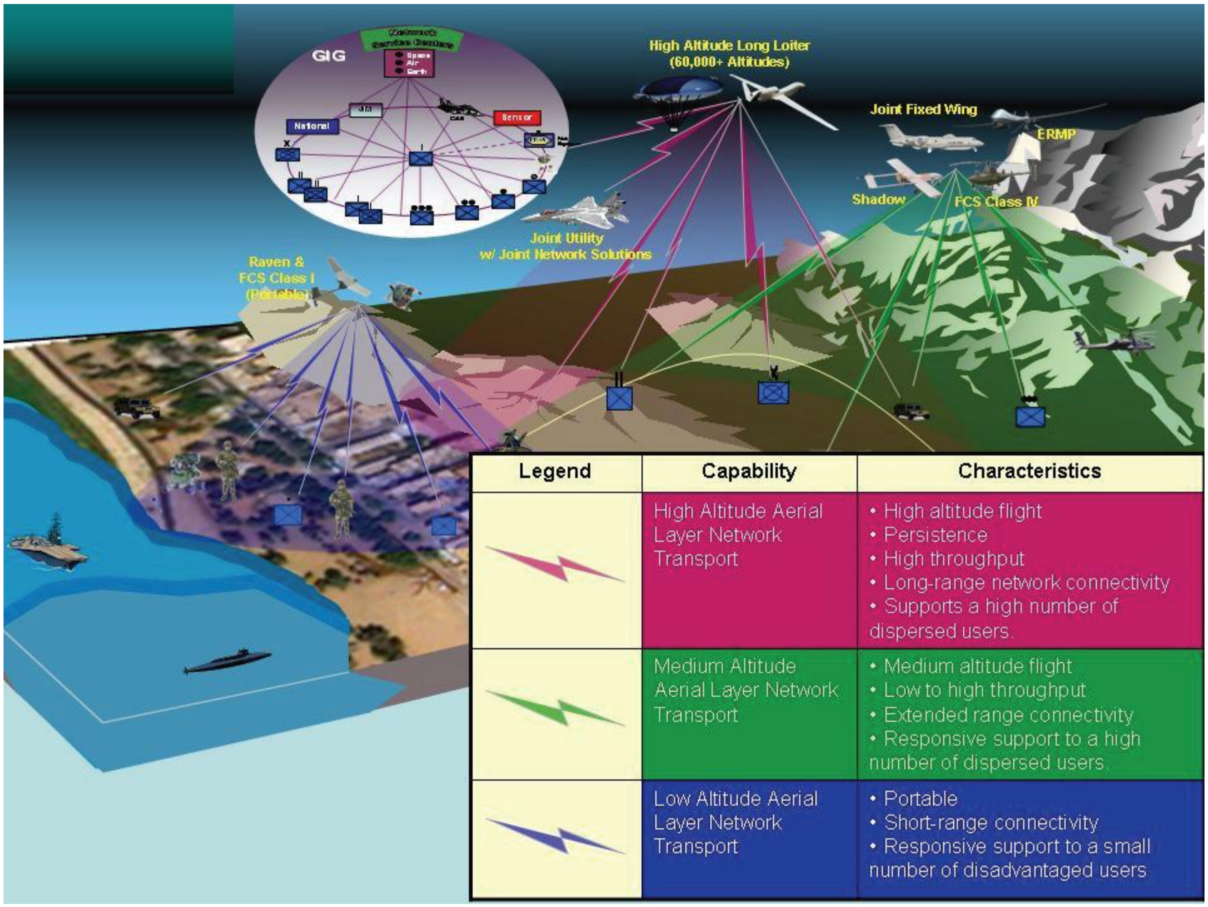
3-80. The Army, as part of a joint network, employs a three-tiered communications system. This network has aerial, space, and terrestrial components provided by individual services, linking the various elements of the joint force to the global information grid. The Shadow UAS provide an additional layer of communications relay capability in support of division- and brigade-level operations.

3-81. Shadow UAS facilitate battle command on-the-move by extending the network. During non-linear operations with little or no physical contact between units, communications capabilities are strained and operational effectiveness decreases. Shadow UAS provides the ability to maintain the network over longer distances through OSRVT and CRP capabilities.

THE AERIAL LAYER

3-82. Land forces require a network capable of providing information to all users regardless of movement and environment. The aerial layer (figure 3-48, page 3-44), along with existing terrestrial and space layers of the network, will enable high capacity network connectivity regardless of movement or environment. To provide the required capabilities under all conditions the aerial layer consists of high, medium, and low altitude layers. The aerial layer includes─

- High altitude long loiter assets providing network connectivity to users dispersed across a theater (material solution under development–high altitude airship).
- Medium altitude assets providing tactical network connectivity to dispersed tactical users with CRPs.
- Low altitude assets providing portable network connectivity to users when all other means are lost (Shadow CRP-L).



Legend	Capability	Characteristics
	High Altitude Aerial Layer Network Transport	• High altitude flight • Persistence • High throughput • Long-range network connectivity • Supports a high number of dispersed users.
	Medium Altitude Aerial Layer Network Transport	• Medium altitude flight • Low to high throughput • Extended range connectivity • Responsive support to a high number of dispersed users.
	Low Altitude Aerial Layer Network Transport	• Portable • Short-range connectivity • Responsive support to a small number of disadvantaged users

Shadow Communications Relay Package–Light

3-83. Shadow CRP-L (figure 3-51 and figure 3-52, page 3-46) consists of two Harris SINCGARS radios, brackets, mounts, antennas, and wiring mounted on Shadow UA wingtips. This system provides extended tactical voice communications.

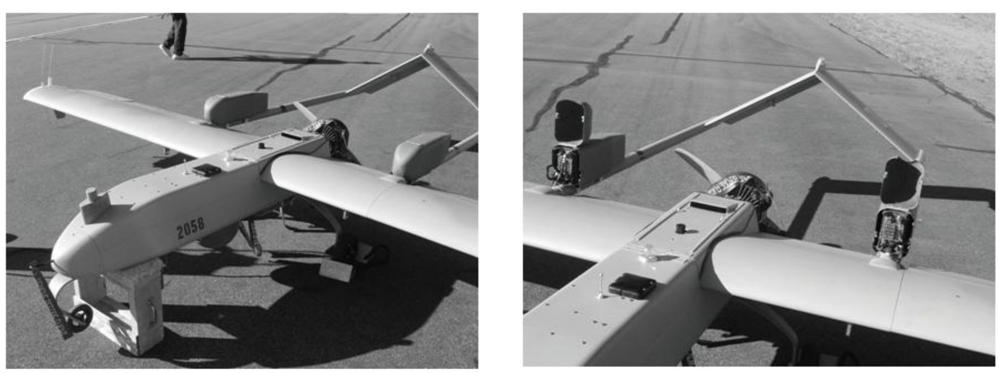


Figure 3-51. Shadow communications relay package-light

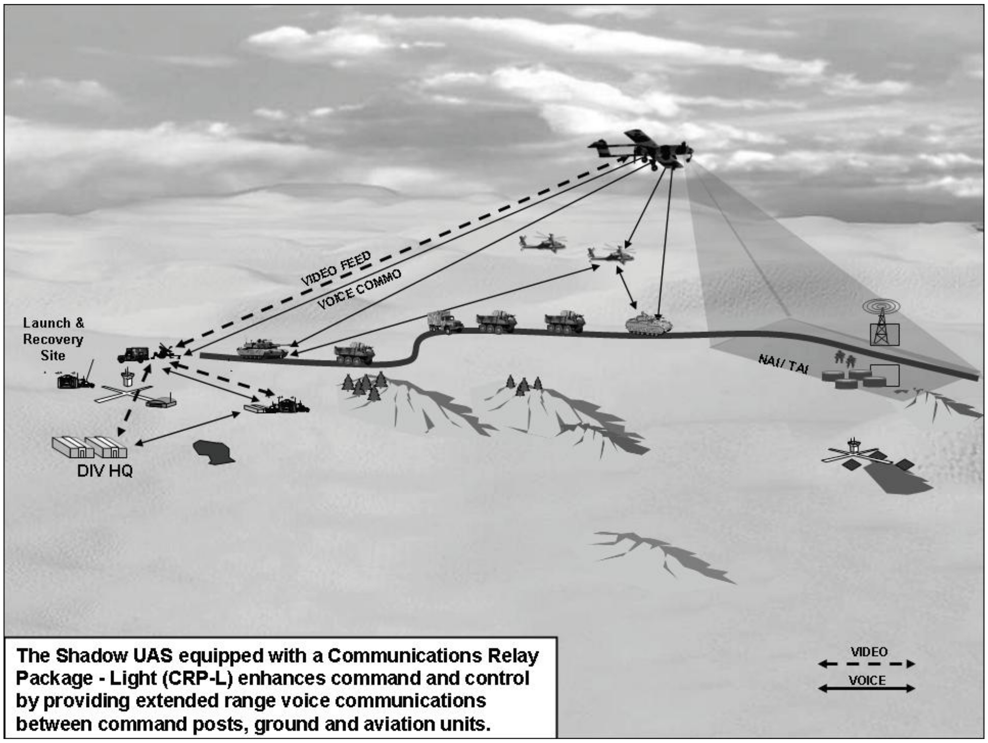


Figure 3-52. Extended range tactical communications

SECTION V – HOMELAND SECURITY OPERATIONS

3-84. The inherent capabilities of long-endurance, ease of deployment, flexible payloads, and communication networks, make UAS a useful platform to support Homeland Security. UAS provide first responders with a variety of payloads to rapidly develop SA during an emergency. UAS responds to—

- Natural disasters.
- Manmade disasters.
- Civil support action.
- Border security.
- Search and rescue.

3-85. The Shadow Troop should reference FM 3-04.155, the FAR/AIM, and Joint DOD publications to reference specific requirements, limitations, and capabilities for Homeland Security Operations.

Chapter 4

Sustainment

The recent integration of UAS into Army Aviation has made a significant impact on how sustainment is performed. System uniqueness, combined with rapid fielding, has resulted in a sustainment challenge. The UAS sustainment effort relies heavily upon manufacturer and contractor support to maintain operations. Current field and sustainment maintenance is predominately founded in the CLS concept. As with other airframes, UAS goes through reset/reconstitution programs to ensure equipment returned from combat is rapidly prepared for future deployment.

The full integration of the Shadow into the ARS AVUM's technical supply, quality control, and production control sections is imperative to the Shadow Troop's success.

SECTION I – LOGISTICS

LOGISTICS CHARACTERISTICS

4-1. Historically, success in battle is dependent upon unity of effort between the tactical operation and its sustainment operations. The combat commander ensures success by emphasizing accurate and timely reporting. This includes logistics leaders in the planning and preparation process of operations and promoting sound logistical plans to support the commander's intent. A thorough logistics plan includes the following characteristics:

- Responsiveness.
- Simplicity.
- Flexibility.
- Attainability.
- Sustainability.
- Survivability.
- Economy.
- Integration.

SUPPLY OPERATIONS

4-2. The AVUM technical supply with the help of the Shadow FSR is responsible for coordinating and requisitioning supplies for the Shadow Troop. Coordination is made with the brigade/battalion logistics staff officer (S-4) for transportation assets (internal or external) to deliver bulky items. The commander ultimately establishes priorities for delivery. Supplies and equipment in Classes I, III, V, and IX are usually the most critical to successful operations.

4-3. The brigade/battalion SOP provides detailed procedures for requesting, receiving, storing, inventorying, issuing, and turning in supplies, equipment, and repairable parts (serviceable and unserviceable). AR 710-2, FM 3-04.500, FM 4-0, joint publication (JP) 4-0, and JP 4-03 contain detailed sustainment information.

4-4. The Troop commander and AVUM commander should consider the following when developing UAS logistics requirements.

- Components of end item:
  - UA.
  - Control stations.
  - RVTs.
  - Antenna systems.
  - Launchers.
  - TALS.
  - Payloads.
- Additional authorizations list items:
  - OSRVT.
  - OSGCS.
  - Mobile directional antenna system.

- • Additional support item of equipment:
  - Unit vehicles.
  - Generator sets.
  - Communications equipment.
- Fuel availability.
  - The Shadow uses Aviation Gas (AVGAS) which is uniquely acquired depending on the environment. Generally speaking, garrison posts and US Army Forward Operating Bases do not have sustained fuel points with AVGAS.
  - The AVGAS may be procured using a fuel card through the S-4 at a nearby airport while CONUS and major Logistical Supply Areas (LSAs) while in a deployed environment.
  - The Forward Support Troop should maintain at least one fuel tank truck specifically for AVGAS and maintain the fuel level for the Shadow Troop.
- Projected parts needed (scheduled maintenance).
- Not mission capable-supply parts requested.
- CLS, field service representative (FSR), or LAR requirements.
  - The CLS, FSR, and LAR should integrate into the AVUM to receive additional assets and capabilities
- Property book accountability.
- Unit ATP standards program.
- Aviation accident reporting plan.

4-5. The FSR handles all ordering and stocking levels of parts. The technical supply should be integrated into this process, but will continue to be managed by the FSR until the Shadow parts are fully embedded in the Army supply system.

4-6. Currently, Shadow TUAS utilizes the Enhanced Logbook Automated System (ELAS) which will not communicate with the ARS's current Unit-Level Logistics System-Airborne (Enhanced) (ULLS-A [E]). The technical supply will be further integrated when the TUAS moves to ULLS-A(E).

SECTION II – MAINTENANCE

4-7. The maintenance system is organized around forward support. All damaged or malfunctioning equipment should be repaired onsite or as close to the site as possible. UAS are maintained under the two-level maintenance concept. Field maintenance is performed by UAS unit military and/or contractor personnel. UAS maintenance personnel perform authorized maintenance procedures within their capability. Sustainment maintenance supports beyond unit-level repair and is generally performed by the depot or forward repair activity. Contractor Logistics Support (CLS) may or may not be provided by original equipment manufacturer (OEM) representatives. If the supportability strategy calls for CLS, these elements will likely be located in the brigade support area with the aviation support battalion.

4-8. The Shadow TUAS maintenance program should be integrated into the AVUM upon fielding. The technical inspectors will become a section of the Quality Control platoon in the AVUM. The FSRs will report directly to Production Control (PC) and work closely with the technical supply section within PC. This manning level prevents a conflict of interest and ensures the ARS commander the quality of maintenance performed.

4-9. All of the personnel in the component repair platoon should be cross-trained in Shadow maintenance procedures to assist in maintenance surges or large maintenance tasks. Any aviation maintainer can conduct maintenance on the Shadow TUAS, but only the qualified personnel with specific MOS and identifier are authorized to conduct the technical inspection.

UNMANNED AIRCRAFT SYSTEM RESET PLAN

4-10. UAS are incorporated into a reset program along with other Army aviation assets. FSRs inspect UAS at the unit location. UAS are inspected and inventoried prior to shipment to the contractor depot. The contractor—

- Conducts maintenance and upgrades.
- Disassembles sub-systems.
- Cleans, repairs, and replaces obsolete items.
- Rehabilitates and reconstitutes components.
- Applies outstanding modifications.

FIELD MAINTENANCE PERSONNEL

4-11. The Shadow TUAS systems repairer (15E) and the OH-58D armament/electrical/avionics systems repairer (MOS 15J) or EW/intercept systems repairer performs the following maintenance functions on UAS sensors:

- Fault detection and isolation.
- Removal and replacement of inoperative chassis-mounted components and line replaceable units (LRUs) down to card level. Functional tests and built-in tests (BITs).
- Periodic inspection or replacement to comply with scheduled maintenance requirements, corrosion prevention, detection, and removal.
- Electronic maintenance covering payloads and electronic-based components repair by removal and replacement of LRUs.

4-12. UAS operator (MOS 15W) maintenance tasks are intended to keep the system operational and prevent deterioration. Operators will perform—

- Preventive maintenance checks and services (PMCS).
- Preoperational tests to verify the system is ready to operate using BITs.
- Visual inspection and a BIT analysis.

SUSTAINMENT MAINTENANCE PERSONNEL

4-13. Sustainment maintenance personnel perform UAS component repair, part replacement, fault detection, and fault isolation of specific parts. At this level of maintenance, maintainers focus on repair of component items and their return to the distribution system. Component repair includes items such as major assemblies, LRUs, and repairable line items. Corps and theater maintenance activities, special repair activities, or contractors on the battlefield can perform sustainment maintenance.

4-14. Sustainment maintenance actions typically involve repair of reparable Class IX components, off-system, for return to the supply system. Uniformed maintenance personnel, DA civilians, or contractors can perform sustainment maintenance. The decision to have sustainment maintenance includes detailed off-system, inside-the-box repair of LRUs through shop replaceable unit repair/replacement; and rebuild of engines or transmissions.

UNIT-LEVEL LOGISTICS SYSTEM–AIRBORNE (ENHANCED) AS MODIFIED FOR UNMANNED AIRCRAFT SYSTEMS

4-15. Unit-Level Logistics System-Airborne (Enhanced) (ULLS-A [E]) as modified for UAS, once fielded, will enhance the Army's ability to accurately track and control aviation maintenance, logistics, and aircraft forms and records IAW Department of the Army pamphlet (DA Pam) 738-751. It is designed to be user friendly while reducing man-hours through automation. This system enhances aircraft reporting, status, and flying hours IAW AR 700-138. Furthermore, ULLS-A (E) as modified for UAS can process aircraft transfers, maintain operational and historical records, and processes Class IX (Air) repair parts. It automates bench stock listings by shop codes (stocked and maintained manually with an automated reordering process), PLL, reportable component management, and maintenance management processes performed by production control.

4-16. ULLS-A is the current system of record for all PLL/bench stock and Army maintenance management system-aviation operations at unit level. It enhances and supports those tasks associated with the controlled exchange of reportable components. This system is configured, at aviation maintenance company level, into a network operation. A notebook computer assigned to line companies facilitates those tasks previously performed on the manual logbook. Army aviation units are normally supported by three workstation computers (production control, quality control, and technical supply) and a file server (database) positioned in the production control office. These automated systems comprise the LAN. Tasks and activities performed by quality and production control are transferred to the aircraft notebook. These procedures will ensure the ULLS-A (E) as modified for UAS is current and reflects the latest maintenance and logistics status assigned to the airframe.

4-17. The enhanced logbook automated system (ELAS) is fielded to Army UAS units. ULLS–A (E) as modified for UAS, once fielded, will be the system of record tracking logistics and maintenance actions for all aviation maintenance units. The manual system (hard copies of forms and records) will be used as a backup if ULLS-A (E) as modified for UAS becomes nonfunctional. The production control office is responsible for coordinating the input and update of all maintenance and logistics actions into ULLS-A (E) as modified for UAS once the system is fully operational. ULLS-A (E) as modified for UAS is the baseline system. It will become the standard configuration baseline for all aviation systems and platforms including manned-rotary, unmanned, and FW aircraft.

4-18. The Raven and OSRVT will be supported through the Standard Army Maintenance System– Enhanced (SAMS-E), and Unit-Level Logistics System-Ground for units not yet upgraded. These systems are essentially "ground systems" as they are issued primarily to infantry personnel who do not have ULLSA (E) access. SAMS-E was primarily designed to support Army motor pools, not aviation maintenance which requires a partially mission-capable category. Systems will only be reported as full mission-capable or not mission-capable; however, units will have an automated parts-ordering and reporting capability.

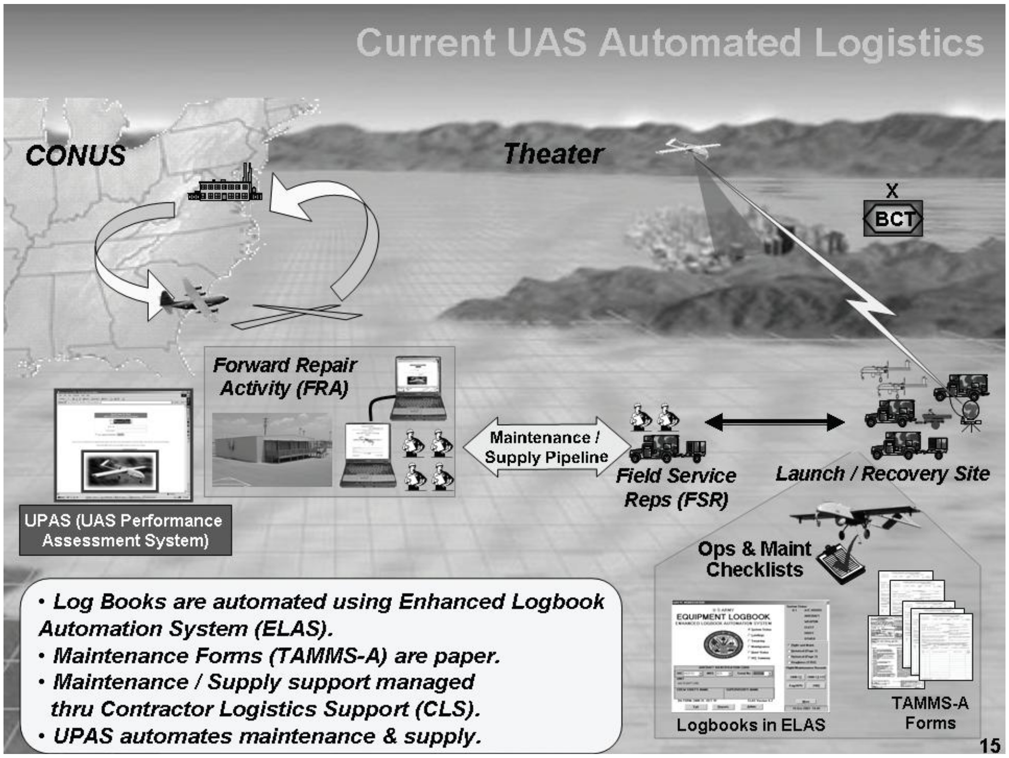


Figure 4-2. Current logistics support

4-19. Maintenance and supply procedures will become more automated as UAS further integrates into the Army sustainment program. This will provide streamlined, standardized procedures that support visibility of system status throughout the sustainment process (figure 4-3).

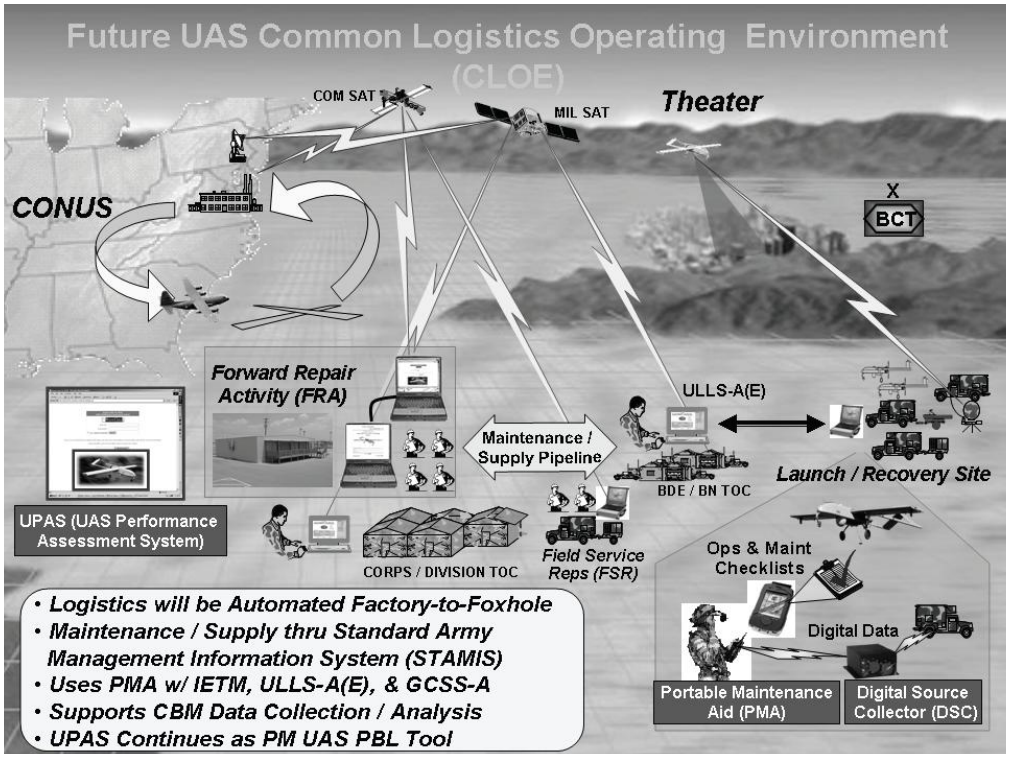


Figure 4-3. Future logistics support

CONTRACTOR LOGISTICAL SUPPORT

4-20. Contractors play a key role in the Army's ability to support their mission, and provide a responsive alternative to increasing the number of support personnel necessary to perform the mission. During each phase of an operation, contracting support is used to augment the support structure. Contracting personnel establish their operations with, or near, the local vendor base to support deployed forces. Contracting support bridges gaps that occur as military logistics resources mobilize, and may be necessary for the duration of the contingency.

4-21. Commanders must understand their role in planning for and managing contractors on the battlefield, and will ensure their staff is trained to recognize, plan for, and implement contractor requirements. FM 3 100.21 is key to understanding basic contracting and contractor management.

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