INCORPORATION OF AUTOMATED ISR SYSTEMS BY THE 75TH RANGER REGIMENT

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ABSTRACT

INCORPORATION OF AUTOMATED ISR SYSTEMS BY THE 75TH RANGER REGIMENT, By MAJ Douglas G. Vincent, 92 pages.

Current and proposed developments in technology will continue to enhance and change the way combat units conduct combat operations on the modern battlefield. This study will assess recent and proposed advancements in automated ISR technologies in relation to the 75th Ranger Regiment. As significant advancements in the area of automation and robotics continue to emerge, they drive the primary research question of how the 75th Ranger Regiment should incorporate new technologies to increase their ISR capabilities during direct action operations. The study will show how the regiment should integrate new technologies in the automated ISR arena by analyzing the research data against the following criteria: unmanned aerial vehicle capabilities, unmanned ground vehicle capabilities, remote sensor capabilities, and level of incorporation within the regimental structure. The final results of the research will be to establish what capabilities Ranger automated ISR systems should possess, what current systems possess these capabilities, and at what level these systems should be incorporated at within the regiment for greatest efficiency and maximum effect.

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LIST OF ACRONYMS

ISR	Intelligence, Surveillance and Reconnaissance
SOF	Special Operation Forces
SOPMOD	Special Operations Modification
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
DA	Direct Action
R&S	Reconnaissance and Surveillance
ISOS	Intelligence System of Systems
IMINT	Imagery Intelligence
HUMINT	Human Intelligence
C2	Command and Control
DTLOMS	Doctrine, Training, Leader Development, Organization, Material, and Soldiers
MNS	Mission Needs Statement
ORD	Operational Requirements Document
RPUAV	Ranger Portable Unmanned Aerial Vehicle
JORD	Joint Operational Requirements Document
NRaD	Naval Research and Development Division
AMGSSS	Air Mobile Ground Security and Surveillance System
MPRS	Man Portable Robotic System
MSSMP	Multipurpose Security and Surveillance Mission Platform
LTD	Laser Target Designator

PEWS	Platoon Early Warning System
RSTA	Reconnaissance, Surveillance, Targeting and Acquisition
CALL	Center for Army Lessons Learned
MOS	Main Skill Identifier
TTP	Tactics, Techniques and Procedures
GCS	Ground Control Station
RVT	Remote Video Terminal
RSB	Ranger Surveillance Ballons
DARPA	Defense Advanced Research Projects Agency
NAI	Named Area of Interest
MUMMS	Micro Unattended Mobility System
TO&E	Table of Organization and Equipment
HHC	Headquarters and Headquarters Company
RHHC	Regimental Headquarters and Headquarters Company
MID	Military Intelligence Detachment

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CHAPTER 1

INTRODUCTION

On the sixth of June 1944, the 2nd Ranger Battalion disembarked from their landing craft onto the beaches of the Normandy Coast, with the critical operational mission of destroying German gun emplacements threatening the invasion beaches. Standing in the shadow of the cliffs of Point du Hoc and under intense fire from the enemy positions above, the Rangers began to ascend the cliffs on ropes and assault ladders. Upon reaching the top, they quickly defeated enemy resistance and moved to destroy the large-gun emplacements, only to find that the guns had never actually been emplaced in the positions. Modern Rangers, like their predecessors, are often called upon to execute critical and essential missions with operational and sometimes strategic implications. Given modern technology, satellite or aerial imagery may have told the Rangers that the Point du Hoc emplacements were vacant. But if these assets failed, the modern Ranger would possibly be forced to scale the cliffs today just as his predecessors did. However, with advancements in automated intelligence, surveillance, and reconnaissance (ISR) systems, the Ranger of the future could potentially hand launch a portable unmanned aerial vehicle from the inbound landing craft, fly a low-level reconnaissance of the gun emplacements, verify their status, and divert to an alternate objective. This fanciful vignette merely serves to illustrate that like their World War II brethren, the 75th Ranger Regiment performs critical strategic and operational missions in support of National Command Authority and theater-level objectives and that modern technologies can enhance their capabilities and facilitate success.

The Research Question

Current and proposed developments in technology will continue to enhance and change the way combat units conduct combat operations on the modern battlefield. This study will assess recent and proposed advancements in automated ISR technologies in relation to the 75th Ranger Regiment. The significant advancements in the area of automation and robotics continue to emerge, driving the primary research question: how should the 75th Ranger Regiment incorporate new technologies to increase their ISR capabilities during direct action operations? The secondary questions are: Which technologies should be incorporated for the greatest enhancement of capabilities with the least impact on current force structure? and How should they be incorporated into the 75th Ranger Regiment and at what level?

Background

The United States Army has committed itself to transformation to meet and dominate the challenges of warfare and conflict in the Twenty-first Century. Both the Interim Force and the Objective Force are designed to leverage advanced technology to maintain dominance in the global environment. A key element to the success of both the Interim Force and the Objective Force will be their advanced ISR systems and the incorporation of these assets into ISR operations.

The 75th Ranger Regiment has always been a flexible unit that readily adapts to change. With a lineage that dates back to prerevolutionary times and Roger's Rangers, to a modern history that can be traced back to 1974 and General Abrams' charter to establish and design a force to meet threats on a global scale, the Rangers have always been adaptable and forward looking. The 75th Ranger Regiment, along with other Special Operation Forces (SOF), has always led the way on fielding new equipment and doctrine throughout the years. The Rangers were one of the first units to field night vision devices, frequency hopping radios, Kevlar helmets, bullet-proof body armor, individual communication systems, satellite communications systems, Special Operation Modified (SOPMOD) M4 carbines, and computer-based command and control systems. The Regiment helped establish the training path and standard operating procedures for urban combat, close-quarters combat, combative programs, ballistic lasers, and optical sites for the conventional Infantry. The 75th Ranger Regiment is accepted and expected to develop new equipment; new systems; and the tactics, techniques and procedures to support the operation of the new equipment. A relevant illustration of this is the fact that the Rangers have been chosen as the first unit to field the operational version of the Land Warrior, an integrated system worn by a soldier that is supposed to increase the lethality and situational awareness of the individual and the squad. In accordance with its position as one of the leading testbeds for new or experimental equipment, the Regiment has begun to forge ahead with ISR developments, considering both the types of equipment and the techniques to be utilized. Currently, the 75th Ranger Regiment is developing initiatives to incorporate cutting-edge, modern technologies into ISR capabilities to advance operational targeting, lethality, and flexibility, allowing the Regiment to fight more effectively and efficiently. The goal of the Regiment is to incorporate new technologies and systems to allow Rangers to operate in a hostile environment for five to nine days with increased depth and situational awareness. This has become necessary to take full advantage of the opportunities and increased capabilities that new technologies provide ISR operations. However, research has not been formally initiated by the Rangers, resulting in the request for this research thesis by the Regiment.

Assumptions

In order to conduct research and answer the research question proposed by the thesis, it is necessary to accept certain assumptions on the proposed topic. The first assumption is that funding will not be an issue for the Ranger Regiment. This means that throughout the research, the topic of funding will not be addressed, it will be assumed that the systems best suited to support the Rangers will be funded. Another assumption, which will be made to simplify the research process, will be in the arena of acquisitions. The regiment has a rough idea of what types of ISR systems will meet their requirements, but has not yet entered the acquisition or procurement phase or finalized a requirements document. For the purpose of this thesis discussion, the assumption will be made that any system the Rangers are interested in that best suits their requirements can be procured without concern for the idiosyncrasies of the acquisition process. Several simple assumptions will also be made in support of the research topic. The researcher will assume that the global threat will remain basically unaltered, facilitating the understanding that Ranger ISR enhancements will continue to provide a distinct advantage over counter-ISR capabilities. The assumption will also be made that for the foreseeable future (five to ten years out) only evolutionary changes will occur in the development of ISR technology, as opposed to unforeseen revolutionary changes that could rapidly advance the development of systems beyond the scope of what is being proposed in the thesis. By understanding and accepting these assumptions, the research process should be somewhat simplified, manageable and narrower in scope.

Definitions

To ensure that all audiences and recipients understand the concepts proposed in this thesis, it will be necessary to establish a common, accepted vocabulary. The focus will be primarily on basic terms in order to establish a common language concerning the topics discussed. Ranger ISR, the focus of this thesis, consists of intelligence, surveillance, and reconnaissance. The key component of the thesis is the ISR as a system, an instrument of technology, so that will remain the focal point for the definitions. Each of these terms will be individually defined for clarity.

Automated ISR Systems (AIS). For the purpose of this thesis, automated ISR will only refer to the automated or robotic equipment that enhances the Ranger's ability to develop and maintain situational awareness. It will refer to all equipment that provides visual, audio, thermal, meteorological, or seismic information to Ranger command and control, including remote digital equipment, sensors, unmanned aerial vehicles, and unmanned ground vehicles. It does not concern any of the personnel who conduct ISR or collect the data. Thus the reconnaissance element that emplaces a digital sensor near an axis of advance will not be included in this study, but the digital sensor will be.

Intelligence. The product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of all available information concerning foreign countries or areas (FM 101-5-11997, 1-83).

Surveillance. The systematic observation of airspace, surface or subsurface areas; place; person's, or things by visual, aural, electronic, photographic, or other means (FM 101-5-11997, 1-148).

Reconnaissance. A mission undertaken to obtain by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy or about the meteorological, hydrographic, or geographic characteristics of a particular area (FM 101-5-11997, 1-130).

Sensors. Equipment that detects and may indicate and/or record objects and activities by means of energy or particles emitted, reflected, or modified by objects (FM 101-5-11997, 1-139).

Unmanned Aerial Vehicle (UAV). A remotely piloted, unmanned aircraft fitted with sensors or audio visual equipment, capable of conducting reconnaissance and surveillance to increase Ranger situational awareness. For the purpose of the thesis, UAVs will refer to unmanned aircraft providing local or immediate support to Ranger Forces and will not refer to national or strategic assets.

Unmanned Ground Vehicle (UGV). A remotely operated, unmanned ground vehicle with sensors or audio visual equipment, capable of conducting reconnaissance and surveillance to increase situational awareness.

Remote Digital Equipment. Remotely operated or motion activated cameras capable of conducting surveillance of designated areas.

Direct Action (DA) Operations. DA operations are short-duration strikes and small-scale offensive actions by SOF to seize, destroy, capture, recover, or inflict damage on designated enemy personnel or material. DA operations are designed to achieve specific, well-defined, and often time-sensitive results of strategic and operational critical significance (FM 3-05.102 2001, 1-15).

Limitations

The body of research presented here is constrained by several factors. One factor limiting the research is the time limitations imposed by the length of the Command and General Staff Officer Course (CGSOC). The time allocated (ten months) by the United States Army for a selected officer to complete CGSOC places limitations on the amount and detail of the research that can be incorporated into the thesis. Interaction and information sharing will be conducted with the client unit, the 75th Ranger Regiment, to help alleviate some of the restrictions imposed upon the research by the allocated time. An additional limitation imposed on the research is the nature of information available on Ranger operations. Ranger operations are usually conducted in a “classified environment,” and information on specific data may be limited by security classifications. In order to ensure that the thesis remains unclassified, it may be necessary to avoid exact specifics and discuss operations in broad terms. Additionally, only unclassified data will be included in the thesis, regardless of source. The final limitation imposed on the research is the availability of research material on Automated ISR. Automated ISR is still a relatively new initiative, and a significant body of research does not currently exist. However, the amount of research material is growing daily, and can be augmented by materials from the 75th Ranger Regiment’s Regimental Transformation Office and other Special Operation Force sources.

Delimitations

For the purpose of this thesis, certain delimitations will be imposed to provide a framework for the research. Automated ISR systems will only be considered in their application and functionality during Ranger direct action operations, and only systems subordinate to and controlled by Ranger Units. Thus, national assets will not be considered. The research will only target automated ISR systems that are operated by Ranger forces or are operating in direct support of Ranger forces. As stated, national and strategic assets will not be included in the study. The focus on automated ISR systems will be near-term only. Thus, feasible developments based on the projected evolution of technology in the next five to ten years will be considered in the study, anything beyond the scope of what the preponderance of sources say is feasible will be disregarded. The only doctrine that will be considered in the research study and literature review will be currently existing doctrine. The current doctrine will be used to show the relevance of the study in the literature review. Proposed or projected doctrine will not be incorporated into the thesis.

Significance of the Study

The research presented in the following chapters is significant in that it will attempt to provide an initialization or starting point for the incorporation of automated ISR systems into Ranger direct action operations, a topic currently under study by the Regimental Transformation Office and augmented by this research. The incorporation of automated ISR systems will significantly increase the capabilities of the 75th Ranger Regiment by harnessing technology to increase situational awareness, efficiency and effectiveness. The goal is to incorporate new technologies to increase Ranger capabilities to allow the regiment to operate in a hostile environment for five to nine days, verse the current operating period of approximately twenty-four hours (one period of darkness). Additionally, due to the fact that the 75th Ranger Regiment traditionally is in the vanguard of new doctrine and equipment, tactics, techniques and proceedures and standard operating procedures developed by the regiment concerning the incorporation of automated ISR systems will doubtless be disseminated across the remainder of the Army in the years to come, increasing the overall capabilities of the military in general.

CHAPTER 2

LITERATURE REVIEW

To validate the requirement for the research enclosed in the thesis, namely how the Ranger Regiment should use automated ISR to increase their capabilities, it is first necessary to adequately show that a body of work on the topic is or is not already in existence. A review of current material available on automated ISR systems, integration, capabilities, and military ISR operations will meet this requirement. The logical place to start the review is with current US joint and Army doctrine. As FM 34-1, the *Intelligence and Electronic Warfare Operations* Manual, states, "Joint and Army doctrine are the driving forces that determine how we organize, train, and equip our forces. When we rethink our doctrine, we directly influence our training, leader development, force design, and equipment acquisition programs. Doctrine bridges intellectual, physical, and technological change" (FM 34-11994, iii). Accordingly, the bulk of the review will consist of a commentary on current doctrine, with a lesser part allocated to civilian literature and Ranger standard operating procedures and tactics, techniques and procedures.

Automated ISR in US Army Military Intelligence Doctrine

The existing catalog of military intelligence field manuals that support MI doctrine mainly addresses ISR as separate topics. The military intelligence manual, FM 34-1, *Intelligence and Electronci Warfare Operations*, discusses many of the principles of force projection integrated electronic warfare, to include intelligence support to military operations, fundamentals of IEW, force projection, and combat operations in general, joint, combined and interagency operations, operations other than war, and information operations. The manual does cover intelligence support to special operations, but in a very broad sense. The discussion of Ranger operations is limited to a definition of direct action missions (short duration strikes or small-scale offensive actions which seize, destroy, or damage specific targets and capture or recover personnel or material) and examples of IEW support (FM 34-11994, 6-9). No mention is made of any form of internal IEW support provided by Ranger specific personnel or equipment or any type of automated ISR system.

Another military intelligence manual FM 34-2-1, *Tactics, Techniques, and Procedures for Reconnaissance, Surveillance and Intelligence Support to Counterreconnaissance*, discusses Reconnaissance and surveillance (R&S) principles, ISR assets owned by maneuver battalions and brigades, monitoring the R&S effort, and employment of electronic assets. FM 34-2-1 states that the two principles of R&S are to provide commanders the intelligence they need to act and provide as much of the intelligence in advance as possible. To provide some of the R&S requirements internally, FM 34-2-1 discusses assets controlled or available to regular maneuver battalions and brigades, to include scout platoons, ground surveillance radar, REMBASS (day/night surveillance system activated by magnetic, seismic-acoustic, or infrared changes from moving targets) and additional systems, and personnel. The array of equipment and trained personnel discussed in FM 34-2-1, however, are generally available only to regular Army units with a large support structure, not Ranger forces, and are not adequately suited to direct action missions as executed by SOF units. The manual also provides useful insights as to the employment of electronic warfare assets in support of the overall R&S plan. An understanding of the principles of R&S, the already existing assets currently controlled by maneuver battalions and brigades, and techniques to employ EW assets will be useful in focusing the automated ISR research, but does not solely answer the thesis question.

FM 34-8, *Combat Commander's Handbook on Intelligence*, describes the intelligence challenges faced by a commander, the command estimate process, military intelligence unit capabilities, prioritizing requirements, assets, and intelligence training tips for commanders. One of the most valuable portions of the manual, which may be relevant as a form of criteria for screening automated ISR systems during the research portion of the thesis, is the description of characteristics of effective intelligence: relevance, usability, timeliness, accuracy, completeness, objectivity, and predictive. FM 34-8 also provides a relevant appendix on current IEW systems currently operating. The manual does not, however, discuss or provide any information on developing automated ISR systems or their integration at any level of command

The *Brigade and Battalion Intelligence and Electronic Warfare Manual*, FM 34-80, like FM 34-2-1, covers IEW resources available to maneuver battalions and brigades and R&S planning factors and priorities. Although the R&S planning factors and priorities commented on in the manual may be useful later in developing thesis research concerning planning and employment of automated ISR systems, FM 34-80 does not discuss Automated ISR systems in any form or manner and most definitely does not answer the primary thesis question.

FM 34-130, *Intelligence Preparation of the Battlefield*, focuses mainly on intelligence in the planning phases of an operation and less on intelligence, surveillance, and reconnaissance during the operation. The manual does very briefly discuss the intelligence system of systems (ISOS), the "flexible architecture of procedures, organizations, and equipment that collect, process, store, and disseminate intelligence" (FM 34-130 1994, 1-13). FM 34-130 states how IPB products enable the exploitation of the ISOS' technology by allowing staffs to focus collection systems and provide immediate information, which facilitates direct targeting. In this respect, the manual is scratching at the surface of automated ISR systems, but a serious discussion concerning the actual incorporation of the systems is not addressed in the manual.

A review of the compiled and relevant military intelligence doctrine shows that guidelines exist for conducting R&S, and principles are provided for ISR planning and operations. Additionally, current systems available to augment purely human sources are carefully cataloged. However, because of the still-developing nature of this technology, current military intelligence doctrine pertaining to automated ISR systems and their integration into Ranger or maneuver operations has not yet been developed.

Automated ISR in Current Joint Doctrine

Although an extremely large catalog of data exist concerning intelligence, surveillance, and reconnaissance topics in joint doctrine, the bulk of the information reveiws ISR as individual or separate topics and does not mention of the fusion of the three into automated systems. The joint publications focus mainly on intelligence at the strategic and operational level of war and do not discuss ISR in support of Ranger specific operations.

Joint Publication 2-0, *Doctrine for Intelligence Support to Joint Operations*, discusses the flow of intelligence from the joint headquarters to the subordinate unit, but does not discuss at all internal assets of SOF, like the Rangers or their ISR capabilities. Joint Publication 3-05, *Doctrine for Joint Special Operations*, comments on the characteristics of Special Operations and their ability to influence the will of the enemy, to create conditions favorable to United States strategic aims or objectives, to direct offensive capabilities at high value targets with precise force. Joint Publication 3-05 also discusses Special Operations and their relation to the principles of war. Of particular note in this portion of Joint Publication 3-05 is the discussion on the relation of Rangers and the principle of economy of force. Joint Publication 3-05 states that economy of force is essential to SOF because units, like the Rangers, cannot squander their limited assets on secondary tasks, a fitting justification for the use of automated ISR systems by Ranger Forces and other SOF units. Joint Publication 3-05 also comments on intelligence support of SOF, stating that timely and detailed intelligence, tailored and fused, is critical to Special Operations. The publication does not elaborate on intelligence beyond providing the basic characteristics of SOF requirements, and no mention is made of current Ranger or SOF ISR assets or projected automated ISR systems. Joint Publication 3-05.1, *Joint Tactics, Techniques and Procedures for Joint Special Operations Task Force Operations*, provides information on the intelligence flow between different elements within the joint task force and on the intelligence integration, management, and dissemination. It also discusses the shortcomings in Special Operations Task Forces' intelligence capabilities and the fact that SOF units require a great deal of intelligence support from external assets to operate effectively. Like the other joint publications, internal ISR operations or assets available to SOF units are not included as a topic. The last pertinent joint publication 3-05.5, *Joint Special Operations Targeting and*

Mission Planning Procedures, is similar to Joint Publication 3-05 in that it provides broad view information on Special Operations intelligence support requirements, but does not discuss the internal assets available or internal integration of automated ISR systems by any SOF units.

As stated, the one common thread with all the joint publications is their focus on strategic or operational level intelligence, normally provided by national assets. Due to this focus, the publications do not include tactical level operations or the integration of intelligence provided by integral Ranger assets, like future automated ISR systems. The publications do stress the extreme importance of timely intelligence to SOF units and the necessity for Rangers to adhere to economy of force operations, strong justifications both for the development and integration of automated ISR systems.

Automated ISR in US Army Operational and Maneuver Doctrine

The current US Army operational and maneuver manuals that discuss the prescribed way the Army conducts operations and executes tactics have undergone relatively new revisions. FM 3-0, *Operations*, and FM 3-90, *Tactics*, were revised as recently as 2001. Despite the neoteric nature of this doctrine, it does not incorporate technologies still in the developmental stage, such as automated ISR systems. However, in order to conduct a truly comprehensive review of all pertinent literature, it is still necessary to survey the primary manuals concerning operations, maneuver, and tactics, as well as the manuals discussing the Army units that are the conventional equivalent of the Ranger Regiment.

FM 3-0, *Operations*, provides a limited discussion on the impact that advances in technology will have on the modern battlefield. The manual states that the key to gaining situational understanding and avoiding overload will be to filter out distractions. While user friendly technologies will help, the basic responsibility for sorting, processing, and acting on the increased information that technology will make possible is still the leader's. FM 3-0 also makes an extremely valid point by stating that information technology will not replace the requirement for small unit training and aggressive leadership, the very crux of Ranger operations. Both of these points will be relevant in the development of the research supporting the incorporation of automated ISR systems by the regiment. The way technology provides commanders with new ways to see and engage the enemy and helps reduce uncertainty and increase opportunities is also discussed. The manual provides these brief discussions on the impact of technology at the close of each major chapter, but does not discuss future or projected technologies, like automated ISR systems or what impact they may have on operations.

FM 3-90, *Tactics*, focuses an entire chapter on reconnaissance operations, to include subchapters on characteristics of reconnaissance assets and intelligence, surveillance, and reconnaissance planning. The reconnaissance chapter includes several useful items, to include the seven fundamentals of successful reconnaissance; "ensure continuous reconnaissance, do not keep reconnaissance assets in reserve, orient on the reconnaissance objective, report information rapidly and accurately, retain freedom of maneuver, gain and maintain enemy contact, and develop the situation rapidly" (FM 3-90 2001, 31-1). The definitions of these fundamentals may prove productive as additional criteria to evaluate automated ISR systems during the research portion of the thesis. The subchapters incorporate some useful information as well, to include defining different types of reconnaissance assets and their abilities. A table is provided to display the types of assets available to platoons up through echelons above corps, and there is a brief description of technical systems and their integration into the ISR plan to highlight the abilities of these assets. According to FM 3-90, a commander is going to combine manned ground and air assets with technical systems in order to create synergy, overcoming the weaknesses of one system with the strength of another (FM 3-90 2001, 13-7). The manual also points out that the majority of technical systems perform surveillance, not reconnaissance. "Surveillance provides information, while reconnaissance answers the commander's specific questions" (FM 3-90 2001, 13-7). FM 3-90 contains some relevant information which may be useful in researching how the Rangers should incorporate automated ISR, to include deciding what automated assets can perform surveillance and reconnaissance. It does not, however, contain specific information on potential automated ISR systems or their tactical integration to support operations.

FM 7-30, *Infantry Brigade Operations*, discusses the integration among the S2, the military intelligence assets, and the commander in order to answer his intelligence requirements. The manual also reviews the principles of intelligence synchronization and some inherent intelligence tasks, to include indications and warnings, IPB, situation development, target development and support, force protection, and battle damage assessments. Similar to select data provided in FM 3-90, some of the information in FM 7-30 may prove useful in the research portion of the thesis, but the topic of projected automated ISR systems and their capabilities is not discussed. The Infantry brigade manual also includes an appendix on the Ranger Regiment, but FM7-

85, *Ranger Unit Operations*, reviewed below, contains an even more in-depth study of the Ranger mission and their capabilities.

The Army's operational and maneuver doctrine contains a lot of pertinent information that will be helpful in establishing criteria for evaluating automated ISR systems and what their capabilities should be in the research portion of the thesis. FM 3-0 highlights the value of the human factor in the technological equation, FM 3-90 provides some important fundamentals, definitions, and asset characteristics, and FM 7-30 discusses the integration of the intelligence effort and the principles of synchronization. However, similar to the Military intelligence's doctrine, these manuals lack an in-depth study or discussion of the utilization of automated ISR systems to increase capabilities, most likely due to the still-developing nature of the tactics and technologies associated with these systems. The numerous other manuals covering the Army's operational and maneuver doctrine are equally devoid of any significant study of automated ISR, and are not mentioned in the review due to their lack of relevance to the research portion of the thesis.

Automated ISR in Current SOF and Ranger Doctrine

Available SOF and Ranger ISR doctrine is similar to conventional Army sources in that it is focused on current ISR capabilities and operations, and does elaborate on developing technologies or proposed systems like automated ISR. FM 3-05, Army SOF doctrine, discusses the SOF characteristics, fundamentals of SOF operations, and the different type of SOF available to the National Command Authority. FM 3-05 also discusses the strategic nature of most SOF operations, and the importance of initial execution and success for a SOF mission. The manual does not provide any in-depth information on the particulars of Ranger Operations, what ISR assets currently may support them, or what their future ISR asset requirements may be.

FM 3-05.102 *Army Special Operations Forces Intelligence*, elaborates over FM 3-05 on Ranger missions, the Ranger intelligence organization and the organic and nonorganic intelligence support provided to the Rangers for operations. According to FM 3-05.102, Ranger missions have high-risk and high-payoff attributes, and require accurate, detailed and timely intelligence to ensure successful execution (FM 3-05.102 2001, 4-1). In order to help satisfy its' intelligence requirements, the Regiment's intelligence organization consist of the Regimental S2 shop (RS2), a military intelligence detachment consisting of a weather section, a counterintelligence section, an all-source analysis section, and a collection management and dissemination section. The Regiment also has a Ranger Reconnaissance Detachment (RRD) consisting of a headquarters element and three teams. The Reconnaissance Detachment allows the Regiment to answer immediate tactical intelligence requirements. The Regimental S2 shop can act as an Army Special Operations Task Force (ARSOTF) S2, augment the Ranger Battalions S2 shops as required, or augment and integrate in with an ARSOTF or Joint Special Operations Task Force (JSOTF) as necessary. FM 3-05.102 states that the Regiment is normally dependent on its supporting higher headquarters or national assets to fulfill most of its intelligence requirements and provide intelligence support, to include imagery intelligence (IMINT) support from UAVs. The manual also clarifies that the Rangers currently do not possess automated ISR systems, and once on the ground they are highly dependent on their own human intelligence (HUMINT) sources, like RRD and regular patrols, or external sources to help them maintain situational awareness. The lack of internal ISR systems that promotes economy of force while still providing situational awareness is one of the limiting factors on the duration of Ranger operations that this research will address.

FM 7-85, *Ranger Operations*, is the manual providing doctrinal guidance for the Ranger Regiment, and is the Army publication that this research will have the most impact on. FM 7-85 covers special teams and equipment of the Regiment and the Ranger Battalions, methods of insertion and extraction, strike operations, Special Light Infantry operations, combat support and combat service support. The manual discusses the importance of intelligence to Ranger operations, and similar to FM 3-05.102, highlights the fact that with the exception of the Reconnaissance detachment, most of the Regiment's intelligence must be provided by it's supporting headquarters. FM 7-85 is currently being revised, but neither the original version nor the revised form comment on the integration of automated ISR systems to increase capabilities and the duration of Ranger operations.

The entire library of Ranger specific publications and circulars produced internally by the Regiment has also been reviewed for content and to evaluate if they provide the requisite answer to the thesis question. The publications, like RTC 350-1, the training circular, discuss the administrative or tactical standard operating procedures for the Regiment, and the tactics, techniques and procedures used in training and operations. None mention, however, automated ISR systems, or any basic integration of ISR into operations.

Automated ISR in Current Military Literature

Unfortunately, similar to the shortcomings of current doctrine, the bulk of literature available on automated systems is concerned with conventional Army transformation and the Interim and Objective Forces. Documents with a broader scope are readily available, both the Joint Vision 2010 and the Joint Vision 2020 discuss C4ISR, net-centric warfare, and technological advancements as the key to transformation. However, these works, as well as the Army Chief of Staff's White Paper, do not concern themselves with the particulars. Numerous additional sources exist which discuss portions of the ISR equation, like a boon of Military intelligence articles elaborating on technological advances, but the focus of most of these works is mainly on national-level assets or their integration by MI elements alone. Additionally, there are several articles in technological periodicals such as Popular Science that discuss automation and robotics on the battlefield. However, the bulk of this periodical information focuses primarily on the technology, not on its employment. The nearest thing to a body of work that exists on the issue as a whole is in a multitude of Army Times, Army Journal, and Joint Force Journal articles elaborating on current transformation, but similar to the White Paper, these sources are not concerned with the particulars, but on the broader concepts of transformational doctrine.

In summation, large amounts of doctrine currently exist on intelligence, maneuver, and special operations, most of it having been recently revised. As doctrine is the driving force behind the techniques and tactics used to conduct military operations, it is the natural source of review to validate the thesis question. The review conducted of current doctrine, Ranger specific publications and current literature shows that the problem of how the Regiment should incorporate automated ISR systems to increase their capabilities has not yet been addressed. It has produced a useful catalog of data concerning Ranger operations, existing assets, fundamentals of reconnaissance, and the characteristics of intelligence, which will be utilized in the research process as criteria in developing and evaluating existing and future systems and technology and integrating them into Ranger operations.

CHAPTER 3

RESEARCH METHODOLGY

Research Approach

The research approach will be conducted in three phases to collect, collate and analyze the research data. The first phase will consist of a restatement of the primary and secondary research questions, with an explanation of how the research categories will provide the solutions to the problems forwarded. The second phase will consist of collecting and collating the research data by categories. Five research categories have been selected, and will be explained in detail. The five categories are the Ranger future requirements vision for automated ISR systems, (consisting of the Ranger transformation vision, the Regimental Commander’s baseline requirements concerning ISR capabilities, and the joint operational requirements document for the rucksack portable unmanned aerial vehicle); interviews with Rangers on automated ISR systems capabilities; the incorporation of similar systems by other units and countries; a study and comparison of existing and forecasted systems; and a study of the pros and cons of incorporation of ISR systems at different levels within the Ranger Regiment. The third phase will consist of analyzing the data generated by the five research categories for criteria, trends and themes. The baseline criteria identified by the Ranger Regiment’s Future Requirements Vision will be evaluated and compared to the results of the interviews, and the actual capabilities of existing and forecasted systems. A final revised list of criteria, labeled benchmark criteria, will then be forwarded to the Regimental Transformation Office for approval, and utilized in the analysis of the research. The final requirements for the selected benchmark criteria will be that they meet the needs of the Regiment as outlined by the Transformation Office, are definable and measurable.

The research data will also be analyzed for trends and themes and the compared to the final benchmark criteria. For the purpose of this study, a trend will be established when 33 percent of the evaluated samples (the Ranger interviews and current capabilities primarily) concur on a requirement or capability. If an outright trend is not established (less then 33 percent concurrence), but a common consensus is perceptible due to the strength, weight or emphasis placed on a requirement or capability, this will be labeled a theme, and will be similarly evaluated as if it were a trend. The trends and themes, after being evaluated and analyzed against the selected criteria, will answer the primary and secondary research questions restated below. A graphic portrayal of the complete research methodology is enclosed below as Figure 1.

Constant Comparative Method of Qualitative Analysis

The research methodology utilized throughout the process will be the Constant Comparative Method of Qualitative Analysis (Glaser and Strauss 1967). The data will be coded into separate sub-categories, which will most likely correspond to the separate capabilities for automated ISR systems, like information provided, range duration of operation, weight, payload, ease of operation, and ease of integration. Additional categories may be identified based on the coding of the researched data, and some categories may be discarded as irrelevant to the overall study. As the data is coded and then compared, trends and themes will become more readily apparent, and will begin to provide the answers to the five primary research categories.

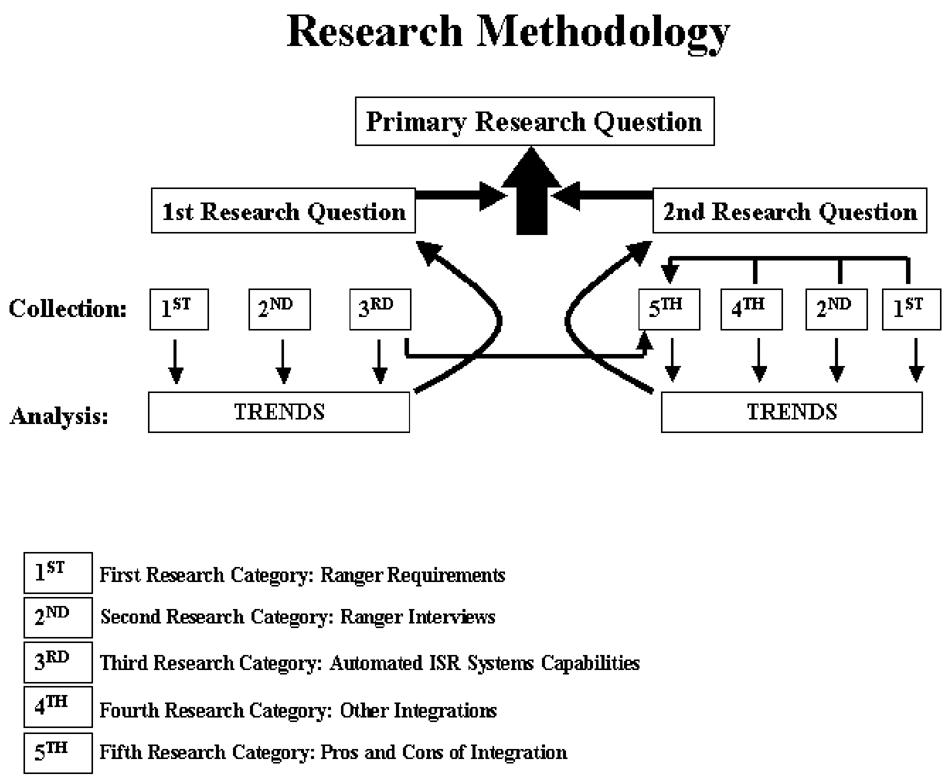

Figure 1.

Querying the Regimental Transformation Office for the Regimental Future Capabilities Vision, conducting interviews with fellow Ranger officers, and additional research will collect the data. The data will be analyzed by using developed charts to compare capabilities versus desired requirements for trends and themes in equipment capabilities, and comparing opinions on integration with established pros and cons of integration and previous integration for common trends.

Biases

The primary strength of the adopted research methodology is that it utilizes an inductive approach that is more suitable to the varied data received, most of which contains subjective information and personnel opinion. The primary weakness of the adopted methodology is that portions of the qualitative analysis, particularly the category on the pros and cons of the integration of automated ISR systems, will be biased by the same subjective information and personnel opinion. In discussing the weaknesses of the research methodology being utilized in this study, it is also necessary to address the inherent threats to internal validity that are present. The initial threat to internal validity that must be acknowledged is the size and nature of the sample utilized for the second research category, Ranger interviews. The Rangers interviewed comprise only a small portion of the overall Ranger population. The sample is composed entirely of officers, primarily Infantrymen currently assigned to the Command and General Staff College. The individuals in the sample population have their own biases and opinions concerning Ranger operations based on their relatively similar experiences in the Ranger community. As a result of this small sample, the trends and themes established might be skewed off-center from the normal results of survey of a much larger population consisting of the entire Ranger population. However, time constraints and the availability of the sample population necessitated the size of the sample. The additional threat to internal validity is the primary weakness of the research methodology, the subjectiveness of the researcher in evaluating the fifth research category, the pros and cons of the incorporation of automated ISR systems at different levels. Personal opinion and biases will be filtered out as much as possible using the established criteria and trends, but the threat should be addressed to the reader for the validity of the study. In order to maintain as objective a paper as possible, triangulation will be used whenever possible to compare multiple sources of data and avoid any biases on the part of the researcher. When triangulation is not possible, the researcher will attempt to account for personal biases and maintain as much objectivity as possible.

Research Questions

As stated in chapter one, the primary research question that this thesis is designed to answer is: How should the 75th Ranger Regiment incorporate new technologies to increase their ISR capabilities? The primary question will be in large part satisfied by answering the secondary questions. The requisite data collected to answer the secondary questions will provide the majority of the solution to the primary thesis question. The research categories, in turn, will provide the requisite data to satisfy the secondary questions.

The initial secondary question, which technologies should be incorporated for the greatest enhancement of capabilities with the least impact on current force structure, will be answered by collecting, collating, and analyzing the material from the research categories. The data from the Regimental Future Requirements Vision will provide a baseline criterion for capabilities. The interviews with Rangers will provide the real world input and experience to help with the refinement of the baseline criteria, and the study of the incorporation of systems by other units and countries will further refine the baseline criteria by showing how other units have dealt with similar problems of incorporating new systems. The comparison of existing and forecasted systems will apply the baseline criteria to the data pertaining to actual capabilities that exist or are scheduled to exist in the near term (five to ten years), and provide the initial answer as to what systems the Regiment may want to incorporate to increase their capabilities. The final research category, a study of the pros and cons of incorporation of ISR systems at different levels within the Ranger Regiment, mainly pertains to the final secondary question.

The final secondary question, how should the new capabilities be incorporated into the Regiment and at what level, will in part be answered by analyzing the research material from the first secondary question concerning which systems or capabilities meet the baseline criteria and the Rangers' requirements. Due to the fact that the type of systems incorporated will partly dictate at what level they will be incorporated, the solution to the initial secondary question is linked to the next secondary question. The data from the Regimental Future Requirements Vision will also provide a baseline criterion for incorporation of new capabilities. The interviews with Rangers will provide critical data pertaining to what level these new systems should be incorporated at based on opinion (which should carry significant weight as approximately ten to twelve former company commanders will be interviewed, many with real world operational experience). The study of the incorporation of systems by other units and countries will provide additional data by showing the successes and failures of other units based on their incorporation of new systems at varying levels of command. The last research category however, a study of the pros and cons of incorporation of ISR systems at different levels within the Ranger regiment, fortified with the criteria developed in the first and second research categories, should provide the bulk of the required data to satisfy this secondary question.

In summary, the result of the literature review showed that the primary and secondary questions are currently not addressed and unanswered by US Army doctrine. However, once the research data has been analyzed to answer the two secondary questions, the primary question should, with additional refinement and analysis of the data, be answered by default. The answers to the research questions will provide the Regimental Transformation Office with refined information for their requirements document for procurement and Ranger doctrine development for operations, which will in the long term be incorporated into future US Army Doctrine.

Ranger Future Requirements Vision for Automated ISR systems

Military requirements are assessed and determined by a system know as DTLOMS, for doctrine, training, leader development, organization, material and soldiers. In brief, a unit or organization may rewrite its doctrine in order to incorporate new techniques or technologies, or the emergence of new technologies may prompt the rewrite of doctrine. According to one source on the topic, “Doctrine reflects an application of required and attainable capabilities for fighting on today’s battlefield” (How the Army Runs 2001, 5-9).

New doctrine requires new training and leader development and possible unit re-organization based on the requirements imposed by the new doctrine. It also may potentially prompt the assignment of new soldiers or the development of a new MOS and the development and procurement of new materials to meet these emerging requirements. The driving force behind the development and procurement of new materials is the mission needs statement (MNS), a synopsis from the modified organization outlining basic requirements for the new material. The mission needs statement in turn focuses the development of the operational requirements document (ORD), which clearly delineates the capabilities and characteristics required of the new material prior to procurement.

Due to the fact that the 75th Ranger Regiment has not yet revised its doctrine to include automated ISR systems, a DTLOMS cycle has not yet been initiated. Thus a finalized MNS has not been generated, and cannot be included in this research. However, since technology may also drive doctrine, the Regiment has compiled a strategy or future vision outlining proposed doctrine for operating in the near-term future with new technologies, as well as some basic requirements and capabilities that are desired in potential automated ISR systems. Additionally, the United States Special Operations Command has initiated a joint operational requirements document (JORD) for a rucksack portable unmanned aerial vehicle (RPUAV), which sets the baseline capabilities for a Ranger UAV. The Ranger transformation vision and the JORD will be categorized together as the Ranger future requirements vision. For the purpose of the research, the Ranger future requirments vision may be defined as both proposed emerging Ranger doctrine and the basic requirements for automated ISR systems.

The study of the regiment's proposed doctrine for future operations will help determine what the Rangers expect automated ISR systems to provide them operationally on the battlefield, where these emerging technologies fit in to the battlefield architecture, as well as somewhat demonstrating at what level the regiment expects to incorporate these assets. However, since the regiment has not written nor refined these emerging concepts except in the broadest context, the solutions derived from the study will not be absolute, and will have to be augmented from the other four research categories.

A review of the Ranger Regiment's initial statement of requirements and capabilities for automated ISR systems will provide an analysis of what the Rangers expect these emerging technologies to be capable of operationally on the battlefield, which in turn will help in displaying where these emerging technologies best fit within the battlefield architecture and where they should be incorporated. The regiment's initial requirements and capabilities will also provide the thesis' baseline criteria for analyzing what automated ISR capabilities the Rangers need, and where they should be integrated. However, similar to emerging Ranger concepts on the incorporation of automated ISR systems, the initial statement of requirements and capabilities generated by the Regimental Transformation Office is not all inclusive, and any findings concerning its contents will need to be augmented and supplemented with the results from the other four research categories.

Interviews on Automated ISR systems

The interviews will be conducted with a sample population within the Ranger and Special Operations community. The sample will consist of Rangers and Special Operations personnel who have experience in, at minimum, company level operations within the Ranger Regiment. The primary sample will be composed of Ranger and Special Operations officers currently attending the Command and General Staff College, Ft. Leavenworth, Kansas. The majority of the sampled officers currently attending the Command and General Staff College are former Ranger company commanders. Additionally, a small number of interviews may be conducted within the Ranger Regiment, with the Regimental Commander, Regimental Sergeant-Major, Regimental Transformation Officer and Regimental Reconnaissance Detachment Commander the focus of the interviews.

The purpose of the interviews is to solicit the opinions of an extremely experienced field of professionals concerning the expectations for future automated ISR systems' capabilities and integration. In order to establish a base line demographic, the interviews will gage the amount of Special Operation experience the interviewed individual possesses. The subject interviewed will be asked the number and type of Special Operations positions they have held, the number of years experience they have in the Special Operations community, and any real world operations they have participated in (unclassified). The interviewed subject will be asked what capabilities they think a Ranger-specific unmanned aerial vehicle should have. They will be asked to consider range, size, power source, and sensors. They will also be asked what capabilities they think a Ranger-specific unmanned ground vehicle should have, with range, size, power source and sensors again considered. The subject will next be asked for their opinion on remote sensor type and capabilities. As with the UAVs and UGVs, range, size, power-source and sensors array, either image, thermal or seismic, will all be a factor for consideration. The interviewed individual will be asked at what level they think the Rangers should incorporate automated ISR systems, regimental, battalion or company. Finally, the subject will be asked who, in their opinion, should operate the automated ISR systems; INTEL sections, maneuver units, or a combination of the two.

The results of the interviews will be compiled and compared for common themes and trends in the responses. Identified themes and trends will be collated and labeled as a consensus, which will then be added to the baseline criteria derived from the Regiment's future requirements vision. As stated, the interviews with Rangers will provide the real world input and experience to help with the refinement of the initial baseline criteria.

Current Incorporation of Similar Systems by Other Units/Countries

Studying the incorporation of systems by other units and countries will benefit the research in two ways. It will enable the further refinement of the baseline criteria and also provide additional data concerning Ranger integration of automated ISR by showing the successes and failures of other units based on their incorporation of systems at varying levels of command. The literature review revealed that no other unit or country has yet fully fielded a combined automated ISR system consisting of unmanned aerial vehicles, unmanned ground vehicles, and remote sensors in support of Special Operations direct action missions. However, some foreign militaries, such as the British and Israelis, have fielded remote sensors and utilize unmanned aerial vehicles. Additionally, some US organizations, like Federal bomb disposal units, utilize unmanned ground vehicles for select missions. While the systems used by the aforementioned foreign militaries and US organizations may not have the same capabilities as those required by the Rangers' baseline criteria, they still help demonstrate the integration and utilization of automated systems. The bulk of the data that will be compiled in support of this research category is located in the Command and General Staff College Reference Library

Study and Comparison of Existing and Forecasted Systems

Collecting and comparing data on both existing and forecasted systems can apply the baseline criteria applied to the actual capabilities that exist or are scheduled to exist in the near term (five to ten years). The results of this application will assist in providing the initial answer as to what systems the Regiment may want to incorporate to increase their capabilities, which will begin to satisfy the secondary and primary research questions. Several government organizations have been asked for research assistance in order to collect information concerning existing and forecasted systems.

The Naval Command Control and Ocean Surveillance Center's Research, Development, Test and Evaluation Division (NRaD) has been solicited for any data they can provide concerning current and future systems' capabilities and specifications. NRaD is currently developing and/or testing the Air Mobile Ground Security and Surveillance System (AMGSSS), consisting of unmanned aerial vehicles fitted with sensors. NRaD is also developing and/or testing a sensor fitted Man Portable Robotic System (MPRS), and a Multipurpose Security and Surveillance Mission Platform (MSSMP), also fitted with surveillance sensors. Each of these systems has different variants in development, and is being evaluated based on pre-established criteria. The results of these developmental and field test are being compiled by NRaD, and will assist in providing the initial answer to what systems the Regiment may possibly want to field when compared to the established baseline criteria.

The US Army Infantry Battlelab at Fort Benning, Georgia, has also been contacted concerning ongoing development of unmanned aerial vehicles, unmanned ground vehicles and remote sensors. Similar to NRaD, the Battlelab is currently testing automated systems being developed by various defense corporations against existing criteria. The Battlelab is also conducting experimentation concerning employment and integration of these automated systems. The combined results of the testing and evaluations being conducted by the Battlelab will assist in providing the initial answer to what systems the Regiment may want to incorporate, as well as possibly helping to satisfy the research question concerning the Regiment's incorporation of automated ISR systems.

Study Pros and Cons of Incorporation of ISR Systems at Different Levels

As stated in the introduction to the research methodology, a study of the pros and cons of incorporation of ISR systems at different levels within the Ranger Regiment, fortified with the criteria developed in the first and second research categories, should provide the bulk of the required data to satisfy one of the secondary questions. Once the baseline criteria has been established using Ranger requirements and the opinions and input of Ranger and Special Operations officers, a study will be conducted looking at the positive and negative aspects of integrating automated ISR systems at varying levels of command in the Regiment. Using the criteria established for what capabilities the automated ISR systems are required to possess, further refined with the input of Ranger and Special Operations experience, the final research category will consider the second and third order effects of integration of automated ISR systems within the Regiment. Examples of the second and third order effects which will be considered are personnel changes, additional training requirements, additional support requirements, degradation of mission accomplishment, and effects which will be further identified based on the results of the interviews and Ranger requirements. The results of the study of the integration of automated ISR systems, which is the most subjective of the research categories, will be collated and applied towards answering the final secondary research question; how should the new capabilities be incorporated into the Regiment and at what level.

Research Methodology Summary

The five research categories will be researched, studied, collated and applied towards answering the secondary research questions, which in turn will satisfy the primary research question and the thesis. The research categories will be primarily analyzed based on qualitative analysis, though some quantitative analysis will be used to derive themes and trends concerning capabilities and integration of automated ISR from the interviews and study of current and forecasted systems. Ongoing revisions of the research methodology may be necessary based on the responses received from the government organizations queried concerning current and forecasted systems capabilities. The combined results from the five research categories will be analyzed and reported in Chapter 4.

CHAPTER 4

ANALYSIS

Analysis Overview

The research analysis consists of five subphases which present, explain, and analyze the data compiled within the five research categories: the Ranger future requirements vision for automated ISR systems, interviews with Rangers on automated ISR systems capabilities; the incorporation of similar systems by other units and countries, a study and comparison of existing and forecasted systems, and a study of the pros and cons of incorporation of ISR systems at different levels within the Ranger Regiment. Spreadsheets will be used, in conjunction with graphs when applicable, to help display the trends and themes that developed in response to the analysis of the data. Visual presentations will be also be used to help present the Ranger Regiment's Vision of future automated ISR systems. The compiled analyzed data in the five sub phases satisfies the two secondary research questions, which technologies the Regiment should incorporate and how they should be incorporated. The final answers or conclusions to the secondary research questions and the relationship between the secondary questions and the primary research question will be addressed in chapter five.

Ranger Future Requirements Vision for Automated ISR Systems

As stated in chapter three, the 75th Ranger Regiment has not yet revised its doctrine to include automated ISR systems, so a finalized MNS has not been generated and cannot be included in this research. However, the Regiment has compiled a single-image future vision of interim transformation, which outlines the intent for potential automated ISR systems. The Regiment's vision is displayed in figure 2.

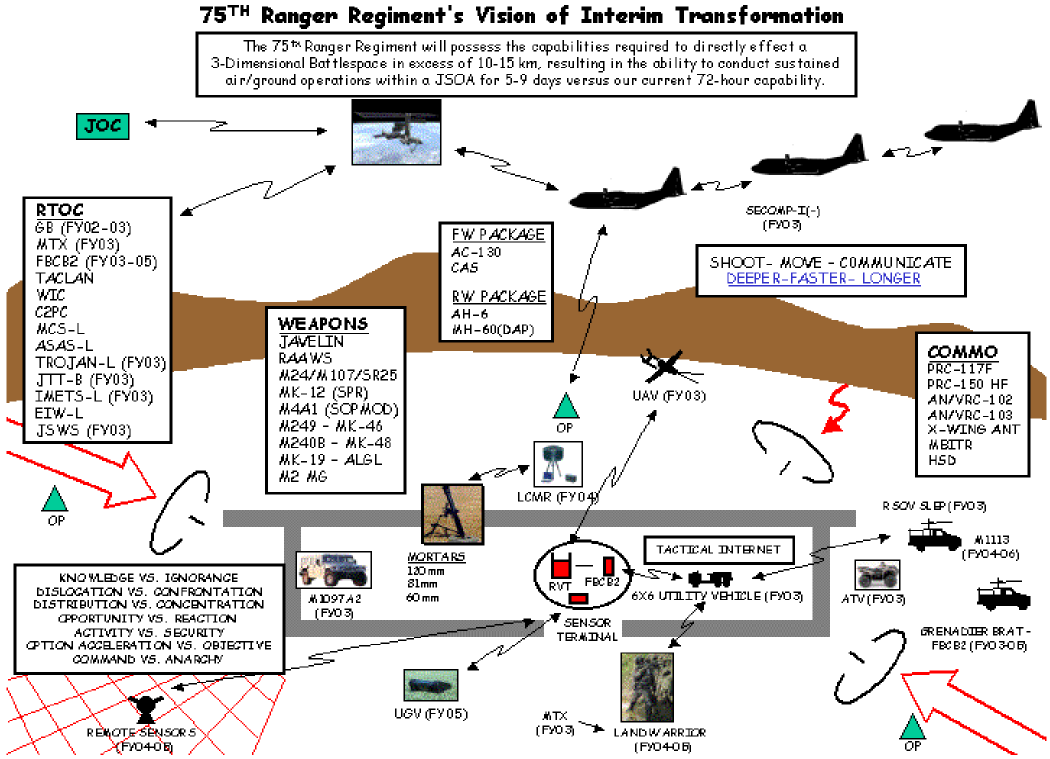

Figure 2

A review of the Ranger Regiment's interim vision, the initial statement of requirements from the Regimental Commanding Officer and the Regimental Transformation Officer, and the Special Operations Command's JORD for the RPUAV provide the basic capabilities the Regiment requires for automated ISR systems in the near term. The basic capabilities for automated ISR systems, as provided by the regiment and the JORD, provide the baseline requirements for the subsequent research in the remaining four research categories. According to the Regimental interim vision, portrayed above in figure 2, the regiment requires UAVs, UGVs, and remote sensors in order to "possess the capabilities required to directly effect a 3-Dimensional Battle space in excess of ten to fifteen kilometers, resulting in the ability to conduct sustained air/ground operations within a JSOA for five to nine days versus our current 72-hour capability" (Kauzlarich 2002). To facilitate the Ranger vision of directly effecting the battle space in excess of ten to fifteen kilometers's for an extended period of time, the ISR systems would have to be able to identify and notify the Rangers operating on the ground of activity within that range, and the Rangers would have to be able to place systems or the effects of systems, whether lethal or non-lethal, to counter that activity. The Regimental interim vision thus states that the desired automated ISR systems are UAVs, UGVs and remote sensors, and that these systems require at minimum a baseline capability of at least ten to fifteen kilometers range for one of the systems and the capability to identify activity and communicate the nature of that activity.

The initial statement of requirements from the Regimental Commanding Officer and the Regimental Transformation Officer augments the Regiment's interim vision and provides the basic capabilities the Regiment requires for automated ISR systems in the near term. According to the initial statement of requirements, the Regiment desires a UAV system, UGV system, and remote sensors. The UAV system should have a range of approximately fifteen to twenty kilometers, be capable of long duration flight, be solar or battery powered, and at a minimum possess a day and night video capability. Size of the system was not stated. The UGV system should man-portable, solar or battery powered, and be able to sense or survey at a 45-degree angle to the Earth's surface. Range and operation time were not stated. The remote sensor systems should be able to cover avenues of approach, should be solar or battery powered, and at a minimum possess seismic and possibly weather sensor capability.

Size of the system was not stated. The statement of requirements stated that the automated ISR systems should be integrated into the unit at battalion and regimental level with trained operators, but that company-level personnel should be trained on their operation for contingencies.

The Special Operations Command's JORD for the RPUAV states that, "In order to adequately execute the Global War on Terrorism (GWOT), SOF requires the most up to date information of a target area" (O'Brien 2003, 1). However, current operations have shown a deficiency with current systems, that "due to their limited numbers and Theater tasking priorities, access to direct download of sensor information from Theater assets such as Predator or Global Hawk, can only be expected for high priority missions" (O'Brien 2003, 1). In response to this, the JORD outlines the basic requirement for a RPUAV to provide the small unit with the ability to penetrate denied areas, provided day/night imagery of varied terrain, reconnaissance/surveillance of an enlarged battle space, improved force protection and increased situational awareness.

Based on the regimental vision for interim technology, the regiment's basic requirements statement and the JORD, the following baseline capability criteria can be established.

1. UAV systems should have a ten to twenty kilometer range; be able to operate for a minimum of 90-120 minutes; be battery powered and one man-portable, possess day video capability, night passive video capability, real-time imagery with heading and position, laser target designator (LTD); and be able to communicate with the Rangers on the ground, either through the operator control unit or a remote unit with a maneuver unit. The UAV should also possibly have an NBC detection capability, a

commo relay capability, and SIGINT and MASINT sensor and tagging/tracking capability.

2. UGVs should be man-portable, solar or battery powered, possess a survey-sense capability of at least 45 degrees to the Earth's surface, and be able to communicate with the Rangers on the ground.

3. Remote Sensors should be able to cover avenues of approach, be solar or battery powered, and have seismic or weather sensing capability at a minimum.

4. Automated ISR systems should be integrated into battalions and regiment, with trained personnel at company level.

With the baseline capabilities criteria established, it can be applied to the results of the second research category, the Ranger interviews, to analyze the data for trends or themes. The results of the trends and themes will be combined with the baseline capabilities criteria to establish a benchmark capabilities criteria, which will drive the operational requirements document for Ranger automated ISR systems.

Interviews on Automated ISR Systems

The interviews were conducted on a sample population within the Ranger community. The sample consisted of Ranger personnel who have experience in, at minimum, company level operations within the Ranger Regiment. The primary sample was composed of Ranger officers currently attending the Command and General Staff College, Fort Leavenworth, Kansas. The majority of the sampled officers was former Ranger company commanders. The purpose of the interviews was to solicit the opinions of an extremely experienced field of professionals concerning the expectations for future automated ISR systems' capabilities and integration. The interviewed subject was asked what capabilities they think a Ranger-specific unmanned aerial vehicle should have. They were asked to consider range, size, power source, and sensors. They were also asked what capabilities they think a Ranger-specific unmanned ground vehicle should have, with range, size, power source, and sensors again considered. The subject was next asked for their opinion on remote sensor type and capabilities. As with the UAVs and UGVs, range, size, power-source and sensors array, either image, thermal or seismic, were all a factor for consideration. The interviewed individual was also asked at what level they think the Rangers should incorporate automated ISR systems, regimental, battalion or company. Finally, the subject was asked who, in their opinion, should operate the automated ISR systems; INTEL sections, maneuver units, or a combination of the two. The results of the interviews have been compiled and are in tables 1 to 4.

Table 1.

UAVs	RANGE	FLT TIME	SIZE	POWER	SENSORS
RGT REQs	15-20K	1-2 hours	1 Man-portable	Batteries	Day/Night Video, live feed with heading/pos, LTD, NBC, SIGINT, MASINT
INTERVIEW SUBJECT #1	N/S	6-8 hours	small w/ stealth capability	rechargeable battery	IR, Thermal, sub-surface, NBC,

					intercept-monitor-jam freqs. Send live feed-capture stills
INTERVIEW SUBJECT #2	Strategic Range	N/S	N/S	N/S	Voice Recognition for TGT/Combat ID
INTERVIEW SUBJECT #3	100-1000+	N/S	"Microbird"	N/S	Live -Feed
INTERVIEW SUBJECT #4	10K	N/S	Jumpable	Lithium Batteries	IR, Thermal, Send live feed & Grids -capture stills
INTERVIEW SUBJECT #5	11K	N/S	HMMWV portable (in back)	N/S	Real time sensor to shooter link
INTERVIEW SUBJECT #6	10K	N/S	Jumpable	Fuel	Day/Night IR and Thermal sensors with LTD
INTERVIEW SUBJECT #7	N/S	N/S	Man-portable	Batteries	Camera with live-feed
INTERVIEW SUBJECT #8	200K	N/S	Small	Batteries	EO/IR/Thermal/LTD/GPS
INTERVIEW SUBJECT #9	20K (Arty Range)	4+ Hrs	Hand Launched	Batteries/Fuel	Thermal/Video/GPS with LTD

Table 2.

UGVs	RANGE	OP TIME	SIZE	POWER	Capabilities / Sensors
RGT REQs	N/S	N/S	Man portable	Solar/Batteries	Sense/ Survey at 45 degree angle with earth surface
INTERVIEW SUBJECT #1	N/S	12 hrs- moving 48 hrs – static	HMMWV portable (in back)	Batteries	Traverse all terrain with adaptable mission kits. IR, Thermal, sub-surface, NBC, seismic, intercept-monitor-jam freqs. Send live feed-capture stills
INTERVIEW SUBJECT #2	Strategic Range	N/S	N/S	N/S	Voice Recognition for TGT/Combat ID
INTERVIEW SUBJECT #3	800-1000m	N/S	35pounds<	lithium batteries	FLIR, thermal, 10xpower, motion, seismic, NBC
INTERVIEW SUBJECT #4	N/S	N/S	N/S	N/S	N/S
INTERVIEW SUBJECT #5	1K	N/S	HMMWV portable (in back)	Batteries /Fuel	Real time sensor to shooter link
INTERVIEW SUBJECT #6	2-3K	N/S	Man portable	Electric	IR and Thermal

					with laser capability, able to detect freqs
INTERVIEW SUBJECT #7	N/S	N/S	Man portable	Batteries	Imagery with live-feed and Land Warrior Compatible
INTERVIEW SUBJECT #8	20K	N/S	Very Small	Batteries	EO/IR/Thermal/Acoustic/Seismic/ Magnetic Sensors
INTERVIEW SUBJECT #9	2K	4+ Hrs	2'<	Batteries/Fuel	Audio/Thermal/Video/ GPS with Laser Designator

Table 3.

	SENSOR TYPE	SENSOR CAPABILITY
RGT REQs*	Cover AA. Solar/Battery powered	Minimal Seismic and Weather
INTERVIEW SUBJECT #1	UAVs/UGVs/GSR/REMBASS	IR, Thermal, seismic sub-surface, NBC, intercept-monitor-jam freqs. Send live feed-capture stills
INTERVIEW SUBJECT #2	N/S	Image/Thermal/Seismic
INTERVIEW SUBJECT #3	N/S	FLIR/Thermal/NBC
INTERVIEW SUBJECT #4	N/S	IR, Thermal, Radar, ID TGTs and Laze. Sensor to shooter link capable

INTERVIEW SUBJECT #5	Battery-powered hand-deployed PEWs style with increased capabilities. RT the size of a SINCGARs	Seismic and transmitted IR/Thermal Video image
INTERVIEW SUBJECT #6	Man-portable (5-10 Sensors per man) Range of coverage should be 500-1000m	SIGINT intercept, image, thermal, seismic
INTERVIEW SUBJECT #7	N/S	Image with live-feed
INTERVIEW SUBJECT #8	Self-Deployable. Aircraft or Bomb Launched	EO/IR/Thermal/Acoustic/Seismic/ Magnetic Sensors
INTERVIEW SUBJECT #9	Baseball-size. Airdroppable. Disposable. Solar/Battery powered	Thermal/Audio/Seismic/Weather

Table 4.

	CO Integration	BN Integration	RGT Integration	Operators
RGT REQs*	No	Yes	Yes	All trained for contingencies. Dedicated Operators
INTERVIEW SUBJECT #1	2xUAV,9xUGV ,5xRTs,3xG SR-REM	2xUAV,6xUGV ,6xRTs	3xUAV,3xU GV,10xRTs	CO - PLT & CO PAX BN - Snipers/TOC/JOC RGT- RRD/TOC/JOC
INTERVIEW SUBJECT #2	Long-term	Long-term	Short-term	Strategic cell of SIG, INTELL, FS (RSTA)
INTERVIEW SUBJECT #3	No	"MicroBirds"	RGT - FS UAVs RRD - "MicroUAV "	BN S3/ RRD / MID
INTERVIEW SUBJECT #4	Yes	Yes	Yes	Operations - CO PAX Viewing Feed - INTELL/TOC
INTERVIEW SUBJECT #5	No	Yes	Yes	BNs Operate, COs have access to data
INTERVIEW SUBJECT #6	Pushed Down - Sensors and UGV	Primary- Sensors and UGV	UAV,UGV, Sensors	Rangers Trained. RGTISR Sec. augment BNs
INTERVIEW SUBJECT #7	Pushed Down	Yes	Yes	Rangers Trained. Mission dependent.
INTERVIEW SUBJECT #8	Yes	Yes	Yes	Intelligence Sections
INTERVIEW SUBJECT #9	Contingencies only	3xUAV, 3xUGV, 5xAA Sensor sets	6xUAV, 6xUGV, 10xAA Sensor sets	CO - Trained Operators BN - 1xNCO/2xOPS in S2 RGT- 1xNCO/2xOPS in MID/RRD - Trained

The results have been compared for common themes and trends in the responses. The identified trends and themes are discussed below and have been added to the baseline criteria derived from the Regiment's future requirements vision. As stated, the interviews with Rangers will provide the real world input and experience to help with the refinement of the initial baseline criteria.

Trends and Themes

The following trends and themes were discovered as a result of collecting and analyzing the data from nine interviews with former Ranger officers. As stated, the Ranger officers possessed varied experience, with the majority having served as Infantry officers and company commanders and several as operations officers. All of the interviewed population had a least two years service time, and the majority had some real world experience in the GWOT. The trends and themes were established in regards to the initial evaluation criteria for automated ISR systems. The UAV evaluation criteria was established as range, flight time, size, power source, and payload or sensors. The UGV evaluation criteria was established as range, operating time, size, power, and payload or sensors. The remote sensor evaluation criteria was established as sensor type and capability. The integration evaluation criteria was established as level of integration and identification of operators.

The interviewed population established the following trends and themes with regards to the initial evaluation criteria for UAV capabilities. The UAV should have a minimum of a ten kilometer range, with no stated flight time requirements. The interview population tended to focus less on the flight time capability and more on the minimum range capability. A theme developed which established the rough normal operating distance for the UAV as twenty kilometers. According to the interview population, the reason for the range capability was in response to the rough average range of threat artillery systems. The trend for the size of the UAV was given as small, ("micro-bird" or hand launched), which has been defined as man-portable. A theme was established in regards to UAV size in that the UAV should be jumpable, which would also necessitate a man-portable size, and perhaps a collapsible configuration. The trend for the UAV power source was clearly stated as batteries. The interview population believed that if possible the batteries should be interchangeable with those used to power Ranger communication gear. No theme developed in regards to the UAV power source. The trend for UAV sensors was constituted as at a minimum a video capability, IR sensor capability, live feed capability with GPS positioning and an LTD. No significant theme developed regarding the UAV sensor capabilities.

The following trends and themes were constituted for UGV capabilities. The interview trends showed the UGV should have an approximate range of one to two kilometers, with no appreciative theme being apparent. The requirement for a minimum range of one to two kilometers was in response to the effective range of most direct fire threat weapons. A trend was not discernable in regards to a UGV operating time, but a theme developed stating the operating time capability should be between four to twelve hours. The trend and theme that ensued from the interviews set the UGV size as man-portable. An established trend dictated that the UGV have at a minimum an IR capability, a thermal capability, a seismic capability, and an LTD. A theme emerged in regards to sensor capability that called for an NBC sensing capability. The trend requiring a seismic capability was possibly generated by the interview sample being mainly composed of Infantry officers, who have a passing familiarity with PEWS (platoon early warning system), a seismic sensing remote sensor system that was fielded to most Infantry units.

The trend, which developed in regard to remote sensors called for a small, deployable, battery powered system, which could cover avenues of approach and provide early warning of enemy approach. An apparent theme was established concerning power source for the sensors, suggesting either battery or solar powered. The sensor capability trend that became discernable in the interviews was the requirement for a seismic capability (due to the interview populations familiarity with PEWS, as stated above), an IR capability, and a thermal capability. A theme that was also discernable suggested different types of sensors, for identification of movement and activity, weather information, and NBC contamination sensors.

The final trends and themes were established in regards to the integration of the automated ISR systems, and who should be trained on the systems within the regiment. The interview population trend showed that the automated ISR systems should be integrated at company, battalion, and regimental level. The theme that occurred suggested that the systems should be integrated at battalion and regimental level, and pushed down to the companies only for contingencies. The operator trend that developed showed that the companies should have trained Infantry operators for contingencies, the battalions should have trained and dedicated operators assigned to its intelligence section, and that the regiment should have trained and dedicated operators assigned to its intelligence section. A theme developed which suggested that the Regimental

Reconnaissance Detachment should also be trained on the automated systems for contingencies.

The interview trends and themes, when combined with the baseline capability criteria as discussed in the Ranger future requirements vision, establishes the following benchmark capability criteria for Ranger automated ISR systems. The benchmark capabilities are those attributes that should be included in the operational requirements document for automated ISR systems and delivered with those systems during procurement, within the next five to nine years. Since the JORD for the RPUAV has already initiated the first step of procurement for at least the first generation Ranger UAV, the benchmark capabilities established by this research may have to be achieved with the second or third generation Ranger UAV if the first generation UAV fails to meet the benchmark expectations. The following benchmark capabilities criteria have been established.

1. UAV systems should have a ten to twenty-five kilometer range, be able to operate for approximately four to eight hours, be battery powered, one man-portable and jumpable, possess day video capability, night passive video capability, thermal capability, real time imagery with heading and position, laser target designator (LTD), and be able to communicate with the Rangers on the ground, either through the operator control unit or a remote unit with a maneuver unit.

2. UGVs should have a one to two kilometer range, operate for four to twelve hours, be man-portable, solar or battery powered, possess a night passive video capability, thermal capability, seismic capability, NBC capability and LTD and be able to communicate with the Rangers on the ground.

3. Remote Sensors should be small, deployable, able to cover avenues of approach, be solar or battery powered, and have a night passive video capability, thermal capability, seismic capability, NBC capability and weather sensing capability.

4. Automated ISR systems should be integrated at battalion, and Regimental level and pushed down to the companies for contingencies. The companies should have trained Infantry operators for contingencies, the battalions should have trained and dedicated operators assigned to its intelligence section, and that the Regiment should have trained and dedicated operators assigned to its intelligence section. The Regimental Reconnaissance Detachment should also be trained on the automated systems *for* contingencies.

The benchmark capabilities that have been established for Ranger automated ISR systems can now be compared to the third and fourth research categories. The third research category, the current incorporation of similar systems by other units and countries, will help validate the last benchmark capability criteria, at what level should the new ISR systems be integrated. By evaluating the research from the third category, the lessons learned from similar incorporations will help substantiate whether the established benchmark criteria for integration is feasible, which in turn will provide data for the fifth research category, the pros and cons of integration of the automated ISR systems. Additionally, the benchmark capabilities can be used to evaluate the systems in the fourth research category, the study and comparison of existing and forecasted systems. The results from the fourth and fifth research categories will provide information in response to the two secondary research questions.

Current Incorporation of Similar Systems by Other Units and Countries

Studying the incorporation of systems by other units and countries further validates the necessity and importance of automated ISR systems in support of Regimental operations, and also highlights some of the potential problems and shortcomings. The majority of information available on automated systems mainly concerns UAVs, since this technology has been around the longest and appears to compose the bulk of foreign research and development efforts. However, in-depth information, and particularly lessons learned by units and countries concerning integration of the automated ISR technologies is not comprehensive due to the nature of emerging technologies and the advanced systems sought by the benchmark capabilities criteria.

The use of UAVs by military forces to provide support to special operation missions is not a new concept. The United States has been utilizing UAVs since the early 1960s, the Air Force even used them after the unsuccessful Son Tay raid to conduct reconnaissance of North Vietnamese POW camps for possible SOF Operations in the closing stages of the Vietnam War (Wagner 1982, 192). The UAVs integrated by other units within the US Military, however, does not provide much to parallel Ranger requirements, as the systems are so different from the capabilities sought by the benchmark criteria.

The Stryker Brigades being currently activated and tested, however, do have UAVs integrated into their Reconnaissance, Surveillance, Targeting and Acquisition (RSTA) Squadrons. Despite the fact that the RSTA Squadrons are utilizing a Hunter UAV, which is a much larger platform then established by the benchmark capabilities criteria, they have learned some important lessons which can be applied to a future regimental integration of UAVs and may help further validate the benchmark criteria. The Center for Army Lessons Learned (CALL) published a newsletter on the developments of the Stryker Brigade that contained an article on enhancing situational understanding with UAVs. According to the article by MAJ Brad Dostal, the UAV can provide the commander with enhanced situational awareness, assist with target acquisition, assess battle damage and enhance management capabilities. In the RSTA Squadron, the UAV is operated by the UAV platoon, consisting of command and control (C2) element and a launch and recovery element (as stated, the Hunter UAV is substantially larger then the man-portable sized UAV designated by the benchmark criteria). The platoon personnel consist of a military intelligence officer, a platoon sergeant, three squad leaders, various technicians and some soldiers with the new Main Skill Identifier (MOS) of 96U (UAV operators). Rangers with the 96U MOS should potentially be added to Ranger battalions' S2 shops and regiment's military intelligence detachment to provide the expertise for UAV operations, and this concept will be further evaluated in the fifth research category concerning the pros and cons of integration. In the Stryker Brigade, the brigade S2 is the primary tasking authority for the UAV, and ensures that the UAV is integrated fully with other ISR assets for maximum effect. The Stryker Brigades have learned that a single UAV not fully integrated into the ISR plan is not always successful, and have established some conditions for utilizing the UAV for aerial reconnaissance. According to the Stryker Brigades tactics, techniques and procedures (TTPs), UAVs are best used for aerial reconnaissance when; time is limited or information is needed quickly, detailed reconnaissance is not required, extended duration surveillance is not necessary, the objective is at an extended range, a target needs to be verified, there is a high risks to ground assets, there is restricted terrain, and weather is favorable. The conditions established by the Stryker Brigade obviously favor a reactive and agile UAV, as already established by the small size designated in the benchmark criteria. While these conditions may not necessarily help define the pros and cons of integrating automated ISR systems, they will be useful for a future appendix on automated ISR operations in the Ranger Field Manual, FM 7-85.

The Stryker Brigade also discovered some additional lessons during a recent operational exercise at the Joint Training Readiness Center. The UAV platoon found that when the angle of the UAV antenna (flight path) to a forward ground control station (GCS) exceeded forty-five degrees, as is often the case during non-linear operations, the UAV had trouble establishing a link with the forward GCS and valuable station time was wasted trying to pass control of the UAV to the forward GCS. The antenna angle also affected the live feed capability of remote video terminals (RVTs) that were more then 45 degrees off the flight path. The problem of antenna angle will only effect Ranger operations if one GCS plans on passing control of the UAV off to another GCS, which may not be an issue based on the operating ranges in the benchmark criteria and the number of dedicated operators at battalion and regiment. However, if a higher headquarters wants to pass control of a UAV down to a subordinate unit (regiment to battalion or battalion to company) to increase the range of the UAV, since currently this is mainly limited by the range of the communications link, or pass off targets identified by the UAV between separate tactical ground units, this could pose a problem. Also, the antenna angle may effect the RVTs, particularly if the Ranger UAVs are equipped with separate operating channels for their information links, so that different ground elements (and possibly even SOF rotary-wing support) can tune in to different UAV feeds by flipping channels on their RVTs. The solution may be for Ranger UAVs to have a 360-degree broadcast and reception capability, but this is not necessarily feasible with current technology and size restrictions, and thus should be sought in second or third generation UAV benchmark criteria.

In addition to the United States, Britain, China, Austria, Israel, France and the majority of the modern world is currently engaged in developing UAVs. The Israeli Defense Force has been an innovator in the field, and has integrated UAVs into their ongoing urban and counter-terrorism operations with great success. According to one Israeli commander, quoted in *Aviation Week & Space Technology*, “The arena changes so quickly when the combatants are just a few meters apart. This mini-war has produced the very unusual environment where we were having to innovate every day” (Fulghum 2002, 83). In response to this fluid situation, the Israelis teamed large UAVs with attack aviation and ground forces to provide the most reactive force with the best possible situational awareness, with great success. The Israelis have also begun to use small observation balloons for intelligence, a concept that could provide the Rangers with an observation platform with an almost indefatigable station time, as long as the balloons are remoted away from the C2 site to prevent indirect fires and fitted with the proper sensors. The concept of observation balloons or Ranger Surveillance Balloons (RSBs) is a valid one, particularly if integrated with the other ISR systems, and though not discussed as a part of the Ranger Interim Transformation Vision, it has been added to appendix A for consideration.

An initial problem the Israelis have discovered in regards to UAVs is that automobile GPS systems can interfere with UAV operations, which may possibly raise the requirement that Ranger UAVs have some sort of shielding or be capable of changing operating channels to prevent this. Both the Israelis and the British have stumbled on another of the potential problems of larger UAVs with higher operational ceilings. The issue is airspace, with UAVs occupying the same airspace as civilian aircraft. The need for UAVs to have the ability to sense and avoid other aircraft is seen as a critical one. However, a sense and avoid capability will require more equipment and power, reducing station time and payload. The Israeli and British experience helps to validate the benchmark capability criteria requiring small man-portable "micro-birds" which will be neither large enough or fly high enough to require a sense and avoid capability. The French and Austrians are relatively new to the automated ISR field, but both are currently developing small UAVs. The Austrian design is a mini-helicopter with day and night video sensors, the ability to hover and a six hour station time. The French design currently calls for a small, fixed-wing aircraft, but second generation designs may also require the ability to hover, a capability which the Rangers may want to add to future benchmark criteria. The nature of any particular problems that foreign militaries are experiencing in fielding their systems, however, are currently unavailable. The 75th Ranger Regiment recently participated in an operational testing for the Pointer UAV Combat Mission Needs Statement. The Pointer UAV is a hand-launched "micro-bird" being evaluated and developed by the Defense Advanced Research Projects Agency (DARPA) and the United States Special Operations Command. According to the trip report filed by the primary trainer, Mr. Dan Bernard, the Rangers, personnel who had no previous flight experience or radio-controlled aircraft experience, were able to rapidly learn how to control and operate the Pointer UAV. The Pointer UAV trip report helps validate the benchmark capabilities criteria for training of personnel in Ranger companies to operate UAVs for contingencies.

Information on UGVs and remote sensors and the experiences that other units or countries have had with these systems is far more scarce then data on UAVs. A reason for the disparity is discussed in a research paper compiled by MAJ George Pierce II, USAF, on robotics and military applications. In MAJ Pierce's estimation, UAVs have had more development and success then UGVs because they have fewer obstacles to deal with, and thus are less complicated. MAJ Pierce also discusses five imperatives that have been established by DARPA that UGVs must possess for SOF Operations. The imperatives are the ability for a UGV to right itself if turned upside down, the ability to reestablish a lost communication link, an anti-handling device, a GPS or positioning capability, and the ability to negotiate stairs. None of the imperatives established by DARPA are included in the benchmark criteria, and the two most critical, the capability to reestablish a communication link and a GPS positioning capability, will be added. The other imperatives, however, seem mainly focused on a UGV developed for an urban environment, and while certainly admirable qualities, are not absolutely necessary for an automated ISR system. Accordingly, they will not be included in the current benchmark criteria, thought they may be added to second-generation benchmark criteria. Within the United States, some law enforcement organizations have fielded UGVs to dispose of bombs or possibly gather intelligence in hostage situations. The UGV systems used by law enforcement organizations, however, are larger systems that are different then the vehicles sought by the benchmark capability criteria, and accordingly do not help validate the criteria or provide much insight into integration. The US Army recently used UGVs in Afghanistan to conduct reconnaissance into underground facilities that were possibly booby-trapped. The UGV utilized in Afghanistan is a system called the PACKBOT being developed by DARPA and the IRobot Company. The PACKBOT had great success in assisting US Army personnel in clearing caves without risking the soldiers' lives. The forty-two pound UGV was utilized "at a cave complex outside the village of Nazaraht, near the Pakistani border. The robots send video back to the troops, sparing them the risk of being dispatched by booby trap or enemy combatant" (Hindustan Times.com, 2003). The main shortcoming identified by the Afghanistan experience with the PACKBOT was signal interference due to obstacles, which further validates the need for a benchmark capability for reestablishing communications. However, similar to the imperatives established by DARPA, the PACKBOT's design and performance, in its Afghanistan configuration, is geared towards urban terrain and immediate reconnaissance in very close proximity to the operator, not necessarily farther ranging ISR mission as required for a Ranger automated ISR system. Like UGVs, a similar situation exist in regards to available information on remote sensors. With the exception of fielded systems like the previously discussed PEWS, the military intelligence community's REMBASS, or systems that are currently being developed like Israel's EL/M-2128 (man-portable radar), little to no data is presently available on remote sensors. What information is available for research has no bearing on the thesis problem due to the fact that the accessible data is available on systems that in no way resemble the desired qualities sought by the benchmark capabilities criteria.

As previously stated, due to the emerging nature of the technology required to meet the benchmark capabilities criteria established above, little information on current systems available on the public domain enables the further refinement of the criteria or provides lessons concerning the integration of new systems. The small “micro-bird” size required for UAVs by the criteria has been somewhat validated based on the Israeli and British experience with civil air authorities and airspace issues. Future benchmark requirements may want to address shielding or a channel-changing capability to prevent interference with UAV operations, and a possible hovering capability. The potential to integrate small observation balloons with UAVs, UGVs and remote sensors to create an ISR system of systems should also be considered for future requirements. Additionally, the capability for a Ranger UGV to reestablish communications and have a GPS positioning system has been identified, and will be added to the UGV benchmark capability criteria.

Study and Comparison of Existing and Forecasted Systems

Collecting and comparing data on both existing and forecasted systems has enabled the baseline criteria to be applied to the actual capabilities that exist or are being developed. The results of this application has been compiled into the enclosed tables showing the capabilities of the common UAV and UGV systems available and the following paragraphs discussing the more able systems. A multitude of systems exist, many that have some of the benchmark capabilities criteria, but no single system exist that contains all, or even most of the capabilities. Numerous UAVs and UGVs are currently being developed, and most can be customized or configured for the customer’s needs with a wide variety of sensors and capabilities. The bulk of the data available on sensors, however, currently exist only for components of systems, and not for independent and autonomous systems. As a result of this, a table has not been compiled on remote sensors, the few systems under development will be discussed in a separate paragraph below. The systems listed in table 5 begin to provide the initial answer as to what systems the Regiment may want to consider incorporating, after additional refinement, to increase their capabilities.

Table 5.

UAV	RANGE	FLT TIME	SIZE	POWER	SENSORS	MISC
Benchmark Criteria	**10-25kilometer**	**4-8 hrs**	**man-port & jumpable**	**batteries**	**day/night/thermal live video w/ GPS position/heading, LTD**	**payld/ spec size/ spec cap.**
Aerosonde	2800kilometer	40hrs	30pounds	fuel	video N/S, GPS navigation	2.2pounds payld
BAT	N/S	1 hr	10pounds	fuel	video N/S, GPS navigation	1 pounds payld
Black Widow	750m	30 min	1 pounds	batteries	video N/S, GPS navigation	6” long/ wide
Exdrone	800kilometer	3 hrs	55 pounds	fuel	video N/S, GPS navigation	40 pounds payld
Gator	400m	10-12 min	2 pounds	batteries	currently only day video	hnd-lnchd cost <$200
Hawk-i 7B	LOS	1 hr	16	fuel	N/S	3

			pounds			pounds payld
Hawk-i 7F	N/S	2 hrs	N/S	fuel	N/S	12 pounds payld
Hawk-i 7H	N/S	1 hrs	N/S	fuel	N/S	5 pounds payld
Javelin	1.5 kilometer	2 hrs	15 pounds	fuel/battery	video N/S, GPS navigation	3.2 pounds payld
Pointer	5kilometer	2 hr	9 pounds	batteries	day/night live video, GPS navigation	auto-nav, sensor
Pointer Micro-Blimp	5kilometer	2 hr	10 pounds	batteries	video N/S, GPS navigation	1.5 pounds payld
Raven	5kilometer	80 min	man-port	batteries	day/night live video, GPS navigation	hnd-lnchd, auto-nav
Seascan	N/S	15 hrs	24 pounds	fuel	N/S	7.11 pounds payld
Tern	LOS	4 hrs	75 pounds	fuel	N/S	22 pounds

The UAVs listed above are a sampling of the total population of systems currently being sold or developed in the world. The data was compiled from the Space and Naval Warfare System Center’s website, NASA’s Wallops Flight Facility website, and a United States Special Operations Command brief on small UAVs. The systems above were selected for evaluation and inclusion in this study because they met the minimum benchmark criteria of being somewhat man-portable, which was established as seventy-five pounds or less for this research. The two best performers overall in regards to the benchmark criteria have been noted and will be briefly discussed. Sensor capability will not be discussed (though included in the table) as almost all the listed manufacturers stated that systems could be configured for customer requirements, and all systems (even those not stated) appear to have at least a basic video feed. The Aerosonde system is by far the best performer in range and endurance. With a 2,800 kilometer range, forty hour station-time and GPS navigation, the Aerosonde would doubtless provide the Regiment with the greatest amount of intelligence purely based on the time it could stay on station over a Ranger Objective. However, the Aerosonde is fuel powered, which could create an additional logistical requirement, and at thirty pounds on the larger side, which could impact on whether it could be jumped in and hand-launched. The Pointer is battery powered and hand-launched, and at nine pounds can most likely be configured to jump, but its five kilometer range and two hour station-time fall short of the benchmark criteria. The critical factor above is that the UAVs which appear to be jumpable lack range and station-time, and those fuel powered craft with the best endurance and range may be to large to be effectively jumped in. What appears to be required is a combination of the two, which may dictate a smaller, fuel powered craft, or a more efficient battery powered craft. One option that could be considered is the integration of different systems to provide benchmark capabilities. A further discussion of the combining of systems for desired capabilities is incorporated in the final paragraphs of this chapter in response to the two secondary research questions and with the final refinement of the benchmark criteria. Suggestions for system designs and future capabilities are discussed in appendix A, “Recommendations.”

The UGVs listed in table 6 are also a sampling of the systems currently available in the world. The data was compiled from the Space and Naval Warfare System Center’s website and the IRobot Corporation’s website.

Table 6.

UGVs	RANGE	OP TIME	SIZE	POWER	Capabilities/Sensors	Remarks
Benchmark Criteria	**1-2 kilometer**	**4-12 hrs**	**Man portable**	**Solar/ Batteries**	**day/night/thermal live video w/ GPS position/heading, LTD, seismic/NBC sensors, reestablish commo**	**payld/spec size/spec cap./Speed (ft/sec)**
Casper(Ratler)	1.5 kilometer	5 hrs	35 pounds	batteries	video/audio system	20 pounds payld/speed:3
Intruder	N/S	1 hr	25 pounds	N/S	video system	N/S
Lemming	N/S	1 hr	N/S	batteries	sensor package N/S	N/S
Magellan Pro	1 kilometer	12 hrs	35 pounds	batteries	video/audio system, laser scanner	20 pounds payld/sonar sensors/speed: 6.6
Matilda	304 m	2 hrs	55 pounds	N/S	Pan&tilt video/audio system	100 pounds payld/speed: 3
Max II	N/S	1 hr	45 pounds	N/S	sensor package N/S	N/S
Micro-lemming	N/S	1 hr	22 pounds	batteries	sensor package N/S	10 pounds payld/speed: 2
Mini-ratler	500 m	45 min	5 pounds	batteries	video/audio system	micro-UGV/2 pounds payld/speed: 3

Murv-100	1 kilometer	4 hrs	31 pounds	batteries	pan&tilt video system	speed: .85
Packbot	356 m	N/S	40 pounds	batteries	day&night video/audio system, GPS position/heading, inclinometer, temp.sensors	25 pounds payld/speed: 12
Pebbles	N/S	1 hr	25 pounds	batteries	sensor package N/S	speed: 1.3
Pioneer 2-AT	6 kilometer	5 hrs	N/S	batteries	video/audio system	speed: 4.7
Pioneer 2-DX	6 kilometer	12 hrs	N/S	batteries	video/audio system	speed: 4.7
Sea Snoop	N/S	6 hrs	35 pounds	batteries	sensor package N/S	30 pounds payld/speed: 3.5
Subot	N/S	30 min	4.4 pounds	batteries	video system	micro-UGV/speed: 3
Urban Robot	N/S	2 hrs	4 pounds	batteries	sensor package N/S	micro-UGV/1 lb payld/speed: 3
Urbot	300 m	N/S	65 pounds	batteries	video/audio system, GPS navigation, NBC sensors	45 pounds payld/speed: 6.5

Similar to the UAVs, the systems above were selected for evaluation and inclusion in this study because they met the criteria of being somewhat man-portable at seventy-five pounds or less. The best UGV performers will be briefly discussed. As with the UAVs, sensor capability will not be discussed as all the systems can be configured for customer requirements, though speed will be included as it is an issue concerning the flexibility of retasking a UGV to cover separate named areas of interest (NAIs). Both the Pioneer 2-AT and Pioneer 2-DX systems have the best combination of range, endurance and speed. The AT has a six kilometer range, a five hour endurance window and can move at almost five feet per second. The DX has a six kilometer range and a twelve hour endurance window, and also moves at about five feet per second. The weakness of both systems is that they are not adequately built for cross-country use, are on the larger side, and would likely have to be door-bundled or airdropped in to an engagement as opposed to being jumped in by a soldier. At thirty-one pounds, the Casper is smaller and more transportable by a single Ranger, and with a range of one and a half kilometers and operating window of five hours, it satisfies the benchmark criteria. The Casper also has a decent ground speed of three feet per second. However, the major shortcoming of all the UGVs compared above is that if they have a substantial range and endurance, they tend to be somewhat heavy. Additionally, the bulk of them, though labeled as all weather and all-terrain, appear to have a design which favors operations in urban environments in close proximity to their operators, and could perhaps hinder cross-country mobility over any major distance or through significant obstacles. What the regiment needs to meet their requirements is a system that can substitute for a Ranger conducting a mobile patrol to assist the regiment in economizing their force during operations. A system that can move at least as fast as a man can walk, with similar mobility (cross-country, all-weather, all-terrain) between battle positions or to a designated location, and conduct surveillance or reconnaissance for four to twelve hours at a range of approximately two kilometers. The total capabilities suggested as result of this research are discussed below in the secondary research questions, with the final refinement of the benchmark criteria. Suggestions for system designs and future capabilities are discussed in appendix A.

The bulk of information available on remote sensors concerns the components of systems as opposed to complete autonomous systems. The Space and Naval Warfare System Center's website on robotics, the largest one on the internet, contains specifics on nineteen micro sized passive infrared sensors, sixteen pan-tilt camera units, twenty-eight thermal imagers, six radars, and thirty-one video imagers. However, all these systems are plug-in components, not one of them is a stand-alone autonomous system. The benchmark criteria designates a small, deployable, battery or solar powered sensor system that can cover avenues of approach with a multitude of sensors, to included IR, thermal, seismic, NBC and weather. While a comprehensive search of available data failed to reveal any one system currently available that meets all these requirements, two sensors presently under development were discovered which have great promise. The IRobot website had information on two systems being developed in concert with DARPA. The Micro Unattended Mobility System (MUMS) is a sensor package that is designed to be small (3” by 12”), capable of being airdropped, and possess a variety of sensors, to include seismic sensor, audio sensor, and electro-magnetic sensor. The MUMS is also mobile, so that it has the capability of repositioning over short distances in case it is dropped in the wrong location. It is controlled by advanced software that also allows the system to avoid obstacles, and conduct movement to avoid detection. The major shortcomings of the system is that even with its detection avoidance software, at one foot long it is vulnerable to discovery and destruction, and it does not currently possess a video capability. The other system that shows great promise is the MUMS II. The MUMS II system being developed is a mobile sensor system embedded in 40mm casings that can be employed by a grenade launcher, then reposition up to two meters and acquire data. The weaknesses of the MUMS II system is that is also does not have a video capability, and is currently is limited by a 250 meter data-link range. What the regiment requires is a miniature system that can be airdropped, avoid detection, possibly reposition like the MUMS systems, and send data over a substantial distance from a variety of sensors. As stated above, the total capabilities suggested as result of this research are discussed below in the secondary research questions, with the final refinement of the benchmark criteria. Additional suggestions for system designs and future capabilities are enclosed in appendix A.

Pros and Cons of Incorporation of ISR Systems at Different Levels

A study of the pros and cons of incorporation of ISR systems at different levels within the Ranger Regiment, fortified with the criteria developed in the first and second research categories, has provided the bulk of the required data to satisfy one of the secondary questions. A subjective study has been conducted looking at the positive and negative aspects of integrating automated ISR systems at varying levels of command in the regiment. Using the criteria established for what capabilities the automated ISR systems are required to possess, further refined with the input of Ranger experience, the final research category has considered the second and third order effects of integration of automated ISR systems within the regiment. The integration of automated ISR systems within the elements of the Ranger Regiment must be evaluated against the positive and negative effects it may have on personnel manning, training, capabilities, and mission accomplishment at company level, battalion level, and regimental level.

The Ranger Regiment's current manning is designed to project the maximum amount of combat power, or "teeth" forward while requiring the least amount of support or "tail." The Rangers possess very limited organic combat multipliers, because these systems require personnel to man them, and since Army personnel manning is a zero-sum gain (no additional personnel will be allocated to the US Army under the current force structure, so all additional personnel will have to come from another unit or “out-of-hide”), the Rangers prefer to use their manpower to primarily fill Infantry positions. In fact, the regiment’s position within the Special Operations hierarchy is based on this ability, to mass Infantry-based combat power in order to provide enough sustainable firepower to get itself and any adjacent unit out of harms way. For the nature of the research and this discussion, the automated ISR systems will be considered combat support systems, or combat multipliers, not combat systems. As a result of current Ranger manning, the incorporation of automated ISR systems into the company-level Table of Organization and Equipment (TO&E) would negatively impact on company manning, as the Ranger company would only be able to provide dedicated operators for the automated systems at the expense of Infantrymen manning weapon systems. To add even one dedicated operator at just the company-level (not including automated ISR sections at battalion and regiment) to the TO&E would require the addition of a total of twenty-seven personnel to the regimental TO&E, which is not a feasible option. The systems could, however, be allocated down to the companies for contingencies, as long as the company had trained personnel to operate them. The integration of automated systems at the battalion-level would not impact as negatively on the combat power (meaning Infantrymen dedicated to a combat mission) of the battalion because it is the mission of a battalion Headquarters and Headquarters Companies (HHC) to provide the combat support and service support to the companies and the battalion’s HHC currently has an intelligence section within their TO&E. The intelligence sections could be trained to operate the systems, or preferably, dedicated operators could be added to the HHC

TO&E. Adding a four man automated ISR section at the battalion level would require the addition of twelve personnel to the regimental TO&E, a more probable suggestion. Similar to the battalion, the addition of automated ISR systems to the regiment would not impact as negatively on the combat power of the regiment because it's mission is to provide combat support and service support to the battalions and the regiment's HHC (RHHC) currently has an intelligence detachment within its TO&E. Similar to the battalions, the Military Intelligence Detachment (MID) at regiment could be trained to operate the systems, or preferably, a four-man section could be added to the RHHC TO&E. The preferred suggestion of adding dedicated operators to battalion HHCs and RHHC could be conducted with far less negative impact then adding them to the companies or having the companies operate the systems in anything but a contingency.

The addition of automated ISR systems to the Ranger companies TO&Es would probably have a negative impact on training. The Rangers have a large amount of Infantry and specialized training that is already a necessity to maintain MOS proficiency and because of the precise and complicated nature of their missions; the addition of automated ISR systems and additional tasks would require even more specialized training that could detract from the primary focus on Infantry and special skills training. If additional personnel where added to the companies TO&Es to operate the systems then the additional training requirement would not have a significant effect, but that is not necessarily a feasible option, as stated above. However, even if the systems are only added to the Ranger battalion's TO&E, it still may prove beneficial to detract from some of the Infantry training and add basic ISR systems training to the special skills requirements for some of the personnel in the company, so that the company can control the assets in a contingency. The addition of ISR systems to the battalions and the regiment would also negatively impact on their intelligence training, unless the additional personnel to operate the systems were added to their TO&Es. The battalions' intelligence sections and regiment's MID, like the Ranger companies, have an established amount of required training that they must conduct to maintain proficiency at their MOS skills. The addition of automated ISR systems and an additional set of skills would detract from the MOS training, as time is limited. However, if dedicated personnel were added to the TO&Es for the battalions and regiment, then there would be no discernable impact, save the added benefit of being able to incorporate these systems into the Ranger training.

The capabilities of the Rangers would be significantly increased and positively impacted by incorporating automated ISR systems into any level within the Regiment. However, the battalions and the regiment would benefit more from the addition of the systems then the companies. The companies would be able to extend the range of their reconnaissance and increase situational awareness, providing additional early warning of enemy activity and assisting them in initiating the proper response. But even with the benefits that these systems would provide, the Ranger companies are not designed to take optimal advantage of the information. Equipped only with direct fire weapons, the Ranger company would still have to rely on the battalion to strike any targets identified beyond direct fire range (one to two kilometers), unless they had direct support from aerial assets or indirect fire assets. Regardless, they would still be forced to clear their fires through the battalion, and they do not have the personnel to properly analysis the increased data or react to it. Additionally, the Ranger company should be focused on the close fight and the commander's intent, the battalions and regiment should be focused on the deeper fight and setting the conditions for success. A more advantageous use of these systems would be at the battalion and regimental level. If companies had a requirement for the systems, they could request it through the battalion (similar to a call for fire), the battalion could use their systems to focus on the battalion objective (setting the conditions for the companies, weighting the main effort, etc.) and the regiment could use their systems to focus outside the battalion objective on deeper threats. As stated, the addition of automated ISR systems would positively impact the capabilities of companies, battalions and the regiment, but the optimal utilization would be at the battalion and regimental level based on current and proposed manning and the appropriate focus of these elements during operations.

Like Ranger capabilities, mission accomplishment would increase and be positively influenced by incorporating automated ISR systems into any level within the regiment. However, as with capabilities, the battalions and the regiment would benefit more from the addition of the systems then the companies. As stated, the Ranger companies are not designed to take optimal advantage of the information. The company would still have to rely on the battalion to strike any targets identified beyond their range and the battalion is better manned to properly analysis the increased data. Additionally, the Ranger company should focused on achieving the battalion commander's intent and the close fight, the additional capabilities that the automated ISR systems would provide could detract from this focus. The optimal overall use of these systems to ensure mission accomplishment would be at the battalion and regimental level, with companies receiving control of these systems for contingencies only.

The overall results of the study of the integration of automated ISR systems, which is the most subjective of the research categories, will be applied towards answering the final secondary research question; how should the new capabilities be incorporated into the regiment and at what level. In summation, the incorporation of these systems will have a negative impact on the personnel manning of the companies, battalions and regiment, but will least effect the battalions and regiment. The optimal solution is the addition of personnel to operate these systems to the battalions' and regiment's TO&E. The incorporation of these systems will also negatively impact on the primary focus of Infantry and special skills training for the companies, but will have less of an impact on the MOS training of the intelligence personnel in the battalions and the regiment, unless additional personnel are added to the TO&E to operate these systems. Automated ISR systems will enhance the capabilities and mission accomplishment of Ranger companies, battalions and the regiment. However, it will provide the greatest benefit to the battalions and regiment, as they have the optimal organization to take full advantage of the benefits of automated ISR systems on a permanent basis.

Summary of the Analysis

The final solutions to the two secondary research questions and the primary research question will be discussed in the conclusion chapter. A brief summary of the five research categories is discussed below. The first research category established the baseline capability criteria for automated ISR systems as outlined by the Ranger requirements. The baseline capability criteria was father refined based on the trends and themes identified in the second research category, Ranger interviews. The trends and themes were added to the baseline capabilities, and these new modified requirements were established as the benchmark capability criteria. The benchmark criteria was validated and further refined by comparing it against the research data from the third research category, the current incorporation of similar systems by other units and countries. The benchmark criteria was also validated for realistic standards, and an approximate idea of the systems available or forecasted was refined in the fourth research category, the study and comparison of current and forecasted system. Finally, the fifth research category provided insight and analysis into the actual incorporation of automated ISR systems within the regiment.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The data gathered and analyzed to satisfy the five research categories in the Analysis Chapter have provided the basic answers to the research questions. The conclusions portion of this chapter will show how the data from the research analysis has fulfilled the secondary research questions, which in turn satisfy the primary research question.

Which Technologies Should Be Incorporated

The initial secondary research question, which technologies should be incorporated for the greatest enhancement of capabilities with the least impact on current force structure, has been primarily answered by the benchmark capabilities criteria. The benchmark criterion establishes what capabilities the Rangers will want to include in an ORD or MNS for automated ISR systems. Recommendations for refinements to the benchmark criteria are covered in the recommendations portion of this chapter. Recommendations for future or advance capabilities are discussed in more detail in the appendix A, “Recommendations.” The restated benchmark capabilities criteria for automated ISR systems are:

1. UAV systems should have a ten to twenty-five kilometer range, be able to operate for approximately four to eight hours, be battery powered, one man-portable and jumpable, possess day video capability, night passive video capability, thermal capability, real time imagery with heading and position, LTD, and be able to communicate with the Rangers on the ground, either through the operator control unit or a remote unit with a maneuver unit.

2. UGVs should have a one to two kilometer range, operate for four to twelve hours, be man-portable, solar or battery powered, possess a night passive video capability, thermal capability, seismic capability, NBC capability and LTD and be able to communicate with the Rangers on the ground.

3. Remote Sensors should be small, deployable, able to cover avenues of approach, be solar or battery powered, and have a night passive video capability, thermal capability, seismic capability, NBC capability and weather sensing capability.

The comparison of existing and forecasted systems capabilities, when applied to the benchmark criteria, has not yielded one complete system that meets all the required capabilities. However, the analysis of the data has shown several different systems are available or under development which have the potential to meet the benchmark requirements with further refinement. As stated, recommendations for refinement and potential actions the Regimental Transformation Office should pursue are covered in the recommendations paragraph in this chapter (short term) and in the appendix A, "Recommendations."

How Should the New Capabilities Be Incorporated and at What Level

The final secondary question, how should the new capabilities be incorporated into the regiment and at what level, has partly been answered by analyzing the fourth part of the benchmark capabilities criteria, and partly by analyzing the pros and cons of incorporation of automated ISR systems at different levels within the regiment.

The fourth part of the benchmark capabilities criteria establishes the requirement that automated ISR should be integrated mainly at battalion and regimental level. The benchmark capabilities criteria for incorporation of automated ISR systems is:

4. Automated ISR systems should be integrated at battalion, and regimental level and pushed down to the companies for contingencies. The companies should have trained Infantry operators for contingencies, the battalions should have trained and dedicated operators assigned to its intelligence section, and that the regiment should have trained and dedicated operators assigned to its intelligence section. The Regimental Reconnaissance Detachment should also be trained on the automated systems for contingencies.

The analysis of the pros and cons of the integration of automated ISR systems at different levels within the regiment validated the benchmark criteria. The incorporation of the ISR systems at the company level for anything but a contingency would, according to the research, detract from company manning, training, control of capabilities and mission accomplishment. The analysis showed that these systems would be best incorporated at the battalion and regimental level, and that they should be integrated into the battalion's intelligence sections and regiment's MID. Further recommendations for the integration of these systems are discussed in appendix A, "Recommendations."

Incorporation of New Technologies to Increase Ranger ISR Capabilities

The two secondary research questions have answered the primary research question for the thesis; how should the 75th Ranger Regiment incorporate new technologies to increase their ISR capabilities? The initial secondary research question provides the benchmark capabilities criteria, which furnishes the answer to what capabilities the new technology should possess for the greatest enhancement to capabilities with the least impact on force structure. The final secondary research question answers the question of how these new technologies should be incorporated into the regiment to best increase their capabilities during direct action operations.

Summary

In summation, the 75th Ranger Regiment should incorporate automated ISR systems consisting of at a minimum UAVs, UGVs and remote sensors. The UAVs should have the capabilities of a direct support aerial scout; a range of approximately ten to twenty-five kilometers, four to eight hour endurance, be battery powered, man-portable, jumpable and have an array of all-weather, all-light sensors. The UGVs should have the capabilities of a walking reconnaissance patrol; a range of approximately one to two kilometers, four to twelve hour endurance, be battery powered, man-portable and have an array of all-weather, all-light sensors. The remote sensors should have the capabilities of a surveillance outpost; small, deployable, solar or battery powered with an array of adaptable sensors. All automated ISR systems should be incorporated into battalion intelligence sections and the regimental MID to best increase ISR capabilities during direct action operations.

Short-Term Recommendations

Based on the data researched and the analysis conducted in the process of undertaking this thesis, two short-term recommendations have come to light. The regiment should attempt to institute these recommendations to facilitate success with their automated ISR program.

The first recommendation to the regiment is to continue to refine the benchmark capabilities criteria. Currently, the criteria specifies that the regiment needs a battery powered UAV. The research showed that fuel powered UAVs have far better range then battery powered platforms, but tend to be much larger. The Regiment may want to refine the criteria to specify either fuel or battery powered platforms are acceptable, based on size and performance parameters. The benchmark criterion also does not call for the ability for any of the systems to reestablish communications with the controlling station if communications should be lost. The capability to reestablish communications may prove crucial and possibly should be added. Most importantly, the regiment needs to circulate the benchmark criteria to receive feedback and validation on the capabilities. The regiment should provide the current test labs and manufacturers with a copy, and distribute it amongst the non-commissioned officers in the regiment and in the SOF community. Based on recent operations in Afghanistan and current operations in Iraq, the non-commissioned officers within the regiment will likely have a specific idea of what systems are required to enhance Ranger capabilities, and it is critical that this perishable input be captured and included in the benchmark critieria.

The second recommendation is that the regiment should procure UAVs, UGVs, and remote sensors, even in developmental form, and start incorporating them into their training operations as soon as possible. By utilizing these new technologies, even if they do not meet all the benchmark criteria, the regiment can further refine what their requirements are for the systems, what changes need to be made to the criteria, and what tactics, techniques and procedures work best with these systems. The incorporation of these new systems will also help drive the development of second and third generation systems, which will further enhance Ranger capabilities. Additionally, the sooner the regiment can field these new systems, the sooner they can start the process of changing the regimental TO&E to provide authorizations for additional intelligence MOSs (96U) to operate these new systems.

A Final Word

Though this project proved somewhat more daunting then initially expected, the topic matter was always interesting and relevant. The addition of automated ISR systems to the 75th Ranger Regiment will only serve to enhance an already capable organization. Future recommendations for technologies and operations have been included in appendix A, "Recommendations," as food for thought when the technology develops to support the systems discussed.

APPENDIX A

RECOMMENDATIONS

In order to maintain a technological edge in the modern and future contemporary operating environment (COE) it is necessary that Ranger automated ISR systems be continually developed and continue to evolve to face new and developing threats. Enclosed below are some recommendations for future capabilities and systems that the 75th Ranger Regiment may want to pursue to further enhance their capabilities. The enclosed recommendations are based roughly upon the benchmark criteria, but expound upon these basic capabilities by suggesting systems that have not been developed yet (but could possibly be developed with a Ranger initiative). The recommendations are based upon a natural progression of the existing or forecasted near-term ISR systems' capabilities, combined with the researcher's personal vision of what may be possible with the continued progression of technology. The recommendations suggested are purely subjective and the opinion of the researcher alone.

Ranger Operations and Future Automated ISR Systems

The 75th Ranger Regiment should initiate the development of a variety of automated ISR systems for different tactical employments. The array of systems employed by the regiment should in effect provide a layering of capabilities. The capabilities should be layered in accordance with the size unit and type of weapon systems they support. The strategic, or first layer of systems, would be provided by national assets, which would provide planning intelligence prior to the execution of the operation and facilitate striking targets with strategic weapons (cruise missiles, strategic bombers, and the Ranger Regiment). The operational, or second layer of systems, would be provided by regimental assets and would provide enroute intelligence of the target area, intelligence on the situation outside the objective area, and facilitate striking targets with operational assets (aerial fire support assets, IEW assets and Ranger battalions and companies). The battalion tactical, or third layer of systems, would be provided by battalion assets and would provide intelligence on the target area, intelligence on immediate approaching threats, and facilitate striking targets with tactical assets (aerial fire support assets in direct support, battalion mortars and Ranger companies and platoons). The company tactical, or fourth layer of systems, would be provided by company assets and would provide intelligence on and around company objectives, intelligence on the situation surrounding company and platoon battle positions, and facilitate striking targets with company tactical assets (aerial fire support assets in direct support, battalion mortars in direct support and direct fire weapons systems).

The operational, or second layer, controlled by the regiment, should consist of several subsystems, a UAV with an extended operational range of hundreds of kilometers, a UAV with a normal tactical range of twenty to thirty kilometers, and a suite of air droppable remote sensors with the ability to provide intelligence on activity, weather conditions, and possible nuclear, biological or chemical threat on and around the objective area. While the Ranger force is enroute to the objective area, regimental assets (reconnaissance or military intelligence) would control the first subsystem, the operational UAV, either from a ground site or from a manned aerial platform. The operational UAV would be a system that could provide a direct downlink feed to the Ranger force in the air (through multiple RVTs installed in the aircraft or platforms inserting the force) and a downlink to the aerial fire support assets over the target (to facilitate preparatory fires on the objective). The operational UAV could also possess the capability to deploy the third subsystem, the remote sensors, on choke-points or avenues of approach (or the sensors could be deployed by the aerial fire support assets). The combination of the operational UAV and remote sensors would provide the initial situational awareness for the Ranger force enroute to the objective area, allowing adjustments to the plan based on the current intelligence. Once the regiment had initiated operations to seize the target, the second subsystem of the second layer of automated ISR coverage would be employed. The regimental tactical UAV would allow the regiment to develop and set the conditions for success for the Ranger battalions outside the objective area. It would have to possess the ability to assume targets identified by the remote sensors and designate and pass-off targets for aerial fire support platforms.

The battalion tactical, or third layer, controlled by the battalion, should also have several subsystems, tactical UAVs, tactical UGVs and remote sensors. The tactical UAV would provide the battalion with intelligence within the target area, as well as provide early warning of approaching threats. The battalion UAVs should each possess separate channels for their data downlink, and each company would have an

RVT with a multi-channel capability, allowing the companies to observe the data from multiple UAVs operated by the battalion. Battalion mortars could employ the battalion remote sensors, (also possessing separate channels for data downlink) along identified avenues of approach or at choke points. The companies would also be able to view the data from the sensors on their RVTs, based on the channel selected. Finally, the battalion ISR section would employ UGVs to cover any gaps in the ISR plan. The UGVs could be repositioned to identify and validate possible threats, and would replace or supplement battalion directed observation/surveillance positions. Similar to the UAVs and remote sensors, the UGVs would also have a variable channel data downlink to facilitate information synthesis.

The company tactical, or third layer of automated ISR systems, should also consist of several subsystems, tactical UAVs, tactical UGVs, RSBs and remote sensors. The tactical UAVs would be "micro-birds", optimally with a hover capability, employed by platoon members to provide intelligence on immediate threats "around the corner" on the company objective area, particularly in an urban environment. Each platoon would possess at least one RSB, allowing them to supplement the observation plan and increasing situational awareness while in their battle positions. The primary value of the RSBs is the increased observation provided with an unlimited station time. The RSBs would have to possess a day and night video capability, have a beacon/transponder (for collision avoidance with aerial platforms), and be able to be operated remotely to avoid giving away the Ranger's positions. The company would possess several small UGVs to supplement their internal observation/surveillance positions and provide "around the corner" intelligence on the company objective.

Finally, the platoons would possess a remote sensor suite that could be employed by grenade launcher to provide an early warning capability along avenues of approach and at choke-points.

The combination of the four recommended layers of automated ISR systems should significantly increase Ranger capabilities in the future. The increased situational awareness and intelligence dominance provided by the recommended automated ISR systems should enable the Rangers to identify, analysis and react faster than current threat forces, allowing the Ranger force to dominate the enemy across the full spectrum of operations. However, technological developments do not occur in a vacuum, and as the Rangers develop new capabilities and systems, threat forces will continue to seek out and develop countermeasures. Thus it is imperative, in order to gain and maintain a significant advantage, that the 75th Ranger Regiment accelerate their incorporation of the recommended technologies and continually strive to improve and further refine their automated ISR systems.

APPENDIX B

QUESTIONNAIRE

A. Background: This Survey/Interview is being conducted in order to gather information to be incorporated into the Thesis; How the 75th Ranger Regiment should incorporate Automated ISR Systems in order to increase Ranger capabilities. Automated ISR Systems refer to robotic or remote technologies such as Unmanned Aerial Vehicles, Umanned Ground Vehicles, and Remote Sensors. Your time, opinion and input is appreciated.

B. Questions:

1. In order to establish interview population demographics, please describe in brief the number and type of Special Operations positions you have held, the number of years experience you have in the Special Operations community, and any real world operations you have participated in (unclassified).

2. What capabilites do you think a Ranger-specific UAV's should have (Range/Size/Power-source/Sensors)?

3. What capabilites do you think a Ranger-specific UGV's should have (Range/Size/Power-source/Sensors)?

4. What type of remote sensors and what capabilites do you think Ranger Units should have? (Range/Size/Power-source/Sensors – Image, Thermal, Seismic)?

5. At what level should the Rangers incorporate Automated ISR Systems (Regimental/Battalion/Company)?

6. Who should operate the Automated ISR Systems (Intell Sections/Maneuver Units/Combination)?

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