Collection Tasking of the Corps Unmanned Aerial Vehicle–Short Range (UAV–SR)

A Monograph
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Fielding of the Unmanned Aerial Vehicle-Short Range (UAV-SR) will provide the corps commander a unique collection resource capable of conducting reconnaissance, surveillance, and target acquisition (RSTA) missions; however, U.S. Army doctrine for tasking and employing UAVs is non-existent. The issue of collection tasking for this uniquely flexible RSTA system is examined in this monograph.

The monograph begins with a description of the UAV-SR system including the organization of the corps aerial reconnaissance company and the system's capabilities, limitations, and vulnerabilities. Next, the monograph surveys the definitions, principles, and relationships between each of the three missions the UAV-SR system is capable of: reconnaissance, surveillance, and target acquisition. This is followed by an examination of the corps battlefield intelligence operating system including the relationship between Intelligence Preparation of the Battlefield (IPB), the tactical decisionmaking process, the targeting process, the collection management process, and the resultant products: priority intelligence requirements (PIR), intelligence synchronization matrix, high payoff target list, and the collection plan. Historical use of UAVs in Vietnam, Lebanon, Honduras, and Southwest Asia completes the presentation of research data.

Analysis of this data concludes that the existing doctrinal collection management process is sufficient for tasking the UAV-SR and the most effective tasking will result when commanders, G2s, and collection managers recognize the UAV-SR as a reconnaissance, surveillance, *and* target acquisition resource. Four recommendations are made to ensure that tasking is focused on the corps commander's information requirements. First, the definition of target acquisition needs to be modernized to differentiate it from reconnaissance and surveillance operations. Second, the importance of PIR as the commander's tool to focus his collection effort must be reemphasized within the corps. Third, the doctrinal confusion caused by the relationship between PIR and the high payoff target list must be resolved. Finally, and perhaps most importantly, collection managers must understand in detail the capabilities, limitations, and vulnerabilities of the UAV-SR system.

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I. INTRODUCTION

As the United States prepares to enter the twenty-first century, the global changes sparked by the fall of the Berlin wall and the end of the Cold War continue to profoundly effect the nation's armed forces. The loss of the definitive Warsaw Pact threat and the ensuing reduction in defense spending impacts on the quality of intelligence support provided to warfighting commanders now and in future conflicts. Previously, AirLand Battle doctrine had the luxury of focusing a structured intelligence process to evaluate a well-studied enemy arrayed on a linear battlefield. The June 1993 Field Manual (FM) 100-5, Army Operations, recognizes that future Army operations will likely occur on a non-linear battlefield against an unpredictable and diverse array of possible threats.

This inability to focus analytical study on a primary threat, as well as reduced intelligence budgets, results in a lower level of knowledge (such as order of battle information and threat doctrine) for input into the intelligence process. The warfighting commander's level of confidence in resultant intelligence forecasts prepared during the tactical decision making process is significantly lower than in the past. Consequently, the intelligence battlefield operating system is now more challenged to verify the validity of forecasted enemy actions and to reduce the commander's uncertain view of the modern battlefield. One system which will play a large part toward verifying intelligence forecasts and reducing the commander's battlefield uncertainty is the Unmanned Aerial Vehicle-Short Range (UAV-SR).

On February 12, 1993 the Defense Acquisition Board approved an initial purchase of seven UAV-SR systems.[1] When fielded beginning in fiscal year 1995, the system will provide collection support to the corps as an organic element of the aerial exploitation battalion.[2] However, doctrinal U.S. Army employment procedures for UAVs are non-existent. Three procedural issues confront the U.S. Army: collection tasking; dissemination of collected information;[3] and airspace management.[4]

The monograph's limited length precludes addressing all three issues. Resolution of the latter two issues, dissemination and airspace management, depends on the outcome of the collection tasking issue. Dissemination instructions for reporting of collected information including the recipient, the timeliness, and the medium will largely be a function of the mission tasked to the UAV-SR system. The airspace management issue involves the refinement of existing airspace management doctrine and is also dependent upon a determination of how the system is tasked and the degree of flexibility inherent in the tasking alternatives.[5]

The objective is to partially fill the doctrinal void of UAV employment procedures by focusing on collection tasking of the UAV-SR system. The research question posed is: "How is the UAV-SR system most effectively tasked to answer the corps commander's information requirements?" The unique capabilities of the UAV-SR system as a reconnaissance, surveillance, and target acquisition asset complicate the tasking decision for the corps commander, G2, and collection manager. These difficulties are addressed and solutions recommended.

The information necessary to answer the research question relies on an integration of knowledge from four areas. First, the capabilities, limitations, and vulnerabilities of the UAV-SR system are key to determining how it should be employed on the battlefield. Next, an understanding of the varied missions the system is designed to conduct is necessary to ensure effective tasking. Third, blending the UAV-SR system into the corps intelligence battlefield operating system requires knowledge of that battlefield and the existing system. Finally, observations from previous employment of unmanned aerial vehicles provide valuable insights for development of tasking considerations.

II. THE UAV-SR SYSTEM

"The unmanned vehicle today is a
technology akin to the importance
of radars and computers in 1935."[6]

The UAV-SR system is the centerpiece of the Defense Department's acquisition strategy for unmanned aerial vehicles. This strategy is based on the establishment of a family of interoperable and common UAV systems. In addition to the UAV-SR, the strategy recognizes three other categories of UAV capabilities: Close Range, Medium Range, and Endurance.[7] Chart 1 depicts the categories of UAV capabilities and Chart 2 outlines the mission needs statements for each of the four UAV categories.

As the centerpiece for the UAV family, UAV-SR will provide real time reconnaissance, surveillance, and target acquisition (RSTA) out to two hundred kilometers beyond the forward line of troops, day or night, and in limited adverse weather. Current planning envisions the acquisition of twenty-four UAV-SR baseline systems for the Army allocated as shown in Chart 3.[8] The baseline UAV-SR system consists of the following components: one mission planning station (MPS), two ground control stations (GCS), two ground data terminals (GDT), eight air vehicles (AV), twelve modular mission payloads (MMP)--eight imagery and four air data relay, four remote video terminals (RVT), one launch and recovery system (LRS), and one mobile maintenance facility (MMF).[9] Appendix A provides a description of UAV-SR system components.

The Aerial Reconnaissance Company

The UAV-SR system will be organized into an aerial reconnaissance company within the corps military intelligence brigade's aerial exploitation battalion. The aerial reconnaissance company will be constituted around two baseline UAV-SR systems. Charts 4 through 7 depict the organization of the aerial reconnaissance company. The aerial reconnaissance company can perform system setup within three hours and tear down for movement in ninety minutes.[10] Manning and maintenance requirements will limit the aerial reconnaissance company to a total of four ten-hour missions per day (one per ground control station). Each mission includes launch and recovery of both a mission air vehicle and a data relay air vehicle (total of eight air vehicle sorties).[11] The aerial reconnaissance company can distribute eight remote video terminals throughout the corps sector that provide real time monitoring of the tasked RSTA mission. In a force projection operation the aerial reconnaissance company can provide a rapid deployment capability for air movement. Chart 8 reflects the number of sorties by type airlift required to transport such a capability as well as the remaining baseline system and the entire company.

The Modular Mission Payload

The core of the UAV-SR system is the modular mission payload. The baseline modular mission payload consists of eight multimission optronic stabilized payloads (MOSP) and four air data relay payloads. The multimission optronic stabilized payload consists of a dual sensor, TV and FLIR, mounted on a stabilized gimbal system with a 360° azimuth and +15° to -105° elevation field of regard[12] with "sufficient resolution to recognize light tactical vehicles and personnel in the open through normal battlefield obscurants."[13] The TV has two fields of view and the FLIR three. Chart 9 depicts the footprints in each field of view at an optimum air vehicle altitude of five thousand feet. Chart 10 highlights other sensor technical characteristics. Target location accuracy of the multimission optronic stabilized payload is "sufficient to permit corps fire support systems to fire first-round fire for effect"[14] with an eighty meter circular error probable (CEP).[15]

UAV-SR Limitations

The UAV-SR system limitations include line of sight, weather, field of view, tracking, and logistics. Line of sight considerations between the ground data terminal and the air vehicle limit the range of the UAV-SR system. At a maximum mission altitude of 15,000 feet, the ground data terminal can only maintain line of sight with the air vehicle to an approximate range of 125 kilometers. The use of an air data relay air vehicle extends the system range by an additional seventy-five kilometers (the maximum relay range between two air vehicles).[16]

Weather limitations include a take-off and landing cross wind of twenty knots, a head wind of thirty-five knots with gusts to a maximum of forty-five knots, and heavy rain of over two inches per hour with winds to thirty-five knots maximum.[17] The systems limited field of view precludes wide-area surveillance and requires cross cueing to be effective in some missions.[18] The lack of an automatic tracking or search capability significantly increases operator work load and increases the probability of a search area being missed. Finally, the present system uses gas fueled engines that could cause logistical problems.[19]

UAV-SR Vulnerabilities

Vulnerabilities of the UAV-SR system are active emissions, air vehicle size, and criticality of the ground data terminal. During non-autonomous operations, the UAV-SR system is vulnerable to threat intercept of emissions between the ground data terminal and the air vehicle. The large size of the air vehicle may "increase its susceptibility to detection, acquisition, and engagement by enemy weapon systems."[20] Finally, a critical link in the system is the ground data terminal. While loss of the ground data terminal does not prevent mission execution (autonomous air vehicle and payload operations are possible), it does limit flexibility by preventing monitoring and reporting during mission execution.

Future System Improvements

Planned block improvements to the UAV-SR system include modular multimission payloads with capabilities such as moving target indicator (MTI) radar, signals intelligence (SIGINT), laser designation, chemical agent detection, and meteorological sensor; a lightweight fuel efficient engine capable of burning multiple military supportable fuels (JP-5, JP-8, and diesel); an automatic tracking and search capability; survivability enhancements; and data link hardening.[21]

UAV-SR Mission Execution

The aerial reconnaissance company will execute a typical deep RSTA mission as follows. The launch and recovery section prepares the mission air vehicle for launch, programs navigational parameters into the mission air vehicle, launches the mission air vehicle, and passes control to the ground control station at a prearranged position and altitude. Once the ground control station has control of the mission air vehicle, the launch and recovery section prepares, programs, and launches the relay air vehicle. The relay air vehicle flies the preprogrammed route to an orbit in previously coordinated airspace. The orbit location is selected based upon line of sight considerations and, if required, on a maximum forty kilometer range limitation for reception of mission data by remote video terminals. The launch and recovery section activates mission payloads for both air vehicles during preflight procedures. Once the relay air vehicle establishes an orbit, the ground control station shifts from direct control of the mission air vehicle to control through the air data relay payload on the relay air vehicle. The ground control station maintains direct control of only one air vehicle at a time through the ground data terminal, normally the mission air vehicle. The ground control station accomplishes control of the relay air vehicle through monitoring. (Chart 11)

Upon reaching its planned altitude, the mission air vehicle proceeds to the target area via programmed way points. The ground control station conducts the mission, with control data being passed through the relay air vehicle to the mission air vehicle, and payload data (as well as air vehicle status) being passed through the relay air vehicle to the ground control station. The ground control station operator is able to assume control of the mission air vehicle and alter its course if necessary. Upon reaching the target area, the mission air vehicle begins the programmed RSTA mission of the target area. The mission air vehicle continues until programmed to return to the recovery site or until the operator assumes manual control to divert or terminate the mission early. (Chart 12)

At the end of the mission, the ground control station operator (or the programmed mission plan) will fly the mission air vehicle to some point within direct control range from the ground control station. At this time the ground control station will assume direct control of the mission air vehicle and subsequently pass control of the relay air vehicle to the launch and recovery section for normal recovery operations. Once the launch and recovery section recovers the relay air vehicle, the ground control station passes control of the mission air vehicle to the launch and recovery section for recovery.[22] (Chart 13)

UAV-SR Information Dissemination

Collected information can be reported via several different mediums. First, the UAV-SR can provide real time reports through the use of the remote video terminal. Near real time information is provided by SALUTE (size, activity, location, unit, time, and equipment) reporting provided over SINCGARS or

Multiple Subscriber Equipment (MSE). Targeting data can be directly input into the Advanced Field Artillery Target Designation System (AFATDS). Hard copy freeze frame imagery (taken at intervals up to 7 seconds duration) can be transmitted via MSE or provided via courier. Post mission reporting includes reconnaissance exploitation reports provided via MSE as well as mission video provided via courier.[23]

III. RECONNAISSANCE, SURVEILLANCE, AND TARGET ACQUISITION (RSTA)

> "Fewer forces and the increased lethality and range of modern munitions, will put a premium on information-gathering and processing. Without the ability to know where the enemy force is in near real time, the corps commander will be unable to shape the enemy for destruction."[24]

The UAV-SR provides the corps commander a significant capability with the potential to dramatically enhance his vision of the battlefield. However, like all combat systems the UAV-SR must be properly tasked to meet its potential. An understanding of the variety of missions--reconnaissance, surveillance and target acquistion--the UAV-SR system can perform and their principles is a prerequisite for determining effective tasking procedures.

The starting point for understanding RSTA operations is their relationship to intelligence. Intelligence is defined as

> "the product resulting from the collection, evaluation, analysis, integration, and interpretation of all available information concerning an enemy force, foreign nations, or areas of operations and which is immediately or potentially significant to military planning and operations."[25]

The purpose of intelligence operations is to develop the final product of usable intelligence which answers the corps commander's information requirements through a process referred to as the intelligence cycle. RSTA operations are elements of the collecting phase of the intelligence cycle.[26]

While similar in purpose, RSTA operations are significantly different in execution. Reconnaissance is defined as

> "a mission undertaken to obtain information by visual observation, or other detection methods, about the activities and resources of an enemy or potential enemy, or about the meteorological, hydrographic, or geographic characteristics of a particular area."[27]

Reconnaissance operations are normally time sensitive, are active in nature, and may rely on stealth.[28]

Surveillance differs from reconnaissance by generally being passive in nature, relying on stealth to avoid detection, is normally preplanned, and is generally less time sensitive.[29] Surveillance is defined as

> "a systematic observation of airspace or surface areas by visual, aural, electronic, photographic, or other means."[30]

During reconnaissance operations, the collector pursues specific information during a particular time frame. Surveillance operations wait for anticipated information over a longer period of time. "Reconnaissance is conducted to gain specific information at a particular time while surveillance is conducted to gather information over a wider area, over a longer period of time."[31]

The principles of reconnaissance and surveillance from FM 34-2-1, <u>Tactics, Techniques, and Procedures for Reconnaissance and Surveillance and</u>

Intelligence Support to Counterreconnaissance, are: tell commanders what they need to know in time for them to act (commander oriented and commander directed); and do as much as possible ahead of time (build a data base ahead of time including regional data and enemy order of battle).

The fundamentals of reconnaissance from FM 17-98, Scout Platoon, are: use maximum reconnaissance force forward (none held in reserve); orient on the reconnaissance objective (establishes a requirement for a specific objective, an information requirement); report all information rapidly and accurately (information loses value over time; never assume, distort, or exaggerate-inaccurate information is dangerous; information that the enemy is not there is just as important as where the enemy is); retain freedom to maneuver (do not become fixed; continually maintain an awareness of the tactical situation); gain and maintain enemy contact; and develop the situation rapidly.

Target acquisition is defined as "the detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons."[32] As currently defined, target acquisition occurs as an integral component of both reconnaissance and surveillance operations. Target acquisition supports the target development process by providing collected combat information to analysts for processing. After processing, targets are passed to the targeting team for an engagement decision.[33] Key to successful target acquisition is the ability of the collector to report locations with sufficient accuracy to support first round fire for effect.

Successful execution of RSTA operations is dependent upon focusing information gathering on the corps commander's information requirements as noted in the principles above: "tell commanders what they need to know" and "orient on the reconnaissance objective." Both principles indicate the need for RSTA operations to have specific collection requirements. The next section examines where the corps commander's information requirements are likely to be on the battlefield and the corps process for focusing collection assets on requirements.

IV. THE CORPS INTELLIGENCE BATTLEFIELD OPERATING SYSTEM

> "Corps are the largest tactical units in the US Army...They plan and conduct major operations and battles, create and maintain the conditions for the success of current battles and set up the conditions for the success of future battles."[34]

An understanding of the corps--it's role, collection assets, and intelligence processes--is necessary as a starting point for developing UAV-SR tasking procedures at the corps level. What follows is not a complete description of the corps and it's intelligence operating system, but rather presents those elements germane to integrating the UAV-SR system including the corps' role in Army operations, a brief review of corps' collection systems, and the processes used to focus those assets in support of the corps' mission.

The Army Corps and Its Collection Resources

As the largest tactical unit, the corps' primary role is the planning and execution of tactical-level battles.[35] This planning and execution is based upon the corps commander's visualization of his battle space and his arrangement of battlefield activities in time, space, and purpose. These battlefield activities are characterized in Army doctrine as deep, close, and rear operations.[36]

"Forces in immediate contact with the enemy are fighting close operations."[37] Corps close operations are the current battles of its major maneuver units. The corps *controls* close operations but does not conduct them. The corps sets and maintains the conditions for success of the current battle by ensuring that it's subordinate divisions, separate brigades, and armored cavalry regiments are adequately resourced.

"Deep operations are those directed against enemy forces and functions beyond the close battle."[38] Deep operations deny the enemy the ability to concentrate by delaying or disrupting follow-on forces thereby altering the threat force's tempo and plan of attack. Thus deep operations contribute to the corps' mission to create and maintain the conditions for success of the close fight. "Deep operations place a heavy premium on knowing the scope, scale, and tempo of the threat's operations and where his main efforts will occur."[39] Deep operations conducted in conjunction with close operations may be decisive or may set the conditions for decisive future operations. Corps *conduct* deep operations.[40] Deep operations become the focal point for intelligence efforts at the corps level.[41] A comparison of the collection assets available to the corps and the division, their respective collection ranges and deep targeting capabilities, reveals why the corps is the focal point for deep operations. (Charts 14 and 15)

The ground based Signals Intelligence (SIGINT) collectors available to the corps mirror those found at the division and are limited in range.[42] The corps airborne SIGINT system, Guardrail Common Sensor (GRCS), provides both a non-communications (ELINT) and communications (COMINT) intercept and direction finding capability. Targets are reported in near real time via Commander's Tactical Terminals (CTT) located with the corps FSE, G-2 All Source Production Section (ASPS), and corps maneuver units. Target location accuracy is sufficiently precise to support first round fire for effect by corps long-range artillery. As an aerial collection platform with limited air maneuverability (the air platform is a modified C-12 fixed wing aircraft), GRCS is limited by the requirement for a minimum of air parity and preferably air superiority within the theater in order to conduct collection operations.[43]

The corps Imagery Intelligence (IMINT) and SLAR capability once provided by the OV-1D will be replaced by the fielding of the UAV-SR in FY95 and the Joint Surveillance Target Attack Radar System (JSTARS) in FY97. JSTARS is a jointly developed Army and Air Force system consisting of an E8 aircraft (modified Boeing 707) containing a multi-mode radar and an array of ground station modules (GSMs).[44] JSTARS capabilities include a wide area surveillance radar which provides moving target indicators (MTI) and a synthetic aperture radar (SAR) for fixed targets out to a range beyond two hundred kilometers.[45] The ground station module receives and displays surveillance data from the aircraft sensor. Each corps will receive six ground station modules in addition to six fielded to each division.[46] JSTARS operations are similarly limited as GRCS by a requirement for air parity or better.

The corps Human Intelligence (HUMINT) capability is significantly more robust than the division. The corps long range surveillance company consists of eighteen six-man teams capable of deep surveillance and limited reconnaissance out to 150 kilometers beyond the forward line of troops (FLOT). The corps also has eight three-man Interrogation (IPW) teams and nine three-man counterintelligence (CI) teams.[47]

Additional collection assets are found in the armored cavalry regiment, the corps aviation brigade, and corps artillery. The corps also receives significant collection support from joint systems such as JSTARS noted above and through the Tactical Exploitation of National Capabilities (TENCAP) program. The organic ELINT exploitation system, Electronic Processing and Dissemination System (EPDS), receives data from both national and theater collection systems. The IPDS, Imagery Processing and Dissemination Station, receives, processes, and exploits digital imagery from national and theater systems.[48] While the actual collectors are not organic to the corps nor generally responsive to the priorities of the corps commander, these systems do provide crucial intelligence support.

Focusing Corps Collection Resources

Since "the operational success of the corps depends on the timeliness and accuracy of the corps intelligence,"[49] the collection assets discussed above must be properly focused and fused to support the commander's concept of operations and reduce battlefield uncertainty. The corps synchronizes its intelligence efforts through execution of the following doctrinal processes: the tactical decisionmaking process, Intelligence Preparation of the Battlefield (IPB), the corps targeting process, and the collection management process. The products from these processes--priority intelligence requirements (PIRs), intelligence synchronization matrix, high payoff target list, and the collection plan--ensure that scarce intelligence assets are focused and synchronized with the other members of the combined arms team to achieve the commander's intent.

Tactical Decisionmaking, IPB, and Targeting Processes. The tactical decisionmaking process is a dynamic and continuous process which identifies the corps mission, develops concepts for executing the mission, evaluates the concepts, and communicates the commander's decision in a clear, concise manner.[50] "IPB is a systematic and continuous process of analyzing the enemy, weather, and terrain in a specific geographic area."[51] The IPB process is fully integrated with the tactical decisionmaking process. Chart 16 shows the integration of the tactical decisionmaking process, IPB, and their relationship to the intelligence cycle. As a result of this integration, two essential products for focusing the corps intelligence effort are produced: PIRs and the intelligence synchronization matrix.

PIRs are the corps commander's primary means to focus his intelligence collection effort.[52] The tactical decisionmaking process and IPB give the corps commander and staff a common understanding of the battlefield. As a result, uncertainties (gaps in battlefield knowledge) are recognized and listed as

Intelligence Requirements (IRs). Based upon the commander's selected course of action, certain IRs become critical to mission accomplishment. These commander-selected IRs are prioritized and become PIRs.

The intelligence synchronization matrix is the expanded intelligence portion of the battlefield operating system synchronization matrix produced during the course of action analysis of the tactical decisionmaking process. This matrix establishes deadlines for answering the commander's PIR. Normally these deadlines will correspond to a decision point (DP) on the decision support template (DST) produced during wargaming. However, deadlines for PIR not associated with a DP are also listed to ensure they are answered when required. The significance of the intelligence synchronization matrix is that it timelines all the activities associated with answering the PIR including tasking times, collection and processing times, and dissemination times. This ensures that the intelligence is not only collected but is delivered on time to the right commander.

The corps targeting process is based on the decide-detect-deliver (D3) methodology. The decide function conducts a target value analysis to determine what targets to attack, tasks target acquisition assets, and selects attack means. The decide function corresponds to the intelligence cycle's directing phase and is accomplished through execution of the tactical decisionmaking process and the IPB process (Chart 16). The decide function produces the high payoff target list (HPTL)--targets which if attacked contribute to the success of friendly operations, target selection standards (TSS)--accuracy requirements to produce attackable targets, and the attack guidance matrix (AGM)--how to attack the targets. The detect function executes collection to gather timely information which answers the commander's intelligence and target acquisition requirements. The detect function corresponds to the collecting, processing, and disseminating phase of the intelligence cycle. The deliver function attacks identified targets with lethal or non-lethal means according to the attack guidance matrix and executes target damage assessment.[53]

The Collection Management Process. The products from the processes above--PIR, high payoff target list, and the intelligence synchronization matrix--are input into the collection management process to develop the corps collection plan. The collection management process is a five-phase process which "attempts to acquire and disseminate the most timely and pertinent battlefield intelligence available."[54] The process is divided into three separate functions: requirements management, mission management, and asset management. The five phases are receive and analyze requirements, determine resource availability and capability, task or request tasking of resources, evaluate reporting, and update collection plan.[55] Chart 17 depicts the relationship between the collection management functions and the phases as summarized in the following paragraph.

Within the corps G-2 Collection Management and Dissemination (CM&D) section, the requirements manager receives the requirements developed during the tactical decisionmaking and IPB process (PIRs, IRs, requests for intelligence information, HPTL) and, in coordination with the G-2 All Source Production Section (ASPS), develops and refines requirements into specific information requirements (SIR)--what to collect. SIR confirm or deny specific indicators of situations which answer the information requirement. SIR are passed to the mission manager. The mission manager determines which collection resources are available and capable of satisfying the SIR and develops a collection strategy--how to satisfy the SIR. The mission manager, through the asset manager (the collection unit commander), then tasks, requests, and coordinates the use of specific assets to accomplish the mission. The asset manager plans and executes the actual collection mission. The requirements manager then evaluates reporting and initiates refinement to the collection plan.

The mission management function is of primary interest to determining how the UAV-SR is best tasked to support the corps commander's intelligence requirements. In order to develop a collection strategy the mission manager must first understand what resources are available and the operational status of collection assets; for example, the number of LRSU teams available, the number of GRCS sorties available in a twenty-four hour period, and theater and national asset availability. Next, the mission manager must fully understand the capabilities and limitations of each available collection system as they relate to the satisfaction of an SIR at a specific time as reflected by the intelligence synchronization matrix. Finally, the mission manager develops the collection strategy.

The mission manager has four collection strategies to consider. The first is resource integration. This strategy integrates new collection requirements into ongoing or planned missions. This strategy reduces risk and conserves limited collection resources.

Cueing is also considered as a possible collection strategy by the mission manager. Cueing essentially involves one collection system providing information to another to increase collection effectiveness. Specifically, a wide area surveillance system provides target information to a more accurate, point target collection system, or a SIGINT collection system with no direction finding capability cues one with the ability to locate the emitter.

The third collection strategy is asset mix. This strategy uses the capabilities of collection assets from different disciplines to collect against a specific requirement. For example, a UAV may detect a possible command post while a SIGINT collector determines its identification.

The final collection strategy is asset redundancy. This strategy employs multiple assets from the same discipline. This increases the probability of success and is normally employed against high priority requirements.

The actual development of a collection plan will employ several of these strategies in combination to ensure the satisfaction of the corps commander's information requirements.

An essential component of the collection management process is dissemination. Reporting requirements must be considered simultaneously with collection planning. Collected information has little value if it is not provided when required. The intelligence synchronization matrix described above assists the mission manager to visualize when information is required by the corps commander. As the collection plan is developed, the mission manager must consider the processing and reporting times associated with each collection asset and backward plan as necessary. Collection tasking information provided by the mission manager to the asset manager must also include reporting requirements such as means of reporting and the latest time the intelligence is of value.

The end result of these processes is a collection plan which focuses the corps' limited collection assets on answering the commander's PIR. It must be remembered that doctrine provides a guide for the employment of the system. The collection manager's knowledge of the system, the situation, and the corps commander's requirements will be the ultimate arbiter to tasking the UAV-SR.

V. HISTORICAL USE OF UAVs

The final area which will be useful to the resolution of the UAV-SR tasking issue is history. UAVs have been used almost since man conquered gravity and learned to fly. During World War I, UAV development centered on flying bombs and aerial targets and by World War II was completed with the German use of the V-1 flying bomb and the Allied use of glide bombs. Development of cruise missiles began in earnest following World War II and still continues today. The use of UAVs for reconnaissance and surveillance did not begin until the Cuban missile crisis in 1962 when the United States began converting target drones. The first operational experience for the United States with reconnaissance and surveillance UAVs occurred in Vietnam. The Israeli Defense Force has actively employed UAVs as aerial decoys and for reconnaissance and surveillance since 1973. During the mid-1980s the United States employed UAVs to conduct reconnaissance and surveillance in Central America. Most recently, UAVs were used, perhaps by both sides, during the war in Southwest Asia.[56]

This section examines the use of UAVs by the United States in Vietnam, Israel in the Bekaa Valley, and the United States in Central America and Operation Desert Shield and Desert Storm. In each case a short background and useful observations are provided. The relationships between the broad categories of unmanned aircraft are depicted in Chart 18. An understanding of this chart and the definition of drones, remotely piloted vehicles (RPVs), and unmanned aerial vehicles (UAVs) provided in Appendix B will be beneficial to understanding the remainder of this section.

Vietnam (1964 to 1973)

The successful engagement of a U-2 reconnaissance aircraft by a Soviet-supplied, Cuban surface-to-air missile in October 1962 stimulated United States development of a reconnaissance drone. "Within 90 days Teledyne Ryan produced its first model 147 RPV based on the Firebee, a subsonic jet-propelled target drone." [57] The Ryan 147B was designed for strategic level reconnaissance and surveillance with a ceiling of 62,500 feet, a range of 1,680 miles, a doppler radar navigation system, and both an imagery and ELINT capability. In mid-1963, the Ryan 147B and the 4028th Strategic Reconnaissance Squadron were declared operational and within four days of the Gulf of Tonkin incident on August 4, 1964 were deployed to Kadena Air Force Base to conduct surveillance and reconnaissance missions over China and Vietnam.[58]

Two significant problems were encountered in these missions--weather and an increasingly sophisticated air defense system. The monsoon weather and its associated overcast greatly inhibited photography if the UAV successfully evaded the twin air defense threats of the SA-2 missile and MIG interceptor aircraft. The first combat loss of a drone over China occurred on 15 April 1964 and by April 1965 five UAVs had been lost to the Chinese air defense system. These losses were attributed to the clear vulnerability of drones with steady flight paths and an inability to detect threats and respond to those threats.[59] The initial response to both the weather problem and the air defense threat was to equip the drones with a Barometric Low Altitude Control System (BLACS). This system enabled the UAVs to operate as low as 150 feet where they could evade air defense radar coverage and were less affected by smoke, cloud, or haze.

The UAVs began operating at both high and low levels and were initially successful; however, the increasingly sophisticated air defense system began to take its toll. "The vulnerability of the drones against the constantly improving North Vietnamese air defenses, particularly at low level, now led to a new emphasis on survivability."[60] UAVs were equipped with electronic countermeasures (ECM), a multiple altitude control system, and modified to permit a much smaller turning radius.

The early operational missions relied on a doppler navigation system with preprogrammed routes and target areas. This system used a doppler-signal update every seven miles with pre-set flight events such as turns and photos and a backup system based on elapsed time. As the war progressed UAV operations evolved through operations as a pure drone, to operations as a drone with an override capability, to pure RPV operations with the RPV being flown by a controller in a the launch C-130 (most UAVs were air launched). Once launched, control of the UAV was not always maintained; however, some of the most valuable "bonus" discoveries resulted from UAVs wandering off course. This included such things as key targets like a huge North Vietnamese fuel storage areas in a suburb of Hanoi.[61]

Throughout the Vietnam War from late 1964 to the cease-fire in 1973, the United States conducted over 3,400 UAV sorties over China and Vietnam under such code names as Compass Bin, Buffalo Hunter, and Compass Dawn.[62] Their attrition rate from both accidents and enemy action was less than ten percent[63] (and maybe as low as four percent).[64] In addition to conducting photographic and ELINT missions, the United States used UAVs in Vietnam for leaflet drops, signals intelligence, and as decoys and electronic countermeasures (ECM) platforms for manned bombing strikes or to protect other reconnaissance UAVs.

Israel in Operation Peace for Galilee (1982)

Following the Vietnam War, the next operational use of UAVs probably occurred in the Middle East during the Six-Day War of 1973. However, due to Israeli secrecy little is known about the details.[65] More is known about Israeli operations in the Bekaa Valley in 1982. On June 6, 1982 the Israeli Defense Force (IDF) launched Operation Peace For Galilee designed to destroy the Palestine Liberation Organization as a military force and to neutralize the Syrian SA-6 air defense systems in Lebanon that would interfere with that effort.[66] Innovative application of tactical UAVs played a key role in the IDF success.

Israeli UAV efforts at the time focused on three systems--the Scout, Mastiff, and Pioneer--each similar in operational concept. The Scout is a purely reconnaissance and surveillance platform with a panoramic camera and a TV camera. The Mastiff and Pioneer can carry suites of electronic warfare equipment, laser designators, communications relay, or TV camera payloads. All can be preprogrammed to fly by autopilot or can be controlled from a ground control station. Each makes conventional take-offs or rocket/pneumatically assisted take-offs, uses composite materials and aluminum alloys to reduce radar signature, and provides real time data for analysis and processing in the ground control station. The Scout and Mastiff systems have an operational range of fifty four miles.[67] The Pioneer system has a range in excess of one hundred miles.[68]

The use of UAVs over the Bekaa valley began a year before the actual attack providing tactical intelligence on the SA-6 positions which greatly aided operational planning.[69] The air attack commenced with a wave of UAVs launched as decoys to activate the tracking radars of the SA-6s. Other UAVs, equipped with an ELINT payload, relayed these tracking signals to a ground control station which provided the information to an E2C Hawkeye AWACS aircraft orbiting off the coast. The AWACS in turn advised the pilots of the attacking aircraft of the proper jamming frequencies, passed target data for those enemy radars within range of IDF artillery units for engagement, and handed off enemy radar targets outside artillery range to F-4 aircraft for engagement by anti-radiation missiles.

Once the radars were neutralized or destroyed, F-4 and F-16 aircraft conducted simultaneous low-altitude attacks from varying directions against surviving radar vans and missile launchers.[70]

In addition to their use for the SAM suppression operation, UAVs were also key to the success of the IDF in the air battles. Both Mastiff and Scout UAVs were positioned over three major airfields in a surveillance role. Using their electro-optic cameras and data link these UAVs provided real time video imagery of Syrian fighters positioned for take-off in response to the SAM suppression raid. This information was similarly relayed to the orbiting AWACS which was able to pick up the MIGs on radar as soon as they left their runways and issue intercept vectors to the airborne fighter aircraft.

The Israeli success in this operation was complete. The Syrians lost seventeen of nineteen SA-6 batteries and over ninety MIG aircraft and the Israelis gained complete air superiority within a matter of hours.[71] "Throughout the operation orbiting Scout and Mastiff RPVs provided continuous video coverage of events for the ground based IAF strike commander."[72]

Honduras (1984 to 1986)

The next operational use of UAVs by the United States occurred from November 1984 to April 1986 in Honduras. The U.S. Army deployed a Skyeye UAV system to patrol arms supply routes and conduct other intelligence gathering activities from a dirt strip near San Lorenzo, Honduras on the Pacific Ocean between El Salvador and Nicaragua. The Skyeye system consisted of a FLIR camera mounted on a propeller driven air vehicle with a maximum range of forty miles and a six hour endurance.[73]

Several challenges were experienced during this deployment with the main one being an inability to find targets. This difficulty was caused by three related issues all associated with collection management. The first was the mountainous terrain which forced the Skyeye to high altitudes to maintain line of sight. Local mountains were above 3,500 feet which forced the Skyeye to an even higher altitude. However, the FLIR system needed to be below 1,500 feet to reliably detect a human in the valley paths.

The second issue affecting successful targeting was definition of collection requirements. As a result of not fully understanding the capabilities and limitations of the system (such as line of sight difficulties noted above), the tasking authority levied poor or conflicting requirements for collection. This same difficulty was recognized by the U.S. Marine Corps during exercise Kernel Blitz 88-1. In addition to taskings not making maximum use of the UAV's capabilities and not providing focused collection requirements during this exercise, the taskings received "were often of such a nature that they were accomplished after only a few minutes of time on station."[74] In Honduras, even when the system was able to discern targets which might meet requirements, it was difficult to analyze whether a truck was full of cotton or a truck full of guns covered by cotton. As stated by one of the UAV unit commanders, "We're going after low-tech targets with high-tech systems."[75]

The biggest issue which caused an inability to locate targets was the narrow field of view FLIR and the lack of cueing for the system. Without another collection system or an onboard wide area surveillance system such as a radio direction finding system, Skyeye was left to find targets on its own. Again a UAV unit commander from the deployment comments, "We bored holes in the sky for six hours at a time and unless someone could tell us that something was there, and where to look, it's very difficult [to find targets] if you're trying to cover a forty mile radius looking through a soda straw."[76] Skyeye operations ceased when research and development financing became unavailable.

Operation Desert Shield and Desert Storm (1990 to 1991)

The most recent UAV operational experience for the United States was in Southwest Asia. During Operation Desert Shield and Desert Storm, six operational U.S. Army, U.S. Navy, and U.S. Marine Corps UAV units flew over three hundred missions. Only one air vehicle was shot down while three others were hit by ground fire during combat missions and safely recovered. Navy assets were used for battleship target selection, spotting naval gunfire, and battlefield damage assessment (BDA). The Marine Corps used UAVs to direct air strikes and provide near real time reconnaissance for special operations. The Army used UAVs to accomplish BDA, area searches, route reconnaissance, and targeting.[77] Three different UAV systems were employed--Pioneer, Pointer, and Exdrone.

The Pioneer system (described above for Israeli operations) was the primary workhorse for all services. The need for intelligence became so great (SIGINT provided little intelligence due to Iraqi communication security) that

UAVs built for testing, the Exdrone system, were used to supplement Pioneer operations. The Exdrone system consisted of an expendable, delta-wing UAV equipped with a color video camera and a seven hour endurance. The day only video camera limited Exdrone to daylight operations. Pioneer's electro-optic system provided the night vision capability.[78] The Pointer system "proved practically useless because of its inability to fly in winds of more than fifteen knots and operate out of visual range over the featureless desert." [79]

Prior to the start of the ground offensive, UAVs were used to map Iraqi minefields and bunkers, to locate and direct counterbattery fire on Iraqi artillery positions, and for targeting and BDA on Iraqi targets hit during strike operations.[80] Imagery from UAV operations allowed ground commanders to analyze the Iraqi defenses, including minefield composition and obstacle belts, thereby facilitating attack planning.[81] The Marines used one of their three RPV companies nearly full time to verify JSTARS moving ground targets.[82]

At the start of the ground offensive, bad weather prevented the use of UAVs for two days. Yet as a Marine task force moved to seize the Kuwaiti airport during the third day, UAV reconnaissance displayed a battalion of Iraqi tanks preparing for a counterattack. Naval gunfire and air attacks broke up the Iraqi force before it could attack.[83] VII U.S. Army Corps primarily used UAVs during the ground offensive as a targeting system for both air and artillery strikes.[84] VII Corps even went so far as to request dedicated A-10 close air support sorties for each UAV mission.

The use of RSTA resources strictly for targeting became one of the primary issues surrounding both UAV and JSTARS employment during the war. The Air Force believed, for example, that the primary function of JSTARS was targeting and not wide area surveillance in support of intelligence situation development. Since Air Force aircraft would attack the targets, the Air Force should control JSTARS.[85] However, as noted by then Brigadier General Stewart, Third Army G-2, "The overall question of targeting versus intelligence seems to be a moot one. Target development and validation is intelligence. It is also part of and drawn from situational development. Therefore, the use of and results from collection systems like JSTARS and the UAV depend upon the Commander's priorities and METT-T."[86]

Two other observations from UAV employment in Southwest Asia are important to note. The first concerns distribution of collected information. Those units operating the UAV systems or with a remote receiver capability received real time intelligence. Other units--higher, lower, adjacent, and supporting--received the intelligence, but not in sufficient time to be of combat value. For example, "the squadrons flying battlefield interdiction and close air support missions were not able to capitalize on the UAV information because it was out of date by the time it reached them."[87] However, a recognition that timely dissemination of combat information was crucial to successful combat operations led to innovative use of UAV imagery. In one case, "a few UH-1N helicopters were fitted with video screens that received information directly from the drones so they could immediately launch helicopter attacks."[88]

The second observation regards not the intelligence support the UAV unit can provide, but rather the importance of providing good intelligence support to the UAV unit. Successful UAV mission execution depends on good mission planning. This planning relies on adequate intelligence support to ensure UAV operators are familiar with the area of operations, the threat, the friendly situation, and the commander' intent. The UAV unit as a minimum must receive all intelligence summaries, operations plans and orders, and the air tasking order. In addition, imagery products are of primary concern as they significantly aid mission planning, battle damage assessment, and navigation.[89]

Operation Desert Storm was the last operational use of UAVs by the United States armed forces. However, UAVs played a not insignificant role to the successful outcome of that conflict. As noted by Major General Forster, then the Director of Combat Requirements at Headquarters Department of the Army, "The Desert Storm experience validated the concept of using Unmanned Aerial Vehicles to perform reconnaissance, surveillance, and target acquisition (RSTA) tasks on the battlefield. The Pioneer UAV systems employed by Army, Navy and Marine Corps elements showed that a relatively simple, inexpensive UAV system can extend the eyes of combat commanders and significantly increase combat effectiveness."[90] Determining tasking procedures to maximize that effectiveness is the focus of the following section.

VI. TASKING THE UAV-SR SYSTEM

Employment procedures for a system as complex as the UAV-SR encompass a broad area. The focus of this section is to ascertain how the UAV-SR system is best tasked to answer the corps commander's information requirements. Tactics, techniques, and procedures for actual mission execution including positioning of system components; selection of routes, orbit areas, and altitudes; and internal mission dynamics are not within the scope of the research. However, mission taskings, in conjunction with the battlefield situation and system capabilities and limitations, will significantly influence tactics, techniques and procedures.

Support Relationships

Field Manual 34-22, Military Intelligence Battalion (Aerial Exploitation) (Corps), states that assets of the aerial exploitation battalion are employed in general support (GS) of the corps. This provides for wide area coverage, is the most economical use of resources, and ensures the corps commander's flexibility to redirect efforts as priorities change.[91] The aerial reconnaissance company and the UAV-SR system should be employed in the same manner.

Corps subordinate unit UAV requirements will generally be satisfied by the planned fielding of the UAV-SR system and the UAV-CR system to the division, armored cavalry regiment, and separate brigade level.[92] If subordinate unit requirements can not be satisfied by organic UAVs or by corps GS UAV-SR missions, the corps commander may direct priority of UAV-SR support to a particular corps element. In unusual circumstances, some UAV-SR resources may be provided to a corps subordinate element in a direct support (DS) or operational control (OPCON) relationship. An example of this would be the corps aviation brigade executing a deep attack against a second echelon enemy element receiving OPCON of a ground control and operations platoon to provide reconnaissance of the air attack route and objective area and post attack battle damage assessment.

The following analysis focuses on tasking the UAV-SR when employed GS to the corps, yet recognizes that other support relationships are possible.

The Tasking Issue

The essence of the tasking issue, and the answer to how the system is best tasked to support the corps commander's information requirements, revolves around resolution of two subordinate issues. First, the capabilities of the UAV-SR are evaluated to determine if the system is better suited for a reconnaissance, a surveillance, or a target acquisition mission. Second, the current doctrinal collection management process is assessed to determine if it effectively tasks the UAV-SR system or if a new process is required.

Target Acquisition Redefined. Before addressing the first issue, it is important to note that Section III stated that target acquisition is considered a component of both reconnaissance and surveillance. The unique capability of the UAV-SR system to provide direct sensor to shooter links with targetable location accuracy and zero processing time gives new meaning to the term target acquisition and its relationship to the target development process, reconnaissance, and surveillance.[93]

The UAV-SR system can provide real time target location data direct to a firing unit's fire direction center through the use of a remote video terminal or in near real time through data transfer into the Advanced Field Artillery Target Designation System (AFATDS). Real time target data can also be provided via remote video terminal to an air liaison officer (ALO) or forward air controller (FAC) for immediate engagement by close air support or air interdiction, to the corps TCAE for EW engagement, or to a subordinate maneuver unit for deep maneuver or counterattack. Target acquisition operations now have the ability to skip the processing and correlation phase and provide real time target information direct to the attacker based on the attack guidance matrix.

With this new capability, the definition of target acquisition operations needs to be updated to distinguish target acquisition operations from reconnaissance and surveillance operations. Target acquisition operations, redefined as operations the sole purpose of which is to detect, identify, locate with sufficient accuracy, and report specific targets *directly* to maneuver, fire support, air, or electronic warfare elements *for immediate engagement*, provide an additional capability within the target development process separate from reconnaissance and surveillance operations (Chart 19). Target development is still supported through the processing and correlation of combat information provided by reconnaissance and surveillance operations. Target acquisition operations provide a more timely capability to support the target development process. This recommended definition differentiates target acquisition from reconnaissance and surveillance and is used for the remainder of the monograph.

Reconnaissance, Surveillance, or Target Acquisition. The issue of whether or not the UAV-SR system is better suited to a reconnaissance, a surveillance, or a target acquisition mission is problematic. System capabilities enable it to quickly seek out information by stealth in day, night, and limited visibility and to rapidly and accurately report that information. Any area of the battlefield can be quickly placed under surveillance by the UAV-SR without significant concerns for ingress and egress of long range surveillance units or special operations forces. The UAV-SR capabilities as a target acquisition asset are noted above.

There are also limitations of the UAV-SR system which specifically influence its ability to conduct each of the three missions. The system's reconnaissance capability is limited by the imagery interpreter's abilities especially as concerns route reconnaissance and trafficability.[94] Sustained, continuous surveillance by the UAV-SR system is limited to a maximum of ten hours. Due to the systems narrow field of view, surveillance must be focused upon specific areas of the battlefield such as named areas of interest or target areas of interest. The narrow field of view requires target acquisition operations to be coordinated with a wide area surveillance system to cue the UAV-SR to a general target location.

History demonstrates that the predecessor to the UAV-SR system, the Pioneer system, was effectively used for each of the three mission types. In Operation Desert Shield and Desert Storm, Pioneer successfully reconnoitered Iraqi defensive positions including minefield locations and layout. During another UAV reconnaissance operation, the Pioneer system located an Iraqi battalion size counterattack force that was neutralized before it could be brought into the battle.

Israel also successfully employed the Pioneer system for reconnaissance of Syrian SA-6 positions prior to execution of Operation Peace for Galilee in Lebanon during 1982. In addition to reconnaissance, the Israelis conducted UAV surveillance of three major airfields which provided key information to airborne controllers in an orbiting AWACS.

The Pioneer system was used extensively for target acquisition during Operation Desert Shield and Desert Storm. The Marine Expeditionary Force routinely used one of their three Pioneer Companies to verify targets located by the wide area surveillance radar of the Joint Surveillance and Target Attack System. As noted earlier, VII U.S. Corps used UAVs strictly for target acquisition and routinely requested close air support sorties to attack located targets.

The capabilities of the UAV-SR system as demonstrated by its predecessor qualify it evenly for all three missions. This makes the UAV-SR a unique system in that there are no other collection resources that are equally capable of performing all three of the reconnaissance, surveillance, and target acquisition missions. Of the two other deep-capable corps collection resources--Guardrail Common Sensor and the long range surveillance company, only Guardrail Common Sensor comes close.

As its name implies, the long range surveillance unit is primarily a surveillance resource. It has a limited reconnaissance capability and only performs target acquisition as a component of surveillance operations. Guardrail Common Sensor has the capability to perform both electronic reconnaissance of the battlefield and electronic surveillance of specific areas of the battlefield. Target acquisition is conducted as a component of both reconnaissance and surveillance operations. Reporting of information is in near real time and the accuracy of target locations is comparable to that of the UAV-SR system; however, located targets may not be those desired for attack. Guardrail Common Sensor locates transmitters, either antennas for communications equipment or radars associated with air defense weapons. Guardrail Common Sensor can provide excellent cueing information for the target acquisition mission of the UAV-SR system.

Even the Joint Surveillance Target Attack System (JSTARS) does not rival the flexibility of the UAV-SR system. As a primarily wide area surveillance system, JSTARS has limited capability to conduct target acquisition. Similar to Guardrail Common Sensor, JSTARS can provide good cueing data for the target acquisition mission of the UAV-SR system as was done during Operation Desert Shield and Desert Storm.

The Tasking Process and the UAV-SR. The preceding analysis concludes that the UAV-SR system is a uniquely flexible collection system equally capable of performing each of the reconnaissance, surveillance, and target acquisition missions. This assessment focuses the evaluation of the current doctrinal collection management process for tasking the UAV-SR system. If the UAV-SR system had proven best at one particular mission, then the resolution of this second issue would be simple. The collection management process works well for tasking reconnaissance resources, surveillance resources, target acquisition resources, and even resources capable of both reconnaissance and surveillance. No new tasking procedure would be necessary. However, the UAV-SR provides a unique collection asset equally capable of all three missions. Commanders, G-2s, and collection managers have never before had a collection resource with so much flexibility. This uniqueness, the systems equal capability to conduct reconnaissance, surveillance, or *target acquisition*, provides the focus for determining if the current doctrinal collection management process is adequate for tasking the UAV-SR.

The collection management process was developed to focus limited collection resources to answer the commanders information requirements to include acquiring targets. Currently, the only target acquisition capability with direct sensor to shooter links is the weapons locating radar. These systems have but one function--to locate indirect fire weapons and mortars for attack[95]--and are located within the artillery organization. The addition of a collection resource that is fully capable of long-range target acquisition as well as reconnaissance and surveillance may cause difficulties for the collection manager and the collection management process.

This difficulty will arise whenever target acquisition capable resources are not tasked by the collection management process specifically for target acquisition. The UAV-SR tasked by the collection plan for reconnaissance and surveillance missions and not target acquisition missions, even though the collection plan is clearly based upon the commander's stated priorities, will prove a difficult concept for targeteers and fire support officers to accept. Any and all target acquisition resources, even if capable of other collection missions, will be expected by some to be used only for target acquisition.

Direct evidence of this potential difficulty is not available; however, previous use of UAVs by the U.S. Army and UAV operations in Operation Desert Shield and Desert Storm provide hints of a forthcoming dilemma. The U.S. Army's first Remotely Piloted Vehicle Company operated the Aquila UAV system from 1984 to 1988. The system's sensor was primarily designed for artillery observation and fire control[96] and was assigned to an artillery brigade, similar to the weapons locating radar.[97] During Operation Desert Shield and Desert Storm, UAVs were used for each of the three possible missions; yet the emphasis appeared to be on targeting--the Marine Corps dedicated one entire company to respond to cues from JSTARS in a targeting mission and VII Corps concluded that the UAV is a targeting resource, not a reconnaissance and intelligence asset.[98] A significant issue raised in the Third Army G2's After Action Report concerned the employment of UAVs and JSTARS and "whether they are targeting or intelligence assets."[99]

There are several solutions which present themselves to resolve this dilemma. The first is for the Army to designate the UAV-SR as a reconnaissance and surveillance asset, or as a target acquisition asset. Of course, this solution is unacceptable because it deprives the commander of the flexibility inherent in a system capable of all three missions. Additionally, the fact that the system was designated as a certain type of asset would not stop the alternate capability from being used in the field.

The second solution to this difficulty is for the commander to designate his intent for the use of the UAV-SR system for each operation. A process could be devised similar to the method for allocating air combat sorties between close air support, air interdiction, and offensive/defensive counter air. The corps commander could allocate, for example, twenty five percent of all UAV-SR missions to target acquisition with the remainder to go for reconnaissance and surveillance. This solution has some merit in that it preserves the flexibility of the system and ensures the commander's intent for UAV operations is followed. However, there are some difficulties with this solution as well.

First, the commander's primary method of focusing his collection effort, including target acquisition, is through his selection of priority intelligence requirements. Inviting the commander to also allocate a percentage of UAV missions dedicated to target acquisition, or even for the commander to designate certain missions as strictly target acquisition, undermines the entire collection management process, a process based upon satisfying the commander's priority intelligence requirements.

Secondly, the requirement for the commander to make a decision on UAV operations and dedicate a certain percentage of all UAV missions to target acquisition is probably too specific a decision to be made at his level. A decision to use UAV-SR as a target acquisition asset requires knowledge of the collection resources available for cueing and a forecast of anticipated success by those assets. As noted during UAV operations in Honduras, without cues as to target locations, attempting to acquire targets with a narrow field of view UAV is like trying to find targets in a large area with a "soda straw." The use of UAVs for target acquisition requires an integrated and synchronized collection plan to ensure cueing assets are tasked during the right time and against the correct targets. The specific decision to use the UAV-SR for target acquisition is therefore best left to the collection manager. It is important to note that the collection plan developed by the collection manager is ultimately briefed to and approved by the commander.

The final solution then is to continue to use the existing collection management process. It is a proven process that ensures all collection resources are synchronized to maximize effective collection of information necessary to satisfy the commander's priority information requirements. The difficulty caused by target acquisition resources not being used for target acquisition can be resolved by emphasizing the current process for focusing collection resources and resolving some doctrinal confusion.

The component of the process which must be emphasized is the priority intelligence requirement (PIR). Every member of the staff, as well as subordinate commanders, must understand that the priority for all collection resources will be answering the commander's PIR. If a member of the staff or a subordinate commander believe that the attack of certain targets are critical to the success of the operation, they must convince the commander that detecting, identifying, and locating those targets must be stated as one of the commander's PIR. Only targets designated as a PIR will be assured of tasked collection resources, possibly the UAV-SR.

One doctrinal area that must be resolved for this solution to be effective concerns the relationship between PIR and the high payoff target list. The fact that a target appears on the high payoff target list does not mean that collection resources will be tasked to locate that target. There just are not enough collection resources to always satisfy both the PIR and the high payoff target list. The high payoff target list is nothing more than a planning tool for "determining attack guidance and developing the collection plan."[100] As noted above, high payoff targets which the commander is convinced are critical to the success of the operation become a PIR. This is not clear in Army doctrine. Field Manual 6-20-10, The Targeting Process, states that "the key to the detect function is a focus on the HPTs [high payoff targets] designated during the decide function of the targeting process."[101] This implies that collection resources focus on the high payoff target list. This is not correct. Several pages later in the same field manual, the emphasis is correctly placed on PIR.

> "Information needs to support the detection of the target [high payoff target] are expressed as PIR and/or IR. Their relative priority depends on the importance of the target [or other information[102]] to the friendly scheme of maneuver coupled with the commander's intent."[103]

The current collection management process is a proven process for tasking reconnaissance, surveillance, and target acquisition assets. With emphasis on the importance of PIR reinforced within the corps, and the confusion surrounding the relationship between the high payoff target list and PIR resolved, the current doctrinal process remains the best way to ensure the flexible capabilities of the UAV-SR system are maximized.

Collection Manager Responsibilities. Use of the existing collection management process to task the UAV-SR system places a significant burden on the corps collection manager. Successful tasking of the UAV-SR system to satisfy the corps commander's information requirements depends on a thorough knowledge of the system's capabilities, limitations, and vulnerabilities. As was noted in Section V, collection management was a significant factor of the U.S. Army's ineffective UAV employment in Honduras in 1986. A U.S. Marine Corps remotely piloted vehicle company also noted collection management difficulties in a lessons learned statement from an exercise conducted in 1988.

As collection managers apply the collection management process, they must understand that the UAV-SR system has limited availability in the number of missions that can be flown. Surge capability can be provided, but, as in surge of any other asset, affects future availability. Some of the system's capability factors in terms of range, timeliness, and technical characteristics and the system's environmental factors in terms of weather, enemy, and terrain have already been noted previously in the monograph. The collection manager must understand these in detail to correlate the system capability to the requirements for collection against each specific information requirement (SIR).[104]

The unique capability of the UAV-SR to accomplish reconnaissance, surveillance, or target acquisition missions provides the collection manager an extremely flexible collection resource. Collection tasking to the UAV-SR can include components of each type mission to be accomplished during one mission air vehicle sortie. For example, a UAV-SR system can be tasked to conduct a surveillance mission of a corps deep named area of interest (NAI) from 0430 to 0630, followed by a target acquisition mission from 0630 to 0930 coinciding with planned support from JSTARS, and conclude with an area reconnaissance mission from 0930 to 1230.[105]

Collection managers must also ensure that UAV-SR tasking is sufficiently flexible so that it utilizes the entire mission duration. During the previously mentioned U.S. Marine Corps exercise, the remotely piloted vehicle company received mission taskings that were accomplished in minutes. The collection manager may encounter situations where the UAV-SR is tasked to conduct a surveillance mission and a target acquisition mission separated by a significant amount of free time during the same mission air vehicle sortie. A consideration for collection managers is to use an area reconnaissance to fill the gap. The area to be reconnoitered does not have to be in response to an SIR. The purpose of the area reconnaissance is to give direction to UAV-SR operations during the gap between focused collection operations. Collection in these areas may result in "bonus" discoveries such as those in Vietnam resulting from loss of control of the UAV. The fact that no enemy or targets result from these "gap filling" reconnaissance missions does not mean that they are of not of value. The fact that nothing was found is of intelligence value.

CONCLUSIONS AND RECOMMENDATIONS

The planned fielding of the UAV-SR system into the aerial exploitation battalion will provide a uniquely capable intelligence collection system to the corps. The most effective tasking for this unique system will not occur when the UAV-SR is recognized as a reconnaissance, surveillance, or target acquisition resource. The most effective tasking will result when commanders, G2s, and collection managers recognize the UAV-SR as a reconnaissance, surveillance, *and* target acquisition resource. That is the uniqueness of the UAV-SR system--its flexibility to simultaneously accomplish any of the three missions tasked to it based upon the situation and the commander's requirements.

Tasking of the UAV-SR system and the aerial reconnaissance company should continue through the current doctrinal collection management process. Guided by the commander's approval of priority intelligence requirements (PIR), it is a proven process for managing collection resources to ensure the commander's requirements are satisfied.

To obtain the most from the UAV-SR system's inherent flexibility, four recommendations are made. First, the definition of target acquisition needs to be revised to differentiate it from reconnaissance and surveillance operations. The current definition reflects target acquisition is accomplished as a result of either a reconnaissance or a surveillance operation. Collected target data is forwarded through a processing and correlation phase as part of target development before being provided to a shooter (no direct sensor to shooter link). The UAV-SR has the capability to skip the processing phase and provide real time targeting data *directly to the shooter*. Accordingly, recommend the definition of target acquisition be changed to read "operations the sole purpose of which is to detect, identify, locate with sufficient accuracy, and report specific targets *directly* to maneuver, artillery, air, or electronic warfare elements *for immediate engagement*." This definition differentiates between reconnaissance and surveillance missions and target acquisition. The former still support the target development process by providing combat information for processing and correlation. Target acquisition supports target development by providing targeting information directly to the shooter (Chart 19).

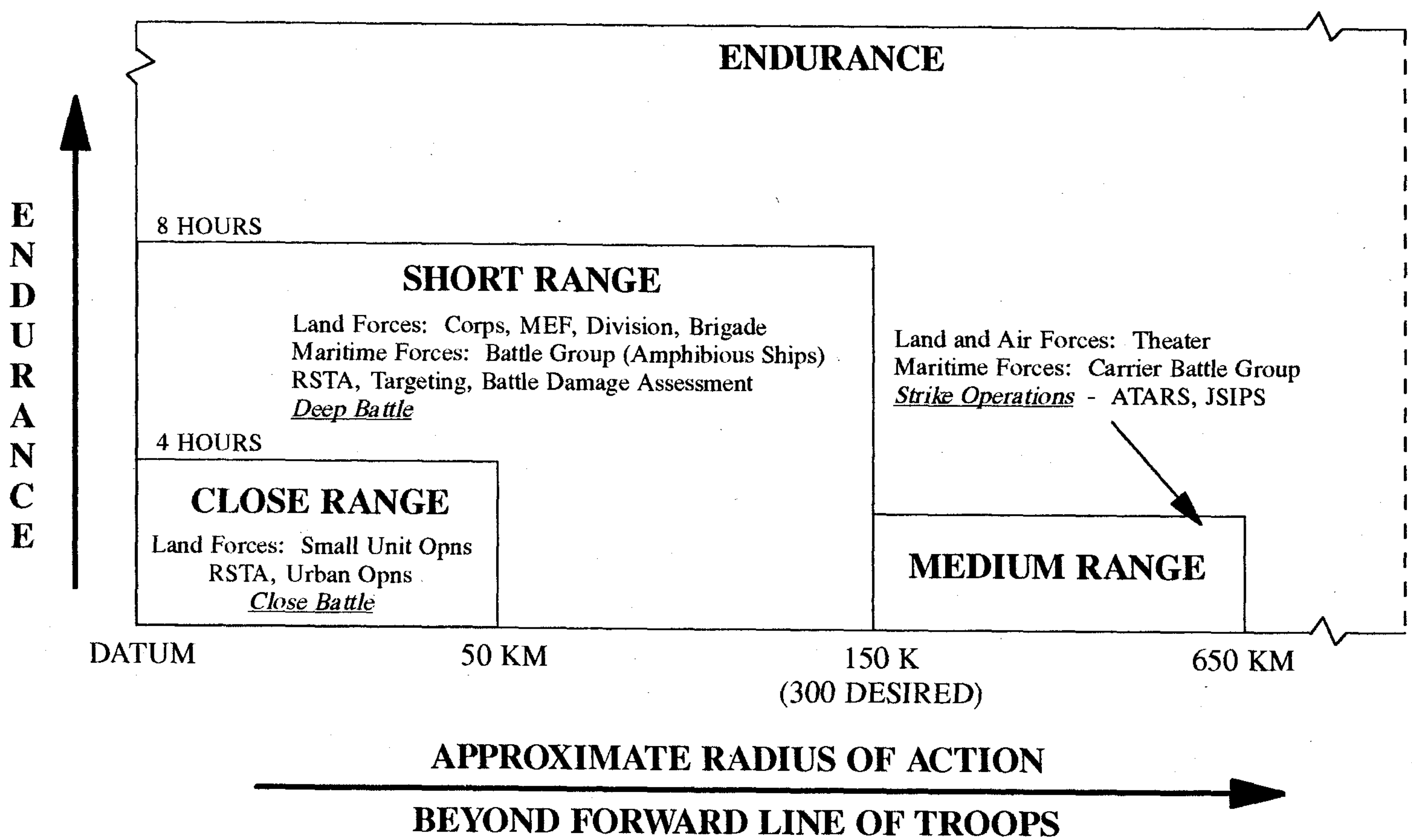
Secondly, the importance of PIR as the commander's tool to focus his collection effort must be reemphasized within the corps. The potential use of a target acquisition capable resource for other than target acquisition missions such as reconnaissance or surveillance will be difficult for some to accept. An asset with the target acquisition capabilities of the UAV-SR may be expected strictly to locate targets from the high payoff target list for attack. Every member of the staff and subordinate commanders must understand the commander's requirements as stated in his approved PIR, and not the high payoff target list, drive the collection effort. Based upon the commander's requirements, the UAV-SR may not be used for target acquisition.

This leads to the third recommendation. The doctrinal confusion caused by the relationship between the high payoff target list and PIR must be resolved. There are not sufficient collection resources to satisfy the commander's PIR and to locate all the targets on the high payoff target list. The collection manager prioritizes and develops a collection plan based on the PIR, not the high payoff target list. The high payoff target list is a tool for developing attack guidance and PIR. If a member of the staff or a subordinate commander believe a target is critical to the success of an operation, the commander must be so convinced that locating that target *becomes a PIR.* Doctrinal manuals including Field Manual

6-20-10, The Targeting Process, and Field Manual 34-2, Collection Management, contribute to this confusion and must be revised to reflect the dominance of PIR.

Finally, and perhaps most importantly, collection managers must understand in detail the capabilities, limitations, and vulnerabilities of the UAV-SR system. The UAV-SR system provides collection managers a reconnaissance, surveillance, and target acquisition resource with more flexibility than any other collection resource. Assuring the maximum benefit is made of this flexibility requires an intimate knowledge of the system. This will ensure the system is effectively tasked to satisfy the corps commander's information requirements.

CHART 1. UAV CATEGORIES



UAV 1993 Master Plan

CHART 2. UAV MISSION NEED STATEMENTS

	CLOSE	SHORT	MEDIUM	ENDURANCE
OPERATIONAL NEEDS	RECON, SURVL, TGT ACQ, TGT SPOT, EW, NBC RECON	RECON, SURVL, TGT ACQ, TGT SPOT, MET, NBC RECON, CMD & CONTROL, EW	PRE- AND POST-STRIKE RECON, TGT ACQ	RECON, SURV, TGT ACQ, CMD & CONTROL, MET, NBC RECON, SIGINT, EW, SPECIAL OPS
LAUNCH AND RECOVERY	LAND/SHIPBOARD	LAND/SHIPBOARD	AIR/LAND	LAND
RADIUS OF ACTION	NONE STATED	150 KM BEYOND FLOT	650 KM BEYOND FLOT	CLASSIFIED
SPEED	NOT SPECIFIED	DASH > 110 KNOTS CRUISE < 90KNOTS	550 KNOTS < 2OK FT .9 MACH > 20K FT	NOT SPECIFIED
ENDURANCE	24 HRS CONTINUOUS COVERAGE	8 TO 12 HOURS	2 HOURS	24 HOURS ON STATION
INFO TIMELINESS	REAL-TIME	NEAR-REAL-TIME	NEAR-REAL-TIME RECORDED	NEAR-REAL-TIME
SENSOR TYPE	DAY/NIGHT IMAGING, EW, NBC	DAY/NIGHT IMAGING, DATA RELAY, COMM RELAY, RADAR, SIGINT, MET, MASINT, TGT DESIGNATE, EW	DAY/NIGHT IMAGING, SIGINT, MET, EW	SIGINT, MET, COMM RELAY, DATA RELAY, NBC, IMAGING, MASINT, EW
AIR VEHICLE CONTROL	NONE STATED	PREPROGRAMMED/ REMOTE	PREPROGRAMMED/ REMOTE	PREPROGRAMMED/ REMOTE
GROUND STATION	VEHICLE & SHIP	VEHICLE & SHIP	JSIPS (PROCESSING)	VEHICLE
DATA LINK	WORLDWIDE/LOW-HIGH INTENSITY	WORLDWIDE/LOW-HIGH INTENSITY	JSIPS INTEROPERABLE, WORLDWIDE/LOW-HIGH INTENSITY	WORLDWIDE/LOW-HIGH INTES]NSITY
CREW SIZE	MINIMUM	MINIMUM	MINIMUM	MINIMUM
SERVICE NEED/REQUIREMENT	ARMY, NAVY, MARINE CORPS	ARMY, NAVY, MARINE CORPS	NAVY, AIR FORCE, MARINE CORPS	ARMY, NAVY, MARINE CORPS

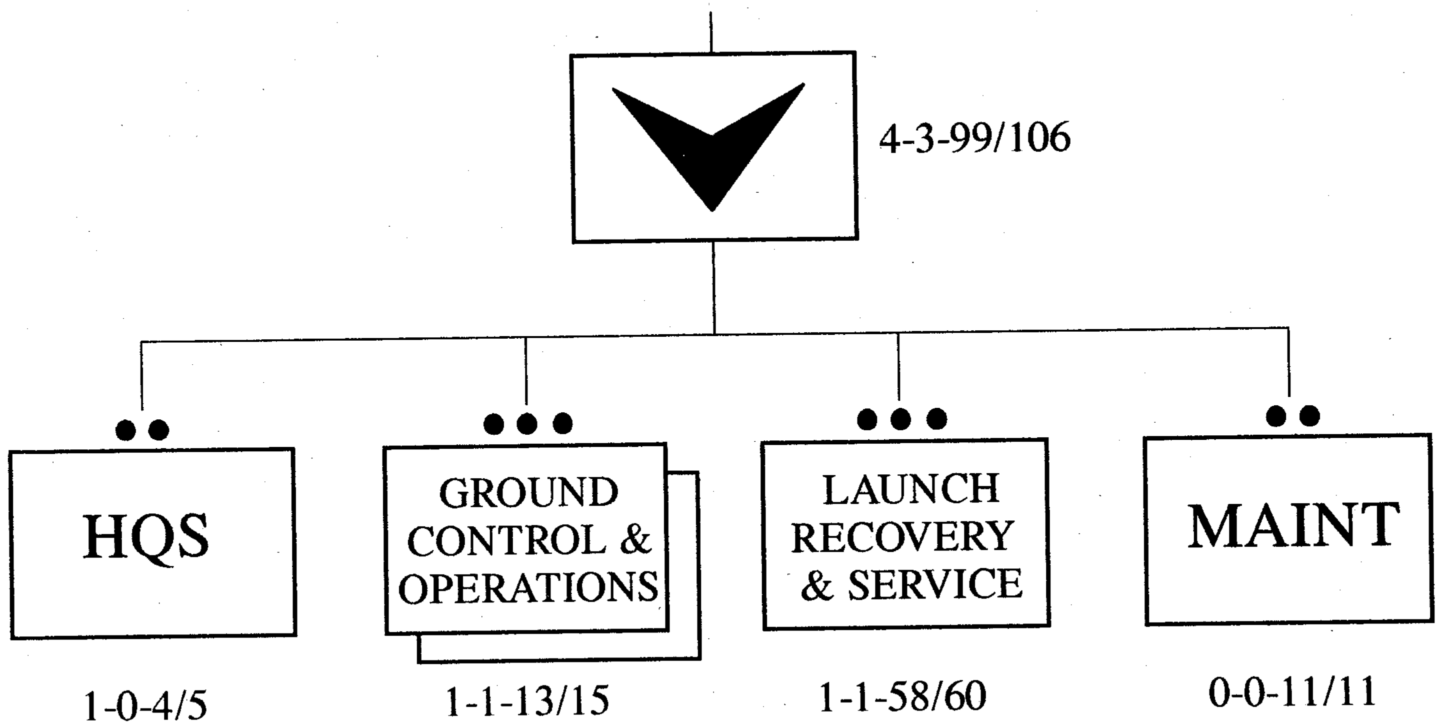
LEGEND

EW - ELECTRONIC WARFARE
MET - METEOROLOGY
SIGINT - SIGNALS INTELLIGENCE
FLOT - FORWARD LINE OF TROOPS
NBC - NUCLEAR, BIOLOGICAL, AND CHEMICAL
JSIPS - JOINT SERVICE IMAGERY PROCESSING SYSTEM

CHART 3. UAV-SR BASELINE ALLOCATION

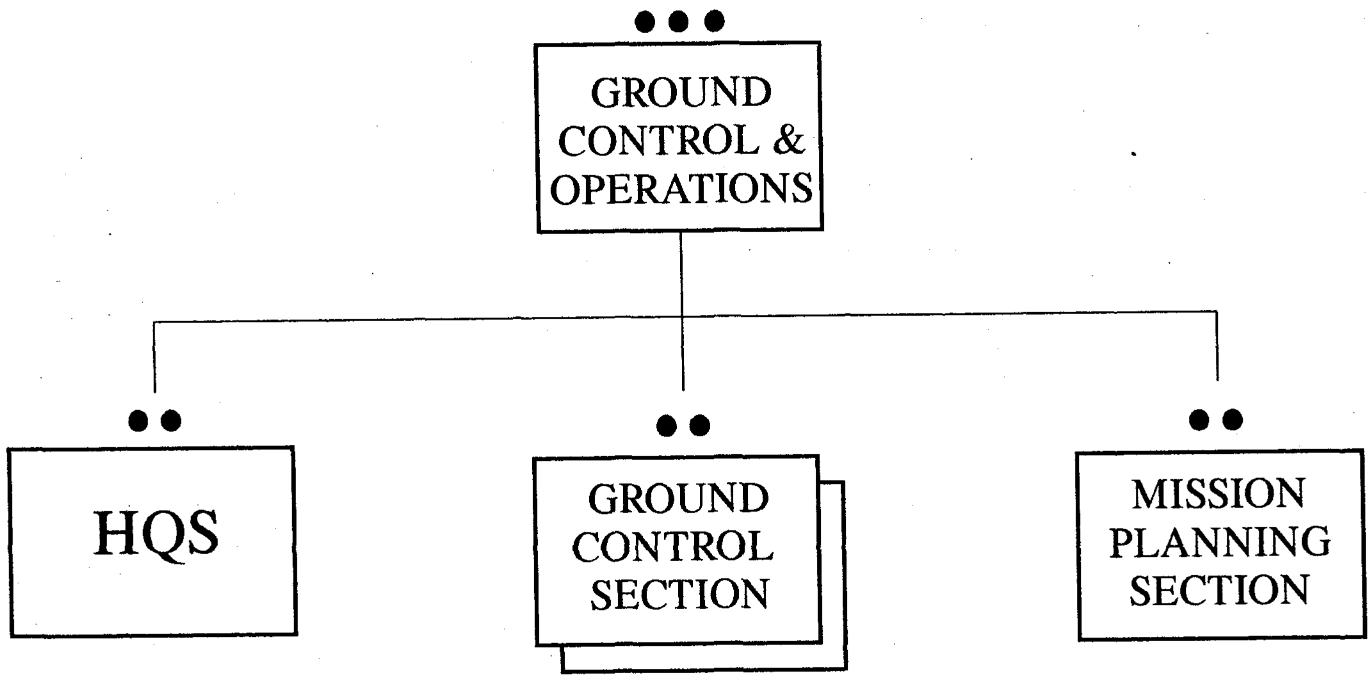
	FP1	FP2	TOTAL	SHORT RANGE BASELINES	TOTAL BASELINES
EAC MI BRIGADES	3	0	3(2)	2	4
CORPS	2	2	4	2	8
HEAVY DIVISION	5	3	8	1	8
LIGHT DIVISION	1	1	2	0	0
AIRBORNE DIVISION	1	0	1	1	1
AIR ASSAULT DIVISION	1	0	1	1	1
ACR	1	1	2	1	2
					24

CHART 4. AERIAL RECON COMPANY



UAV TSM Brief

CHART 5. GROUND CONTROL & OPNS PLATOON



HQS

1 35D (15C) O2 PLATOON LEADER
1 350D CWO IMAGERY INTEL OFFICER
1 96U E7 PLATOON SERGEANT

2 HMWWV
2 VRC-89A

GROUND CONTROL SECTION

2 96U E5/E3 AIR VEHICLE OPERATOR
2 96U E5/E3 MISSION PAYLOAD OPERATOR

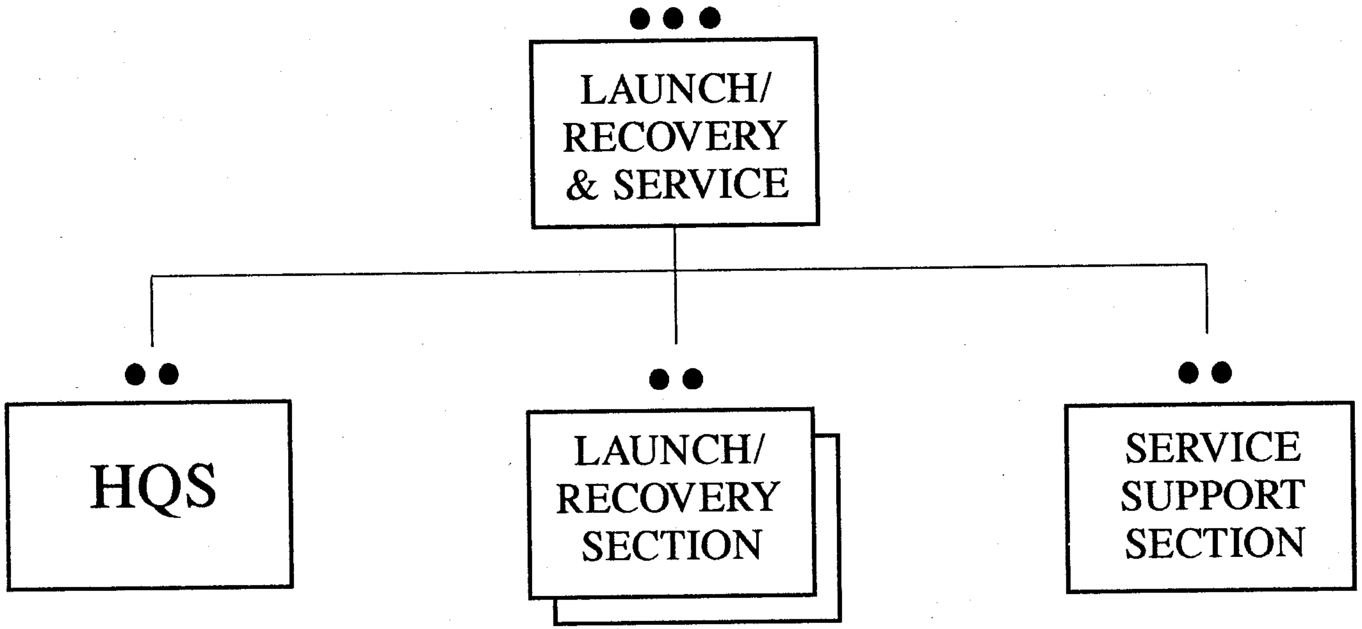
2 GCS
2 GDT
4 RVT
2 10KW GENERATORS
6 VRC-89A
2 VRC-90A
2 MSE TERMINALS
2 3KW GENERATORS
4 HMWWV
3 CARGO TRAILERS

MISSION PLANNING SECTION

2 96U E6 SENIOR MISSION PLANNER
2 96U E6 SENIOR DATA ANALYST

1 MPS
1 10KW GENERATOR
2 HMWWV
2 CARGO TRAILERS
3 VRC-89A
1 MSE TERMINAL

CHART 6. LAUNCH/RECOVERY & SERVICE PLATOON



HQS

1	35D (15C)	O2	PLATOON LEADER
1	353A	CWO	UAV MAINTENANCE CHIEF
1	96U	E7	PLATOON SERGEANT
1	92C	E5	PLL/TAMMS CLERK

2 HMWWV
2 CARGO TRAILERS
2 VRC-89A

LAUNCH/RECOVERY SECTION

1	96U	E6	FLIGHT LINE CHIEF
5	96U	E5/E3	LAUNCH/RECOVERY CREW
5	96U	E5/E3	FLIGHT LINE CREW
2	96U	E4	LAUNCH CTL STATION OPRS
2	96U	E5/E3	EXTERNAL PILOTS

8 AIR VEHICLES
8 MMPS
4 AIR DATA RELAYS
1 LRS
5 5 TON TRUCKS
5 CARGO TRAILERS
2 TRUCK CRANES

1 HMWWV
1 CARGO TRAILER
1 10KW GEN
2 VRC-89A
3 VRC-90A
1 MSE TERMINALS

SERVICE SUPPORT SECTION

1	33R	E7	MAINTENANCE CHIEF
5	33R	E6/E3	UAV ELEC MAINTAINERS
5	52D	E6/E3	UAV MECH MAINTAINERS
2	77F	E5/E3	POL SPECIALISTS

1 MAINTENANCE TENT
3 5 TON TRUCKS
3 CARGO TRAILERS
3 HMWWV
3 CARGO TRAILERS
1 TANK & PUMP UNIT
1 POL TRAILER (POD)

1 10 KW GEN
1 VRC-89A
3 VRC-90A
1 MSE TERMINAL
1 GRC-193A

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CHART 7. HEADQUARTERS & MAINTENANCE SECTIONS

HQS

1	15C	O3	COMMANDER
1	96U	E8	1SG
1	92Y	E6	SUPPLY SERGEANT
1	92Y	E4	ARMORER
1	54B	E5	NBC NCO

3 HMWWV
2 CARGO TRAILERS
2 VRC-90A
1 MSE TERMINAL

MAINT

5	63B	E5/E3	WHEELED VEHICLE MECH
4	52D	E5/E3	GENERATOR MECH
2	52C	E5/E3	UTILITIES EQUIP MECH

1 5 TON TRUCK
1 CARGO TRAILER
1 HMWWV
1 CARGO TRAILER
1 VRC-90A

CHART 8. UAV-SR AIR TRANSPORTABILITY

	C-130	C-141	C-17	C-5
RAPID DEPLOY CAPABILITY 4 AV, 1 GCS, 1 GDT	5	2	1	1
REMAINING BASELINE SYSTEM	10	5	3	2
AERIAL RECON CO	30	14	8	6

CHART 9. UAV-SR FIELDS OF VIEW

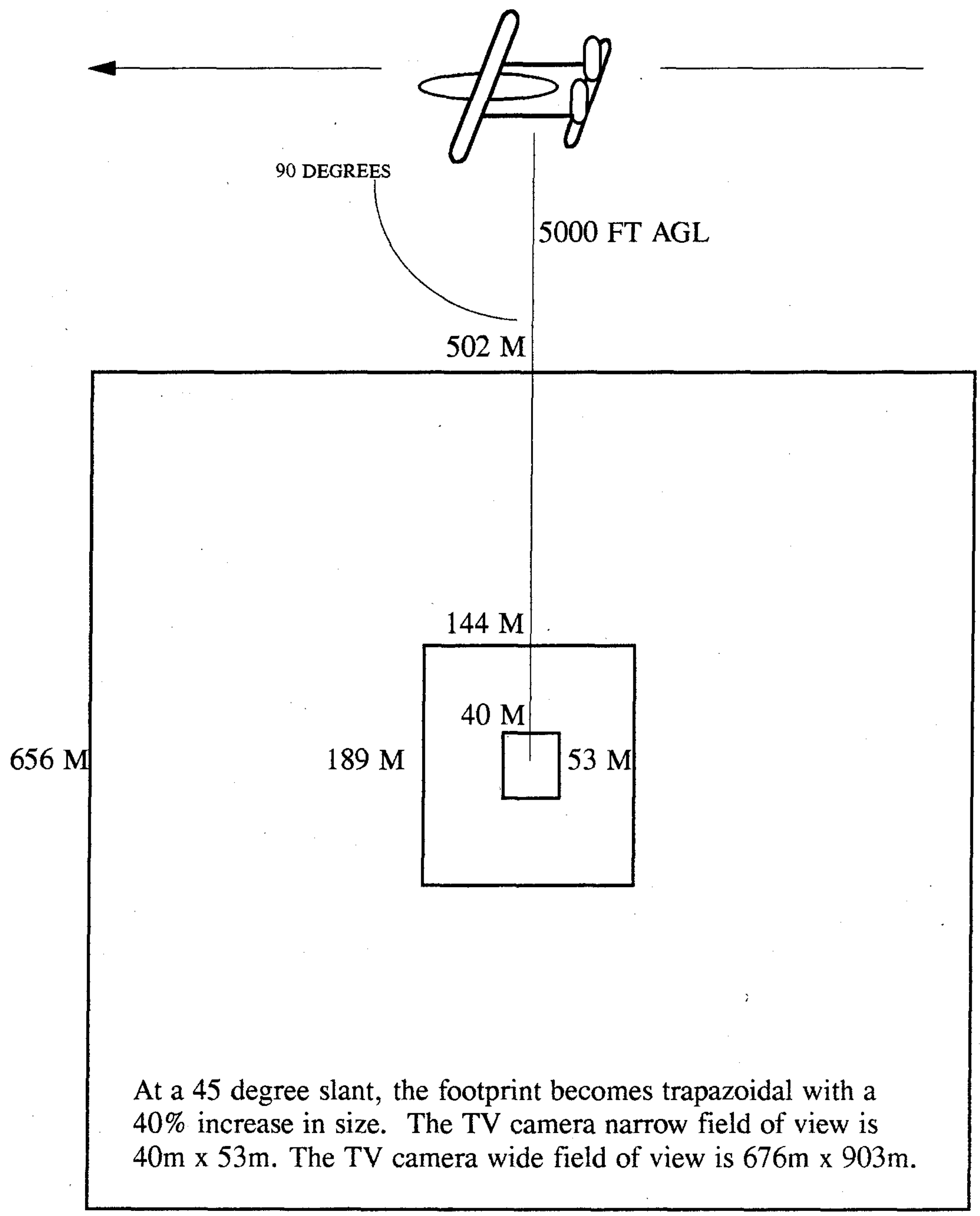


CHART 10. UAV-SR MULTIMISSION OPTRONIC STABILIZED PAYLOAD (MOSP)

TV

- Sensor: 1/2" CCD Camera
- Spectral Region: 0.4 - 0.8 NM
- Automatic Gain Control, Anti-Blooming Protection
- Field of View: 2.5° - 33°
- Continuous Zoom
- Output: RS - 17° Video

FLIR

- Sensor: 120 Elements MCT
- Spectral Region: 8 - 12 NM
- Automatic Gain Level Control
- Closed Cycle, Split Stirling CRYO
  - Cooler 0.5W Capacity @ 85°K
- FLIR Cool Time: 10-12.5 Min
- Field of View:
  - Narrow FOV: $1.5^{\circ} \times 2.0^{\circ}$
  - Middle FOV: $5.4^{\circ} \times 7.1^{\circ}$
  - Wide FOV: $18.7^{\circ} \times 24.3^{\circ}$
- Electronic Zoom
- Output: RS - 17° Video

CHART 11. UAV-SR LAUNCH SEQUENCE

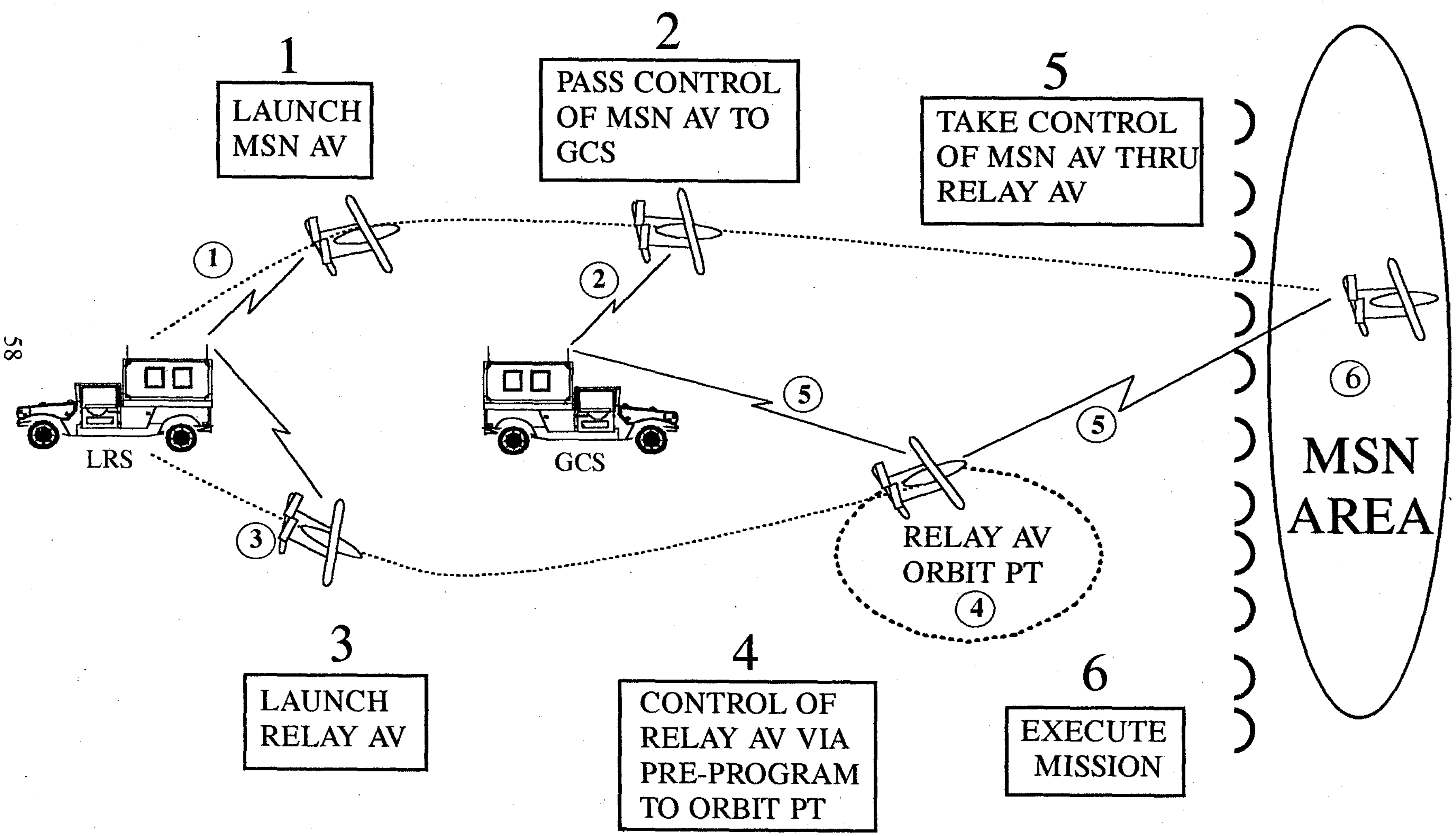


CHART 12. UAV-SR OPERATIONS

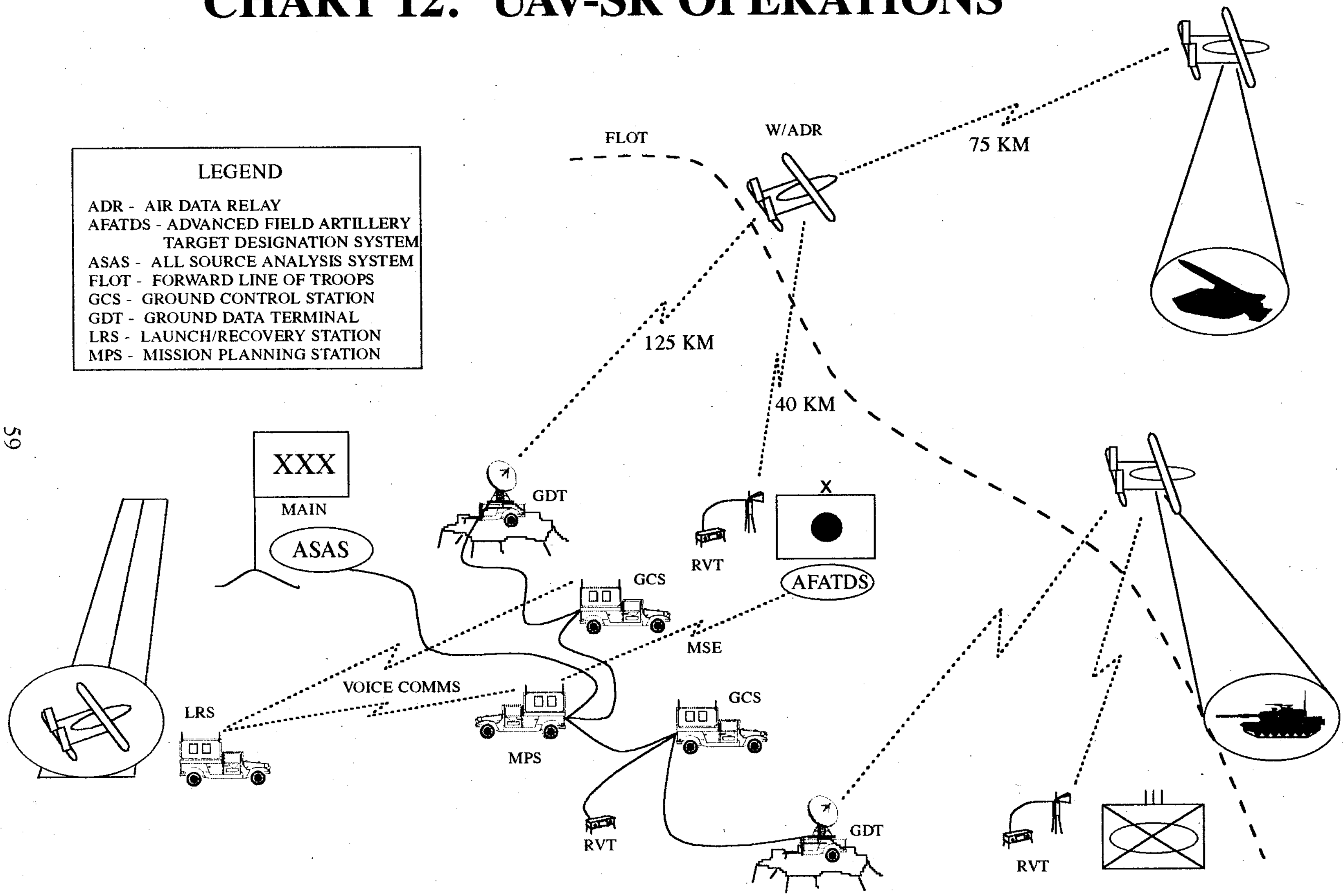


CHART 13. UAV-SR RECOVERY SEQUENCE

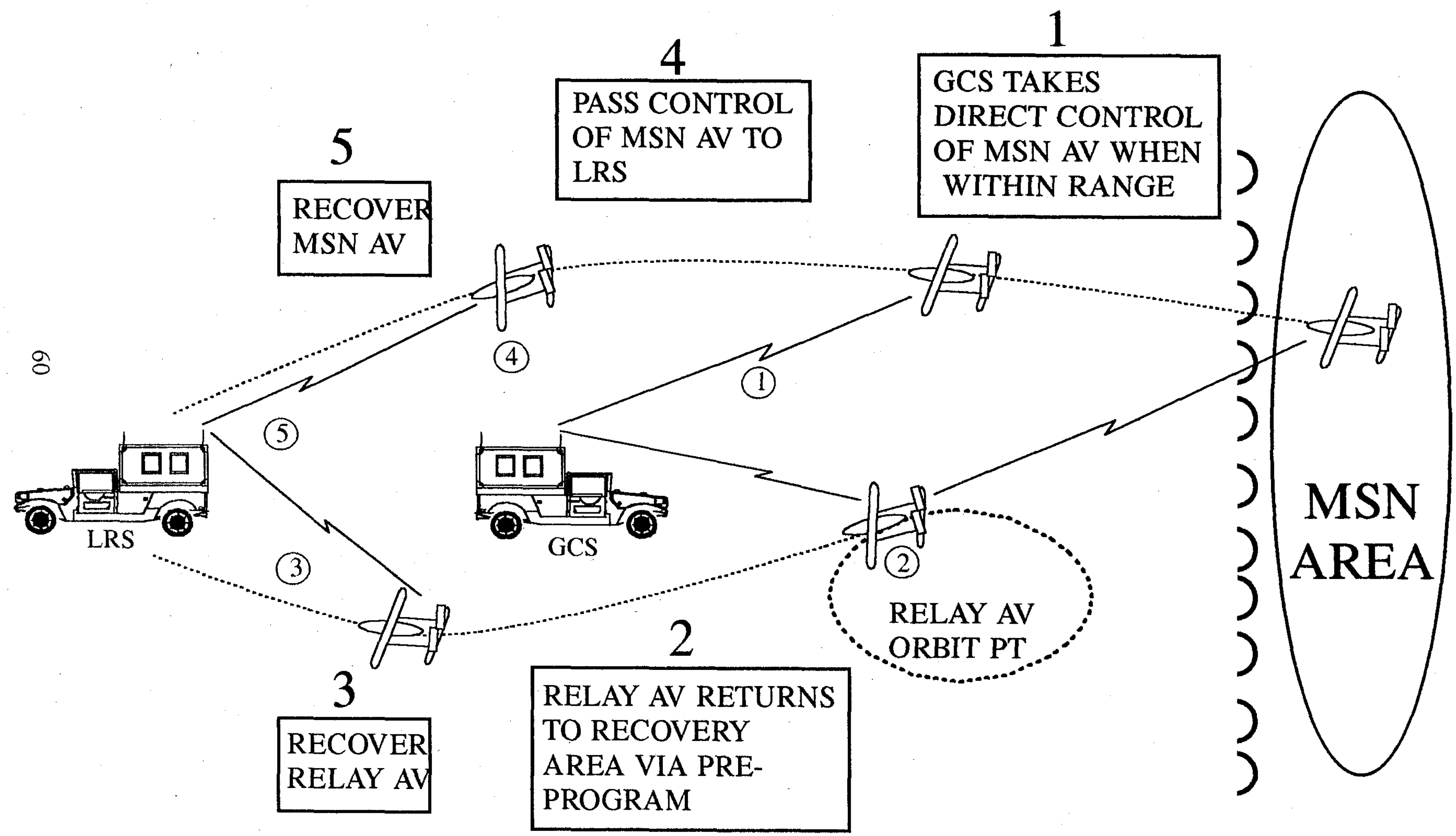
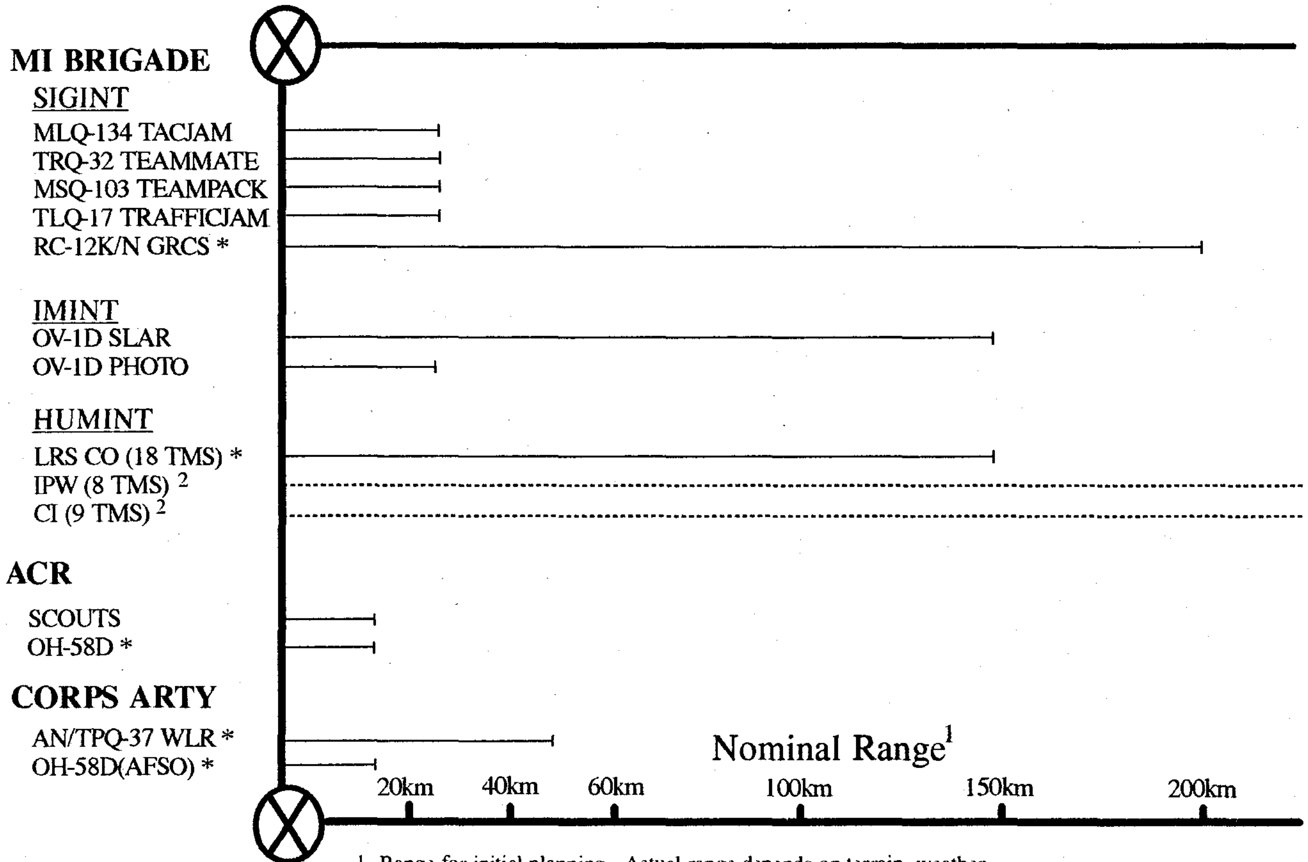


CHART 14. CORPS COLLECTION ASSETS



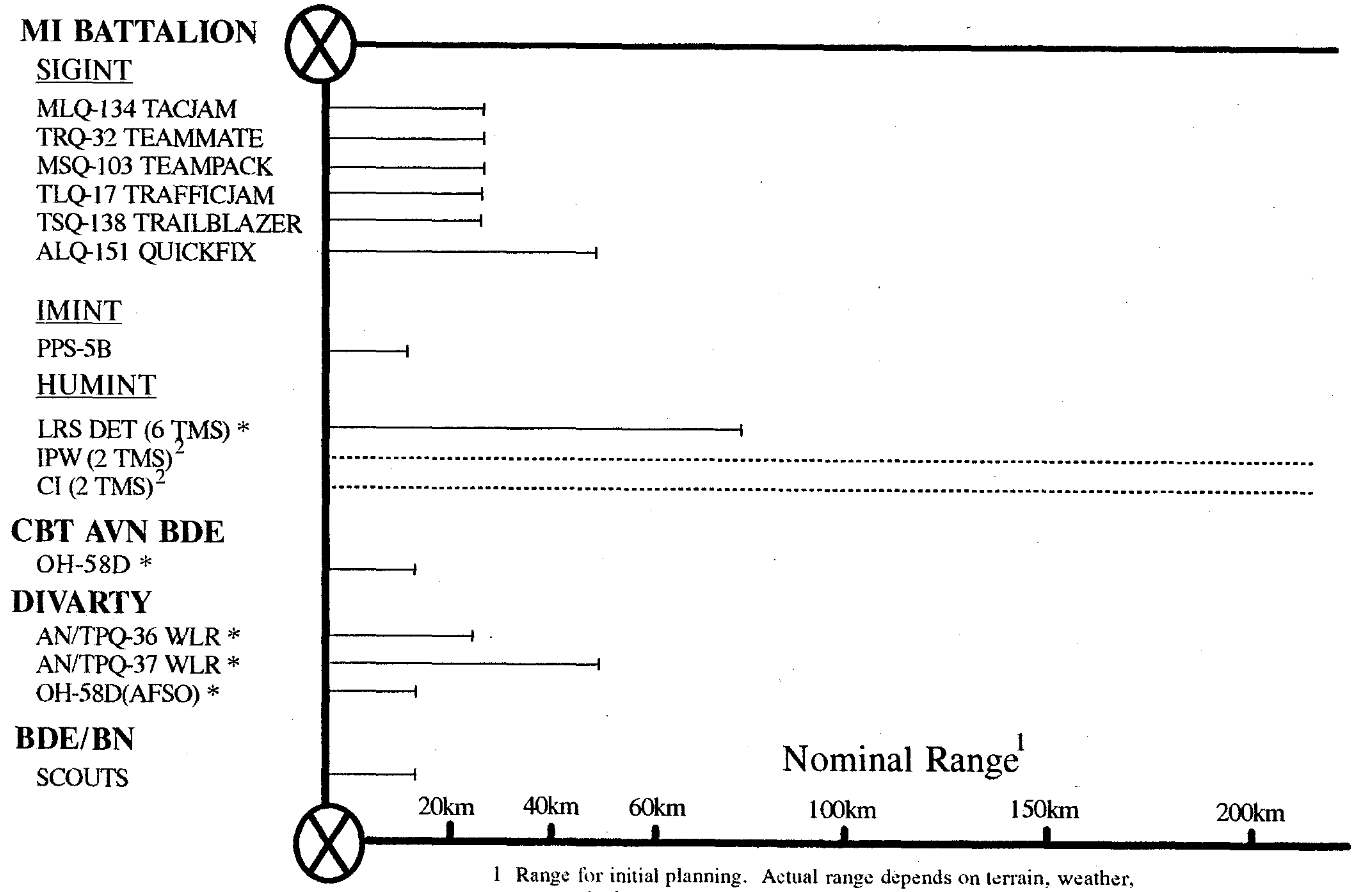
1 Range for initial planning. Actual range depends on terrain, weather, enemy deployment, and location of friendly sensor.

2 Range indefinite. Based on information obtained through exploitation of HUMINT sources.

3 Within their respective capabilities all assets perform target acquisition. Those marked with an asterisk have first round fire for effect target location capability.

FM 34-1, FM 34-8,
FM 34-25, and FM 6-20-10

CHART 15. DIVISION COLLECTION ASSETS



1 Range for initial planning. Actual range depends on terrain, weather, enemy deployment, and location of friendly sensor.

2 Range indefinite. Based on information obtained through exploitation of HUMINT sources.

3 Within their respective capabilities all assets perform target acquisition. Those marked with an asterisk have first round fire for effect target location capability.

FM 34-1, FM 34-8, and FM 6-20-10

CHART 16. PROCESS RELATIONSHIPS

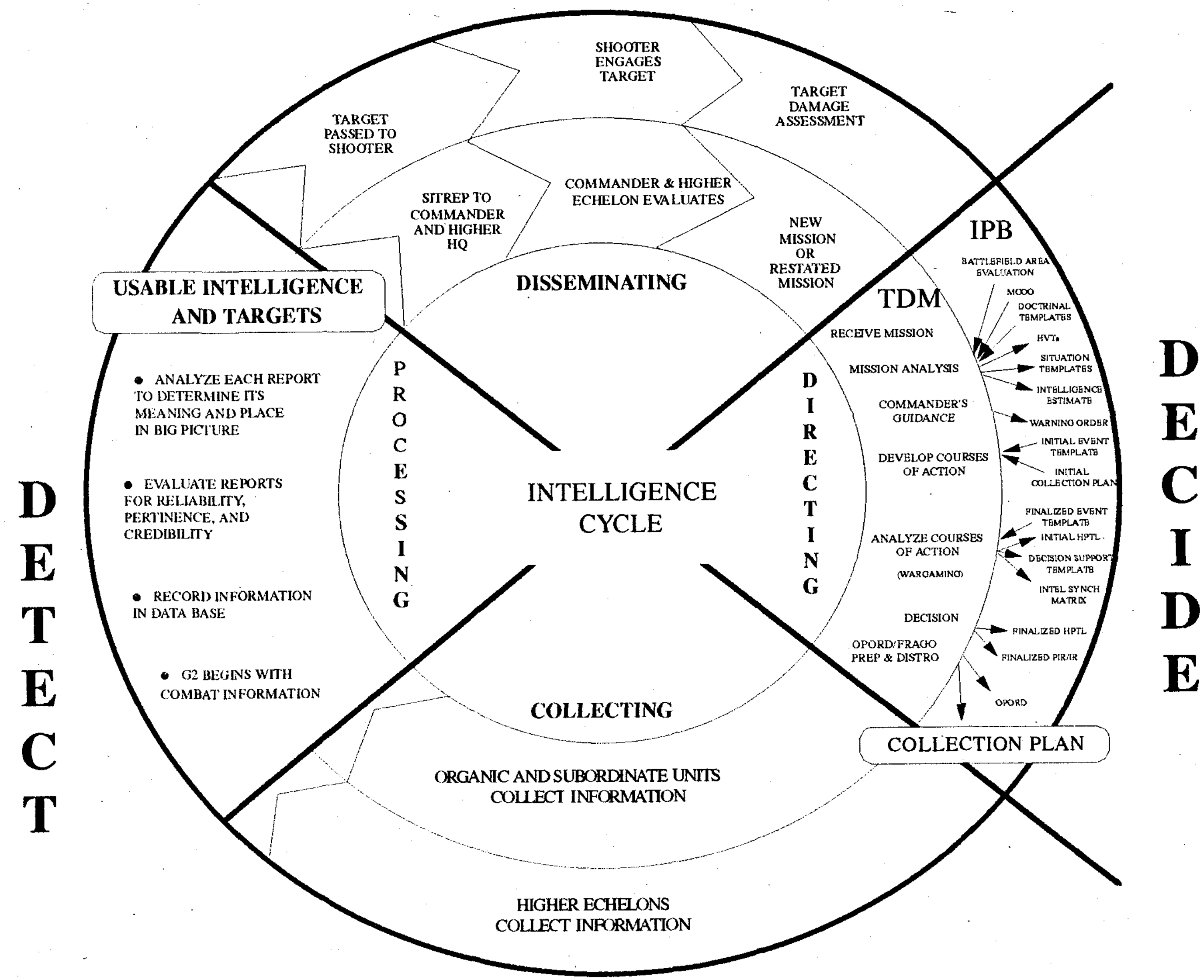
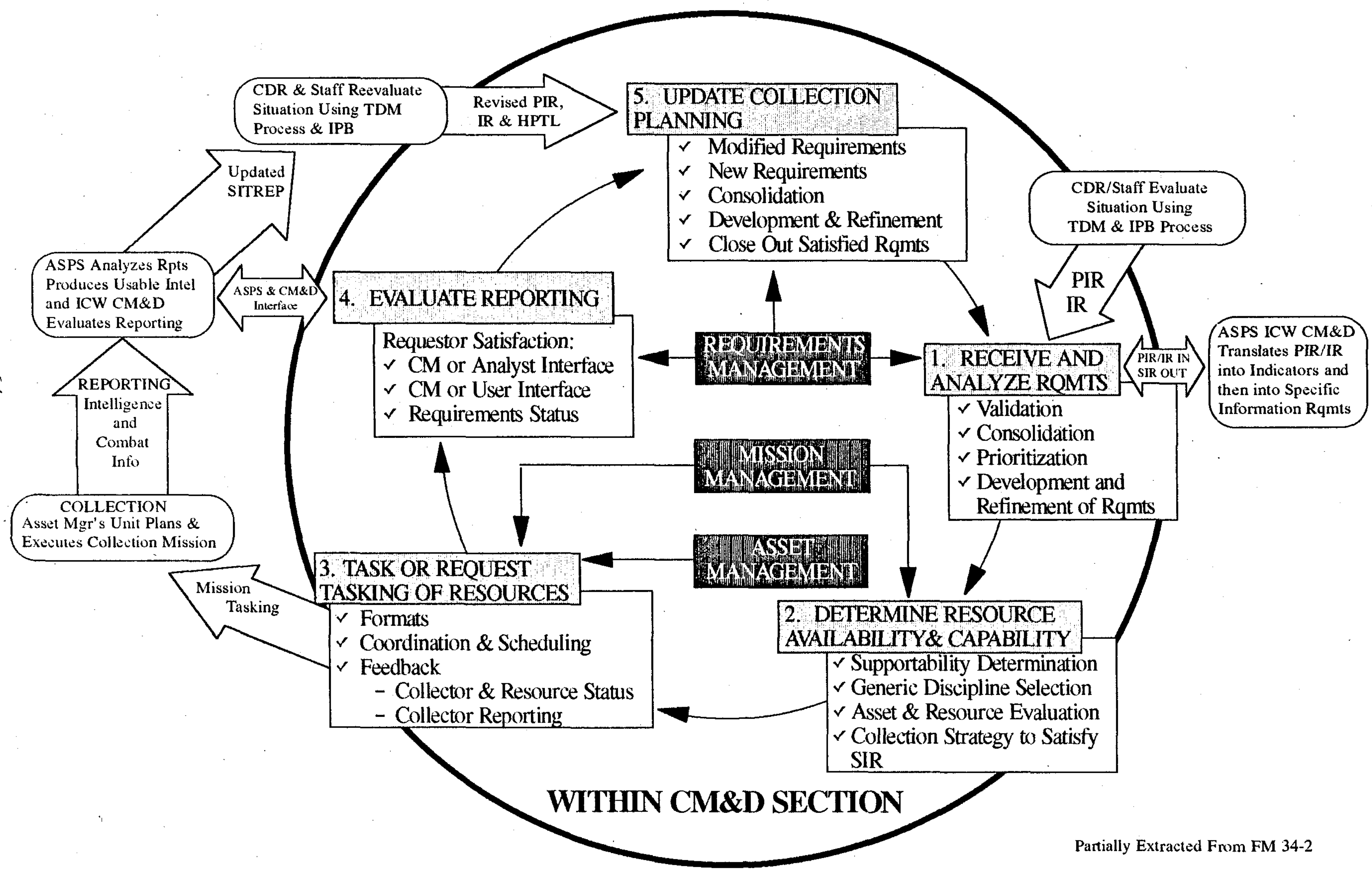


CHART 17. COLLECTION MANAGEMENT PROCESS



Partially Extracted From FM 34-2

CHART 18. CATEGORIES OF UNMANNED AIRCRAFT

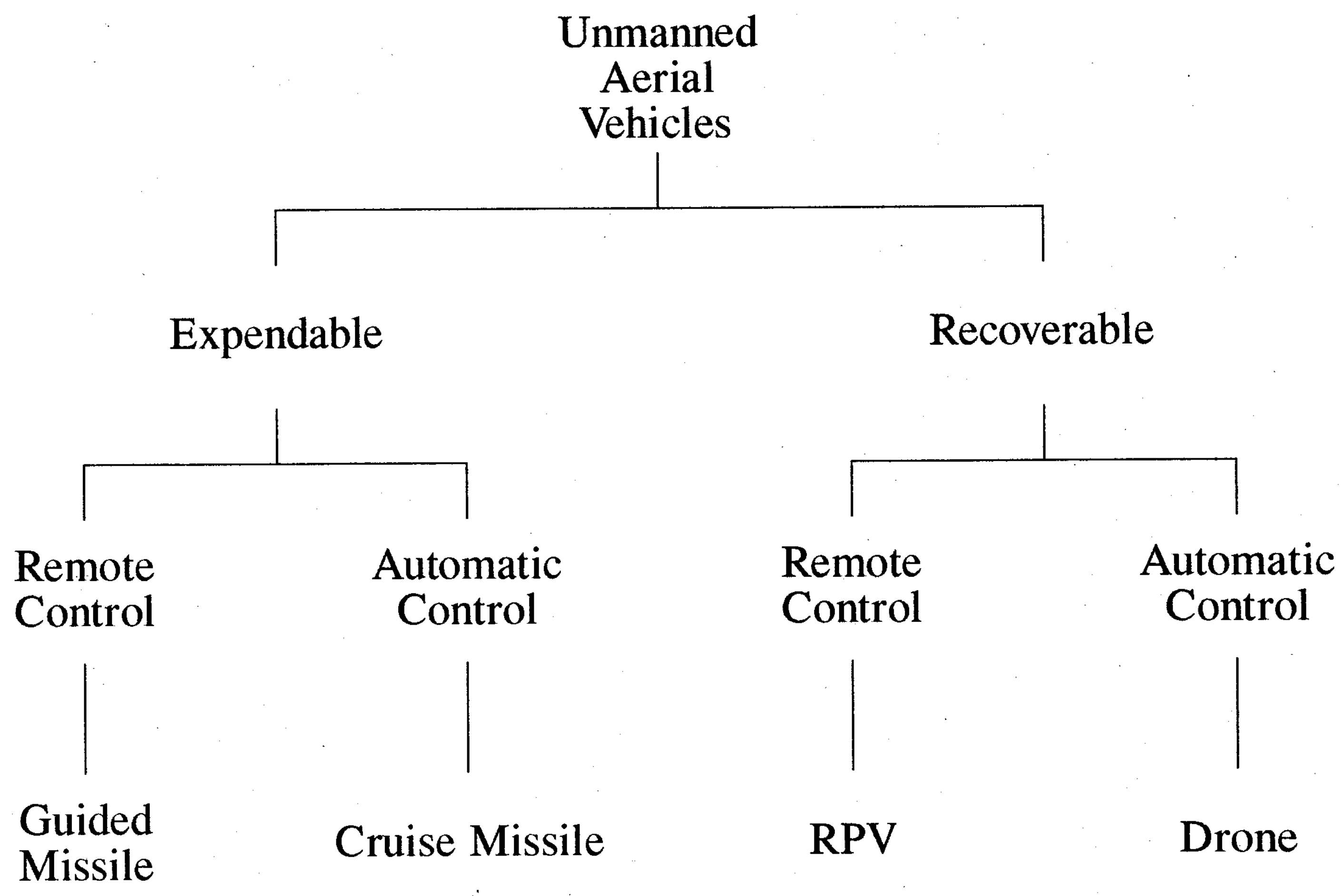
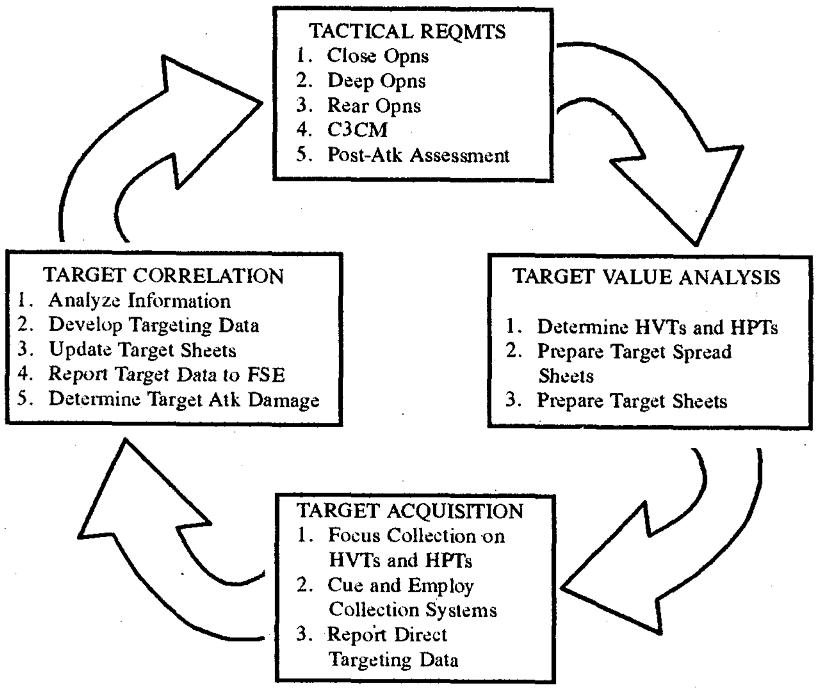


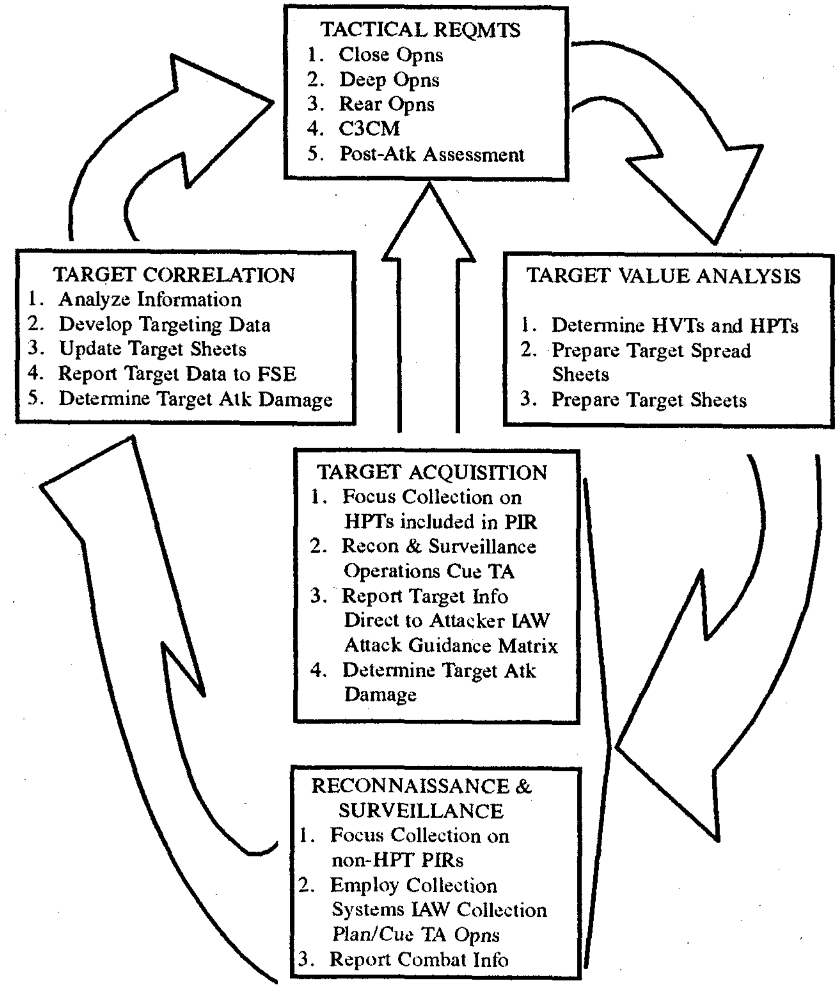
CHART 19. TARGET DEVELOPMENT PROCESS

CURRENT DOCTRINAL PROCESS



FM 34-1

RECOMMENDED PROCESS



APPENDIX A. UAV-SR SYSTEM COMPONENTS

The baseline UAV-SR system consists of the following components: one mission planning station (MPS), two ground control stations (GCS), two ground data terminals (GDT), eight air vehicles (AV), twelve modular mission payloads (MMP)--eight day/night imagery and four air data relay, four remote video terminals (RVT), one launch and recovery system (LRS), and one mobile maintenance facility (MMF).

Mission Planning and Control Stations

The mission planning station and ground control station are modified S-250 shelters mounted on HMMWVs. The mission planning station differs from the ground control station by having a more robust communications system to facilitate dissemination of mission reports. Communications capabilities include both SINCGARS and MSE. Fiber-optic cable provides intercom capability between the mission planning station and the ground control stations.[106]

The mission planning station plans future operations, monitors current operations, processes and analyzes mission results, and prepares and transmits mission reports. The ground control station executes the mission by controlling the air vehicle and modular mission payload. Within the ground control station, the target being imaged by the modular mission payload is displayed with location of both the air vehicle and the target, air vehicle heading and altitude, and time. The ground control station can record the mission video as it is conducted on standard VCR tape. During autonomous preprogrammed flight, two hours of data can be recorded and stored on-board the air vehicle, then retrieved after air vehicle recovery.[107]

Ground Data Terminal

The ground data terminal provides the microwave data link to the air vehicle and requires line of sight with the air vehicle. The ground data terminal is connected to the ground control station via fiber-optic cable available in either 100 meter or 400 meter length.[108] The ground data terminal, and therefore the ground control station, is only capable of controlling one air vehicle at a time. In the event that terrain in the mission area or the distance of the mission precludes maintaining line of sight, a second air vehicle can be launched with an air data relay payload. This air vehicle autonomously flies a preprogrammed route to an orbit which enables it to maintain line of sight with both the mission air vehicle and the ground control station. The ground control station passes mission commands through the relay air vehicle to the mission air vehicle. The mission air vehicle passes payload data and air vehicle status through the relay air vehicle to the ground control station. The ground control station does not control the relay air vehicle but can monitor its mission parameters.

Air Vehicle

The dual engine air vehicle is twenty two feet long with a twenty nine foot wing span. Take off weight is 1,500 pounds including a thre hundred pound fuel capacity and 165 pound payload capacity. Air vehicle rolling take-off requires a fourteen meter by three hundred meter (six hundred meters at three thousand feet above mean sea level) paved or suitable unpaved runway. Takeoff can also be rocket assisted. Landing requires a 250 meter runway with emergency recovery by parachute. Cruise speed is ninety knots with a ten hour mission endurance capability to altitudes of fifteen thousand feet above mean sea level (MSL).[109] Weather limitations include a take-off and landing cross wind of twenty knots, head winds of thirty five knots with gusts to a maximum of forty five knots, and heavy rain of over two inches per hour with winds of thirty five knots.[110] Navigation is provided by an on-board GPS system and autopilot. The air vehicle can be remote controlled from the ground control station or can autonomously fly a preprogrammed route.

Modular Mission Payload

The baseline modular mission payload consists of eight multimission optronic stabilized payloads (MOSP) and four air data relay payloads. The multimission optronic stabilized payload is a dual sensor, TV and FLIR, mounted on a stabilized gimbal system with a 360° azimuth and +15° to -105° elevation field of regard with sufficient resolution to recognize light tactical vehicles and personnel in the open through normal battlefield obscurants."[111] The TV has two fields of view and the FLIR three. Chart nine depicts the footprints in each field of view at an air vehicle altitude of five thousand feet. Chart ten highlights other technical characteristics of both the TV and FLIR sensors. Target location accuracy of the multimission optronic stabilized payload is "sufficient to permit corps fire support systems to fire first-round fire for effect"[112] with an eighty meter circular error of probability (CEP).[113]

Remote Video Terminal

The remote video terminal receives mission data in real time either directly from the mission air vehicle or from a relay air vehicle. The remote video terminal mirror the data presented in the ground control station to include mission information such as air vehicle location and altitude, target location, and time. The remote video terminal has no communication capability to the ground control station and must be within a forty kilometer range of the mission air vehicle or relay air vehicle in order to receive mission data.[114]

Launch and Recovery System

The launch and recovery system includes the equipment necessary to both launch and recover the air vehicles. Upon launch and during recovery, this system has the capability to control the air vehicle and conduct system checks of the payload within a fifty kilometer range.[115]

APPENDIX B. DEFINITIONS

Area Reconnaissance--A directed effort to obtain detailed information concerning the terrain or enemy activity within a prescribed area such as a town, ridge line, woods, or other feature critical to operations. (FM 101-5-1)

Combat Information--Unevaluated data gathered by or provided directly to the tactical commander that, because of its highly perishable nature or the criticality of the situation, cannot be processed into tactical intelligence in time to satisfy the user's tactical intelligence requirements. (FM 101-5-1)

Combat Intelligence--That knowledge of the enemy, weather, and geographical features required by a commander in planning and conducting combat operations. It is derived from the analysis of information on the enemy's capabilities, intentions, vulnerabilities, and the environment. (FM 101-5-1)

Cueing--Using limited assets to identify or verify enemy activity or using one asset to tip off or alert another asset. (FM 34-2-1)

Decision Point--A point or line usually along a mobility corridor where presence of an enemy or friendly unit cues the commander to make a decision. (FM 34-1)

Drone--An unmanned vehicle which conducts its mission without guidance from an external source. (Joint Pub 1-02)

High Payoff Target--High value targets which, if successfully attacked, would contribute substantially to the success of our plans. (FM 101-5-1)

High Value Target--A target whose loss to the enemy can be expected to contribute to substantial degradation of an important battlefield function. (FM 101-5-1)

Information Requirement (IR)--Those items of information requiring the enemy and his environment which need to be collected and processed in order to meet the intelligence requirements of a commander. (FM 101-5-1)

Intelligence--The product resulting from the collection, evaluation, analysis, integration, and interpretation of all available information concerning an enemy force, foreign nations, or areas of operations and which is immediately or potentially significant to military planning and operations. (FM 101-5-1)

Priority Intelligence Requirement (PIR)--Those intelligence requirements for which a commander has an anticipated and stated priority in his task of planning and decision making. (FM 101-5-1)

Reconnaissance--A mission undertaken to obtain information by visual observation, or other detection methods, about the activities and resources of an enemy or potential enemy, or about the meteorological, hydrographic, or geographic characteristics of a particular area. (FM 101-5-1)

Remotely Piloted Vehicle (RPV)--An unmanned vehicle capable of being controlled from a distant location through a communication link. It is normally designed to be recoverable. (Joint Pub 1-02)

Route Reconnaissance--A directed effort to obtain detailed information of a specified route and all terrain from which the enemy could influence movement along that route. (FM 101-5-1)

Surveillance--A systematic observation of airspace or surface areas by visual, aural, electronic, photographic, or other means. (FM 101-5-1)

Target Acquisition--The detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons. (FM 101-5-1)

Targeting Process--A process based on the friendly scheme of maneuver and tactical plan and an assessment of the terrain and threat which identifies those enemy functions, formations, equipment, facilities, and terrain which must be attacked to ensure success. (FM 101-5-1)

Unmanned Aerial Vehicle (UAV)--A powered aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload. (DOD UAV 1993 Master Plan)

Zone Reconnaissance--A directed effort to obtain detailed information concerning all routes, obstacles, terrain, and enemy forces within a zone defined by boundaries. (FM 101-5-1)

[1] Department of Defense UAV 1993 Master Plan, (Washington, DC: Department of Defense, 1993), p. 24.

[2] Burnham, Major William L., Unclassified briefing charts titled "Joint Unmanned Aerial Vehicle (UAV) Program Update", (Washington, DC: Headquarters, Department of the Army (HQDA), DAMO-FDI, undated) (hereafter referred to as HQDA Briefing). The chart titled "UAV-SR Master Program Baseline Structure" reflects first unit equipped (FUE) date of August 1995.

[3] Field Manual 34-2, Collection Management, (Washington, DC: Headquarters, Department of the Army, October 1990), p. 2-1. "Collection management is the process of formulating detailed collection requirements, requesting or tasking collection agencies for required information, and disseminating intelligence."

[4] Bowerman, Randy and Captain Lorenz, Training and Doctrine Command (TRADOC) System Manager (TSM) for Unmanned Aerial Vehicles (UAV) Office, Fort Huachuca, AZ. Series of telephone interviews with author, Leavenworth, Kansas, October thru November 1993 (hereafter referred to as TSM Telephone Interviews).

[5] Field Manual 100-103, Army Airspace Command and Control in a Combat Zone, (Washington, DC: Headquarters, Department of the Army, October 1987), p. 1-8 and 2-23. This doctrinal manual recognizes both RPVs and UAVs as "special airspace users" and provides the organizational framework and procedures to coordinate airspace requirements. These doctrinal procedures require refinement to accommodate the fielding of the UAV-SR due to the anticipated increase in UAV operations, the depth of operations possible, and the degree of flexibility required to obtain the most benefit from the system.

[6] Teller, Dr. Robert, 21 July 1991 Press Conference in Washington, DC (Dr. Teller is considered by some as the father of nuclear weaponry), quoted by William Wagner, Lightning Bugs and other Reconnaissance Drones, (Fallbrook, CA: Aeropublishers, 1982), p. i.

[7] UAV 1993 Master Plan, p. 16.

[8] HQDA Briefing, chart titled "Planned UAV Systems."

[9] HQDA Briefing, chart titled "Short Range Description."

[10] Argersinger, Colonel Steve, Unclassified briefing charts titled "Why Close Range?", (Fort Huachuca, AZ: Training and Doctrine Command (TRADOC) System Manager (TSM) for Unmanned Aerial Vehicles (UAV), U.S. Army Intelligence Center and School, 3 August 1993) (hereafter referred to as TSM UAV Briefing), chart #13 titled "Personnel and Logistics."

[11] TSM Telephone Interviews. The UAV-SR system can surge to provide additional missions each day; however, future mission capability is affected. The aerial reconnaissance company is expected to conduct four missions per day for six days followed by one day for survivability movement and maintenance. A higher level threat environment will require more frequent survivability moves and further limit UAV-SR mission availability.

[12] HQDA Briefing, chart titled "Short Range Day/Night Payload.

[13] "Section II: Means of Employment," UAV-SR Doctrinal and Organizational Test Support Plan (DOTSP) (Draft), (Fort Huachuca, AZ: U.S. Army Intelligence Center and School, Training and Doctrine Command (TRADOC) System Manager (TSM) for Unmanned Aerial Vehicles (UAV), undated), p. 2-2.

[14] Silvasy, Major General Stephen, "Airland Operations and the Employment of Unmanned Aerial Vehicles (UAV)," p. 17.

[15] TSM Telephone Interviews.

[16] Ibid.

[17] Ibid.

[18] Cross cueing involves the use of one or more collection assets which provide information to focus another collection system. For example, the Joint Surveillance Target Acquisition Radar System (JSTARS), a wide area surveillance system, can be used to cue the UAV-SR to possible target locations. With the block improvements planned for the UAV-SR including a SIGINT sensor system, the UAV-SR may eventually be able to cue itself.

[19] Joint Publication 3-55.1, Joint Tactics, Techniques and Procedures (JTTP) for Unmanned Aerial Vehicles (UAV) (Initial Draft), (Washington, DC: Director for Operational Plans and Interoperability, J-7, Joint Staff, 1 April 1991), p. III-8.

[20] Ibid.

[21] UAV 1993 Master Plan, p. 25 and p. 64 - 67.

[22] UAV DOTSP, p. 2-6 thru 2-7 provides the framework for this discussion of UAV-SR mission operations.

[23] TSM Telephone Interviews.

[24] Silvasy, "Airland Operations and the Employment of Unmanned Aerial Vehicles", p. 15.

[25] Field Manual 101-5-1, Operational Terms and Symbols, (Washington, DC: Headquarters, Department of the Army, October 1985).

[26] Field Manual 6-121, Field Artillery Target Acquisition, (Washington, DC: Headquarters, Department of the Army, October 1985), p.1-2 reflects target acquisition as a component of collection. FM 34-2, p. 4-14 classifies reconnaissance and surveillance as collection operations.

[27] FM 101-5-1.

[28] FM 34-2, p. 4-14 and Field Manual 34-2-1, Reconnaissance and Surveillance and Intelligence Support to Counterreconnaissance, (Washington, DC: Headquarters, Department of the Army, 19 June 1991), p. 2-1.

[29] Ibid.

[30] FM 101-5-1.

[31] FM 34-2, p. 4-14.

[32] FM 101-5-1.

[33] Both Field Manual 6-20-10, The Targeting Process, (Washington, DC: Headquarters, Department of the Army, 29 March 1990) and FM 34-2 acknowledge a processing and analysis phase required after a target acquisition resource obtains combat information. "As the various assets collect combat information to support target development, it is forwarded through the IEW system to the intelligence analysts of the G2 or S2 staff. When a target is developed by the analysts, it is passed immediately to the targeting team." FM 6-20-10, p. 3-5. "As the TA assets gather information, they report their findings back to their controlling headquarters which in turn pass pertinent information to the tasking agency. The information gathered is processed to produce valid targets." FM 34-2, p. 7-3.

[34] Field Manual 100-15, Corps Operations, (Washington, DC: Headquarters, Department of the Army, September 1989), p. 1-0.

[35] FM 100-15, p. 1-1.

[36] FM 100-5, p. 6-13.

[37] Ibid, p. 6-14.

[38] Ibid.

[39] Field Manual 34-25, Corps Intelligence and Electronic Warfare Operations, (Washington, DC: Headquarters, Department of the Army, September 1987), p. 2-3.

[40] FM 100-15, p. 4-7.

[41] Field Manual 34-3, Intelligence Analysis, (Washington, DC: Headquarters, Department of the Army, March 1990), p. 1-3.

[42] Ground based SIGINT resources at the corps level are used by the commander to weight intelligence assets in support of a division, armored cavalry regiment, or separate brigade execution of the corps close fight.

[43] Information on Guardrail Common Sensor is based upon my personal experience as Commander, B Company, 3d Military Intelligence Battalion in Korea from May 1988 to May 1989. In December 1988 the unit became the first Army Aerial Exploitation Battalion to be equipped with Guardrail Common Sensor.

[44] Kleiner, Colonel Martin S., "Joint STARS Goes to War," Field Artillery, February 1992, p. 25 - 29.

[45] Sambrowski, Major Leonard J., The Joint Surveillance Target Attack Radar System, (Fort Leavenworth, KS: U.S. Army Command and General Staff College, 1992), p. 50.

[46] Field Manual 34-8, Combat Commander's Handbook on Intelligence (Final Draft), (Fort Huachuca, AZ: U.S. Army Intelligence Center and School), p. B-16.

[47] Ibid, p. B-23/24.

[48] Ibid, p. B-10/11.

[49] FM 6-20-10, p. 5-1.

[50] Student Text (ST) 100-9, The Tactical Decision Making Process, (Fort Leavenworth, KS: U.S. Army Command and General Staff College, July 1993), p. 1-4 and 1-5. Tactical decision making encompasses both the deliberate decision making process (DDP) and the combat decision making process (CDP). Both processes provide a framework for conceptualizing tactical decisionmaking. The DDP is used when sufficient time is available, such as prior to operations, and involves more latitude for staff involvement. The CDP parallels the thought process of the DDP, yet is more time constrained and is therefore driven by the commander to concurrently assess outcomes of current operations and adjust future activities to achieve successful endstates. Although not Army doctrine, this ST is used to train Army officers on procedures which are widely followed within the Army, and as noted in the preface, "the ST is fully compatible with Army

operations doctrine contained in the new FM 101-5, Command and Control for Commanders and Staff, to be published" This monograph uses the deliberate decisionmaking process as the basis of discussion. The combat decisionmaking process is executed in a similar flow pattern, yet is significantly shortened as activities are accomplished concurrently or analysis and decisions are reached conceptually by commanders with minimal input by staff officers and subordinate commanders.

[51] Ibid, p 3-1. ST 100-9 provides a summarized version of the IPB process and the relationship between IPB and the tactical decisionmaking process. Field Manual 34-130, Intelligence Preparation of the Battlefield, (Washington, DC: Headquarters, Department of the Army, October 1989), provides a complete doctrinal discussion of the IPB process.

[52] FM 34-8, p. 2-2 and 2-3.

[53] FM 6-20-10 describes the Decide, Detect, and Deliver (D3) methodology in detail.

[54] FM 34-2, p. 3-4.

[55] The discussion of the collection management process is extracted from FM 34-2.

[56] Armitage, Air Chief Marshal Sir Michael, Unmanned Aircraft, (McLean, VA: Brassey Defense Publishers, 1988). This book provides an excellent history of UAVs from early beginnings during World War I to use of modern UAVs such as Pioneer, Aquila, and Tacit Rainbow. Wagner's Lightning Bugs and Other Reconnaissance Drones focuses on the history of UAV employment in Southeast Asia during the Vietnam war.

[57] "DOD's Use of Remotely Piloted Vehicle Technology Offers Opportunities For Saving Lives and Dollars," Report by the Comptroller General of the United States to the United States Congress, 3 April 1981, p. 1.

[58] Armitage, Unmanned Aircraft, p. 67-69.

[59] Ibid. p. 71.

[60] Ibid. p. 76.

[61] "DOD's Use of Remotely Piloted Vehicle Technology", p. 2.

[62] Armitage, Unmanned Aircraft, p. 67.

[63] "DOD's Use of Remotely Piloted Vehicle Technology", p. 1.

[64] Armitage, Unmanned Aircraft, p. 78.

[65] Ibid. p. 85.

[66] Gabriel, Richard A., Operation Peace for Galilee, (New York: Hill and Wang, 1984) for background on war effort, aims, and execution.

[67] Armitage, Unmanned Aircraft, p. 82 - 85 discusses the various UAV systems available to Israel for Operation Peace for Galilee. Millis, Philip J., "RPVs Over the Bekaa Valley," Army, June 1983, p. 49 - 51, describes the use of the Scout RPV during Operation Peace for Galilee.

[68] UAV 1993 Master Plan, p. 36 -38.

[69] Lambeth, Benjamin S., Moscow's Lessons from the 1982 Air War, (Santa Monica, CA: Rand Corporation, September 1984), p. 5.

[70] Ibid. p. 7.

[71] Gabriel, Operation Peace for Galilee, p. 97 - 98.

[72] Lambeth, Moscow's Lessons from the 1982 Air War, p. 7.

[73] Dornheim, Michael A., "RPV Deployment in Honduras Teaches Operational Lessons," Aviation Week & Space Technology, 11 July 1988, p. 43.

[74] Marine Corps Lessons Learned (MCLL) 60154-71699, Subject: Intelligence, Lesson Event: RPV Study, Submitted by MCCDC on 27 March 1990. Provides information on RPV tasking during Exercise Kernel Blitz 88-1. "The vast majority of tasking that the 1st RPV Company received were in direct support of/requested by G/S-2. At times, requests were made direct to 1st RPV Company without prior approval of 5th Marine Expeditionary Brigade (5th MEB) [the supported headquarters]. Frequently no Essential Elements of Information (EEI's) were provided regarding what type of activity, personnel or equipment the RPV was tasked to locate."

[75] Dornheim, "RPV Deployment in Honduras," p. 44.

[76] Ibid.

[77] UAV 1993 Master Plan, p 36.

[78] Fulghum, David A., "UAVs Pressed into Action to Fill Intelligence Void," Aviation Week & Space Technology, 19 August 1991, p. 59.

[79] "Gulf War Experience Sparks Review of RPV Priorities," Aviation Week & Space Technology, 22 April 1991, p. 86.

[80] Ibid.

[81] Ibid.

[82] "Gulf War Prompts Improvements in Next Generation of UAVs," Aviation Week & Space Technology, 9 December 1991, p. 44.

[83] Fulghum, "UAVs Pressed into Action", p. 59.

[84] Stewart, Brigadier General (P) John F., Operation Desert Storm, The Military Intelligence Story: A View from the G-2, Third U.S. Army, 27 April 1991, p. 31.

[85] Ibid.

[86] Ibid, p. 32.

[87] Fulghum, "UAVs Pressed into Action", p. 60.

[88] Ibid.

[89] Marine Corps Lessons Learned (MCLL) 10401-04797, Subject: Command and Control (C2), Lesson Event: Operation Desert Shield/Storm, Submitted by 3d RPV Company on 8 March 1991. "The 3d RPV Company was not receiving adequate intelligence support throughout Desert Shield/Storm. The Company was not on the initial address group for intelligence related messages...(and) was not on the distribution list for various imagery products available to MARCENT. This would have aided mission planning, BDA, and navigation in the KTO."

[90] Forster, Major General William H., "Systems to Meet Mission Needs," Unmanned Systems, Summer 1991, p. 14.

[91] Field Manual 34-22, Military Intelligence Battalion Combat Electronic Warfare and Intelligence (Aerial Exploitation) (Corps), (Washington, DC: Headquarters, Department of the Army, March 1984), p. 13 - 14. Although the UAV-SR has not yet been fielded to the Aerial Exploitation Battalion, the concept of employment for a system with similar deep collection and reporting capabilities as other AEB assets (i.e. Guardrail Common Sensor) should remain compatible with that in the remainder of the battalion.

[92] TSM UAV Briefing, chart #15 titled "UAV Baselines" reflects planned fielding of UAV-SR to all Army divisions and heavy ACRs less light divisions, and UAV-CR to all divisions, ACRs, and separate brigades.

[93] FM 34-1, p. 3-51 thru 3-59 and FM 34-2, p. 1-7 discuss the relationship between target development and target acquisition. Also see note 33 and Chart 19.

[94] The UAV-SR system is limited to providing information which can be determined by a visual examination of the collected imagery. As with most special skills the relative abilities of imagery interpreters varies with grade and experience. The ability to discern enemy information such as numbers and types of vehicles or combat systems can be readily accomplished through strictly visual means. Determining trafficability requires more than visual observation including items such as soil samples and the judgement of a soldier on the ground.

[95] FM 6-20-10, p. 3-4.

[96] Millis, Philip J., "RPVs over the Bekaa Valley," Army, June 1983, p. 51.

[97] Northrup, Timothy J., "RPV: Above the Threat," Field Artillery, February 1988, p. 21.

[98] Stewart, Brigadier General (P) John F., Operation Desert Storm, The Military Intelligence Story, p. 31.

[99] Ibid.

[100] Ibid. p. 2-6.

[101] Ibid. p. 3-1.

[102] Since this quote was taken from a targeting manual, its focus is on targets. However, not all PIR will pertain to targets. PIR could involve enemy intent, size, composition, or could be focused on information concerning terrain features such as river crossing sites, attack routes, or trafficability.

[103] FM 6-20-10, p. 3-5.

[104] FM 34-2, p. 4-4 to 4-10, discusses asset evaluation and correlation of asset capability to SIR collection requirements.

[105] Any combination or sequence of missions is possible. A total of eight hour mission duration is used in this example supposing that one hour is required to deploy to station and one hour to recover for the total ten hour mission duration.

[106] TSM Telephone Interviews.

[107] Ibid.

[108] Ibid.

[109] HQDA Briefing, chart titled "Short Range UAV Characteristics."

[110] TSM Telephone Interviews.

[111] "Section II: Means of Employment," UAV-SR Doctrinal and Organizational Test Support Plan (DOTSP), p. 2-2.

[112] Silvasy, "Employment of Unmanned Aerial Vehicles (UAV)," p. 17.

[113] TSM Telephone Interviews.

[114] Ibid.

[115] Ibid.

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