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Review and Analysis of BIFV Operations Under All Visibility Conditions

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This report discusses the results of a problem analysis conducted as the initial step of a multiyear research effort. Researchers analyzed Bradley doctrine, tactics, techniques, and training, with particular emphasis on reduced visibility operations. The problem analysis phase identified areas where the Bradley's combat effectiveness could be enhanced. Recommended solutions to some of the problems are presented. For other problems, directions for future research are detailed. This report provides background and guidance for ongoing Bradley research.

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INTRODUCTION

As the introduction to a long term research project, the Army Research Institute, Fort Benning Field Unit, and its resident contractor Litton Mellonics, observed unit and institutional training with the newly fielded Bradley Infantry Fighting Vehicle. This report is intended to serve as a record and summarization of the initial research on problems or shortcomings in tactics, equipment and training associated with the introduction of the Bradley Infantry Fighting Vehicle (BIFV) during the period 1983-1984.

Once problem areas had been identified, the research team defined potential solutions and approaches suitable for subsequent test and evaluation. Specific findings were reported in a series of timely briefings to the Infantry School, and in an unpublished paper which provided feedback to the Bradley community.

The Bradley Infantry Fighting Vehicle

The Bradley Infantry Fighting Vehicle (BIFV) provides the infantry with a mobility equal to that of tank units. Infantry soldiers must be available to protect tanks, seize and hold terrain, consolidate gains made in offensive operations, and to clear areas where armored vehicles are unable to operate. Therefore, a vehicle is required which will allow infantrymen to fight from under armor protection wherever possible, observe the battlefield, and have available their personal weapons for use in a dismounted mode. The BIFV is that vehicle.

The Bradley will replace the M113 Armored Personnel carrier in most armored and mechanized divisions. The M113 is a 12.3 ton tracked vehicle, armed with the .50 caliber machinegun. The M113 has been a "battlefield taxi", carrying soldiers to the battle, where they then dismount and perform either in defense of tanks and other vehicles, or in the traditional role of the infantry foot soldier. For several reasons the M113 is inadequate on the modern battlefield. Its relatively slow speed, while appropriate for accompanying the M60 Main Battle Tank, is too slow for use with the M1 Abrams Tabk. Also, the .50 caliber machinegun is insufficient in the modern battle environment, as it is incapable of defeating the Soviet Union's main personnel carrier, the BMP.

The Bradley was designed to be more than a battlefield taxi. Carrying a nine or ten man squad, the Bradley weighs 23.6 tons loaded for combat and is capable of road movement in excess of 40 miles per hour, and 30 miles per hour cross country. The BIFV can negotiate difficult terrain and can ford water and "swim" at speeds of up to 4.5 miles per hour. In addition, and of great importance to its combat effectiveness, the BIFV carries its crew under

sophisticated space laminate armor protection with the covering support of three major turret weapon systems.

Mounted on the Bradley's three man turret is the M242 25mm main gun which fires both High-Explosive Incendiary-Tracer (HEI-T) and Armor-Piercing Discarding Sabot, Tracer (APDS-T) rounds. It is capable of destroying lightweight vehicles and carriers, including the BMP, at ranges of nearly 3000 meters, and the turret stabilization system allows the 25mm gun to be fired while the BFV is moving.

To the right of the 25mm gun is the M240C 7.62 coaxial machinegun which is effective against personnel or troop targets out to a range of 900 meters. Additionally, the BFV carries a dual tube TOW missile launcher. The launcher, hinged to the left side of the turret, folds flat for travelling, and is raised through a 90-degree arc for firing. The TOW system is capable of defeating tanks at ranges of 3000 meters. Another turret system consists of eight directionally mounted smoke grenades which, when fired, provide concealment for the BIFV. An engine smoke screen generator also aids the BIFV in providing its own security.

The Bradley carries six M231 5.56mm Firing Port Weapons, two on the left and right sides, and two in the rear ramp of the vehicle. These weapons give the troops inside the vehicle a close-in suppressive fire capability while on the move. The overlap provided by the six firing port vision blocks provides 360 degree security and observation for the vehicle, and provides each soldier with a continuous picture of the battlefield. The firing port weapons permit the infantry man to fire while avoiding direct exposure to artillery fire. When the tactical situation directs a dismount, the vehicle and its firepower provide covering fires for the dismounted element.

An important advance brought to the United States Army's fighting capability by the BIFV is its ability to navigate at night and to acquire and kill targets under conditions of limited visibility. The Bradley is equipped with a single sighting system for all three major weapons, a day/night integrated sight unit (ISU). The sighting system operates at 4x magnification for scanning and target identification, and at 12x magnification for target engagement. The thermal imagery system allows heat detection under limited visibility conditions. A direct optical relay permits the Bradley commander to see a sight picture identical to that of his gunner and allows him to engage targets from his position as necessary.

The Bradley driver has a night vision viewer (AN/VVS-2) which complements the gunner's ISU thermal picture and the commander's AN/PVS-5 Night Vision Goggles.

The Bradley Fighting Vehicle provides the flexibility and mobility required to perform close combat missions. It is the only vehicle in the world that can carry a full infantry squad, protect it against small arms and artillery fire, swim, acquire and engage targets both day and night, and kill all known Threat ground and helicopter systems. The Bradley thus represents a significant advance in technoology for the United States Army. As a result,

however, the fielding of the Bradley has required revisions in tactics and techniques, training and training methods.

As the Bradley replaces the M113 armored personnel carrier in mechanized infantry units, doctrinal and tactical issues assume increasing importance. A basic requirement is the need for redefinition of the role the mechanized infantry can and will play on future battlefields. The BIFV is not just a battlefield taxi. Its speed and mobility permit it to maneuver as an essential part of the Combined Arms Team and its firepower dictates its use in an anti-armor, anti-vehicular role. The coaxial machinegun and firing port weapons enhance success in mounted attacks; the infantry element in the troop compartment can conduct dismounted operations with a choice of dismounted weapons as well as support from weapons organic to the BIFV. Thermal sights and night vision devices allow target detection and engagement at night or under limited visibility conditions.

Currently, developers of doctrine and tactics are encountering difficulties in defining the role of the BIFV. These difficulties stem in part from the versatility of the system. It can perform well as an anti-armor, anti-vehicular weapons platform or as a means of moving forces about the battlefield with speed. It offers a close support firing element for advancing or dug-in infantry, protection from small arms or artillery and nuclear fires; and a means for protecting armor from dismounted infantry. A key to understanding the role the BIFV is to fulfill in a combat environment is to understand the number of ways it can be used, and the adverse impact when it is used in ways which do not allow fullest exploitation of its potential.

Objectives

The Bradley project undertaken by Litton Mellonics and the Army Research Institute is divided into three parts: (1) an analysis of tactics, doctrine and training related to the BIFV, (2) assessment of gunnery techniques and training, and (3) an experimentation and test phase wherein some potential improvements in techniques, training, and gunnery are tested. The present report covers the first phase of this project. The primary objective of this research was a multidimensional examination of the doctrine, tactics, techniques, equipment and training of mechanized forces in both day and limited visibility operations.

There were a number of subelements within this project. The first and most comprehensive requirement was to perform an analysis of the activities of BIFV and M113 battalions. This required assessment of squad member performance, especially use of surveillance, target acquisition and night observation (STANO) devices; observation and analysis of the impact of night and limited visibility operations upon human performance; and examination of BIFV training programs, training aids, and training devices. An additional element of this task was a survey of the state-of-the-art technology related to BIFV limited visibility operations.

The final portion of this task required identification of the problems which surfaced as a result of these surveys, observations, and analyses. Once identified, problems were considered for development of potential solutions or

selection for further research during the final experimentation and test phase of this project.

METHOD

The primary focus of this project was directed to analysis of night and limited visibility operations of the M113 and the BIFV. In order to understand and place in perspective the requirements, techniques, and special knowledges required for limited visibility operations, it was necessary first to understand daylight operations, since limited visibility activities are based upon and require modification of daylight procedures, tactics, techniques, and doctrine. Further, tactical operations can shift to the limited visibility mode very rapidly.

The research team gathered information in a number of ways. They attended BIFV resident course instruction, observed gunnery training and firing, and learned to operate the Bradley and all available night observation devices. In addition, U. S. Army Infantry School programs of instruction, field manuals, training texts and lesson plans were studied; and information on Threat force doctrine, tactics and techniques was compiled. Observers also brought to the project extensive background knowledge accrued as a result of participation in previous work with the Mechanized Infantry Combat Vehicle, the M113, and as a result of prior military experience.

The research team also examined military and psychological literature dealing with human performance and fighting under night and limited visibility conditions. Technical and military resources were surveyed to improve BIFV tactics, techniques, and training. Detailed examination was given to the materials related to Bradley training (Infantry OSUT, BIFV Gunners, Commanders and Master Gunners Courses) and Infantry career courses (IOAC, IOBC, BNCOC, ANCOC).

A primary source of information was provided by two separate trips, one to a major training area in Germany, the other to a CONUS location, and by observation of locally conducted field exercises. The purpose of these trips was to observe tactical operations of BIFV and M113 battalions in an extended field environment under varying conditions of weather and visibility. These observations were used as a basis for analysis of tactics, techniques, and BIFV weapon system use, with special focus on the employment of STANO devices. Data derived from these observations formed the basis for many recommendations.

The team observed the conduct of an ARTEP for a BIFV battalion and a M113 battalion in mid-winter, a Combined Arms FTX and a combined arms live fire exercise (CALFEX) in more moderate weather. The team remained at squad level for the entire period of the exercises, riding in the troop compartment. Problems posed by space limitations, adverse weather conditions and fatigue were observed in a mannner that would not otherwise have been possible.

RESULTS AND DISCUSSION

Each of the major subjects investigated by the research team identified issues and problem areas which may impact on the combat effectiveness of BIFV units. They are summarized briefly in the following sections.

Threat

A Threat assessment was prepared to fulfill the need for a suitable statement of Soviet force organization. It was based on the latest available unclassified data; understanding Threat force potential will provide both education and motivation for improved training within U. S. forces. Fundamental to an analysis of tactics and doctrine is an understanding of the enemy one is to fight. Clearly, the Warsaw Pact countries constitute the greatest threat to American forces. The tactics of the Soviets are well known, and the structure and operational techniques are more rigid, and therefore more predictable, than those of the U. S.

Soviet operations are characterized by constant pressure day and night, and night operations are viewed as extensions of day activities. Soviet forces are well practiced in some aspects of night training. Lengthy marches, resupply of troops and ammunition, movement to alternate firing positions, and construction of fortifications are emphasized and performed at night. During the night, reconnaissance and security activities are increased; march columns are shortened and extra traffic controllers are used; observers with night vision equipment are dispersed among the units.

Surveillance, Target Acquisition, and Night Observation (STANO) Devices

A detailed review of current and projected capabilities of STANO technology and devices was undertaken. The review included both military publications and open literature sources. The distribution of STANO devices in the H and J series Infantry Battalions was evaluated, as were human factors assessments of some of these available devices. Observations of field exercises included assessment of use of night vision goggles, starlight scopes, Dragon night sights, the Integrated Sight Unit, and the driver's night sight.

Units must be able to operate under night and limited visibility conditions, and must frequently be able to operate under the same pressures of combat intensity that exist in daytime warfare. Commanders have the same tasks under any conditions - to coordinate and control the movement and fires of the unit in order to effectively mass combat power to destroy the enemy. These tasks are more difficult during conditions of limited visibility, since the capablity for detection, identification and acquisition of targets is severely degraded.

STANO equipment and the techniques for its utilization are designed to ease this difficulty and make the commander's job easier. The range of STANO equipment available to local commanders includes: 1) ordinary vision enhancers such as binoculars, 2) low light level vision devices (image intensifiers like the AN/PVS-5, night vision goggles); 3) no (visible) light vision devices such

as infrared/thermal viewing devices (AN/TAS-5, Dragon Night Tracker); 4) ground surveillance radars (AN/PPS-15, very short range radar); and 5) remote sensors (AN/TRS-?, platoon early warning (PEW) system).

In assessing STANO devices, it must be recalled that a device has no independent capability of its own. Its performance depends not only on the state of the art and the engineering skills of its developers, but on the operator's proficiency. That proficiency depends on the operator's attitudes and the quality of his training. For the BIFV's primary fire control system, the integrated sight unit, the critical task appears to be that of manipulation of the controls in a way to maximize the probability of target detection and identification in the shortest possible time. Little work has been done in this arena, hence the paucity of information about the actual use of the sight under conditions of limited visibility.

Field observations surfaced concern that although one third of all tactical training is supposed to be conducted under limited visibility conditions, less time is being spent in this manner. STANO knowledge, capabilities and uses, must be assessed, and deficiencies remedied.

Recognition of Friend or Foe

Differentiation of friendly from enemy elements on the battlefield is one of the most critical and simultaneously most difficult of the tasks of the Bradley gunner or commander. Without appropriate training, fratricide may occur. The commander, gunner and driver must be extensively trained and able to discriminate friendly from threat elements in both normal vision mode (daylight) and under conditions of limited visibility (thermal ISU and image intensification devices). Training materials intended to teach this should be designed and then used by trainers at all levels.

Performance under Night and Limited Visibility Conditions

Improvements in capabilites for night operations are often thought of in terms of advances in state of the art in STANO technologies. But better devices do not necesarily result in better performance, particularly in infantry operations where much of the success of the enegagement depends on the performance of the individual soldier, the crew, and the small unit. Level of performance depends on training effectiveness, motivation and leadership, and is subject to the limitations imposed by the physiology of the human body.

The literature on performance under exceptional conditions was reviewed as an additional base for the identification of tactical doctrine and gunnery problems related to night and limited visbility operations. Data on human performance includes a continuous operations study which recommends procedures to be followed to improve performance when fatigued. It also covers communications, hearing, memory, numerical facility, perceptual speed, reasoning, and vigilance.

The review of human factors included findings related to night vision, land navigation, and the effects of sleep loss. The findings related to night vision include dark adaption, visual acuity under night and reduced visibility

conditions, depth perception, and variables which affect object detection and identification. The relative effectiveness of soldiers in land navigation under day and night conditions and the use of the lensatic compass at night were evealuated. The effects of sleep loss were also studied.

Review of USAIS Training in Mechanized Infantry Tactics and Related Areas

USAIS instruction in mechanized infantry tactics for the M113 and the Bradley was reviewed. Both career development and BIFV specific/transitional courses were examined. Career development courses included those which prepare the student to serve as a squad leader (Basic NCO Course, BNCOC), platoon sergeant (Advanced NCO Course, ANCOC), platoon leader (Infantry Officer Basic Course, IOBC), and company commander (Infantry Officer Advance Course IOAC).

The Bradley specific courses consisted of the Infantry OSUT add-on course given to initial entry Fighting Vehicle Infantrymen and the gunner's course, designed to train Bradley gunners in technical aspects of the weapons systems, weapons familiarization and tasks related to operation and maintenance of the BIFV. Additionally observed were the commander's course, for senior NCOs and officers in BFV units, similar to the gunner's course, but with the addition of tactical employment of the BFV, and the master gunner course, like the gunner's course, with a greater emphasis on maintenance and training management. The commander's course was examined in great detail; all others for overlap of programs, and for specific content. Bradley tactical training occurs only in the commander's course; mechanized infantry tactical training is offered in officer training. NCO tactical training is dependent on the particular track or academy attended.

Leadership

The field observations brought a number of areas to the attention of the observers. These include leadership skills. The BFV leader must master two dimensions. First he must know armored tactics, techniques and equipment, to conduct the mobile-type war that will be required. Secondly, he must master the mounted and dismounted skills necessary to wage war as infantry. The mechanized infantry commander has a double requirement for the accumulation of expertise: his knowledge of armored tactics and techniques is critical to his successful integration in the combined arms team; and his infantry skills are critical to the achievement of combat success in the traditonal infantry role.

The leader must be ready for rapid reactions, to respond quickly with movement and fire. BIFV speed and fire power increase the need for fire planning, and make the issue of platoon leader span of control critical. The leader must also be aware of the needs of the personnel in the troop compartment, insuring that they perform their traditional infantry roles.

The roles of the fire support team (FIST), providing fire support for the entire unit, and the Forward Oserver (FO), coordinating platoon fires, are critical in the Bradley. The ability of the FO to see and assess the battlefield, and the necessity for detailed fire support plans is magnified in the BFV Company. Also, in planning, there is a need for range cards, and practice in range estimation skills and air guard activities.

BIFV Weapons Systems

The major weapon systems of the BFV are the TOW, the 25mm and the coax machinegun. Firing port weapons are available but not always carried. TOW use is dictated by unit SOP; personnel must know how and when to use it, and how to reload quickly. The 25mm is perceived as the main gun; problems arise when in wooded areas, gun barrels are struck against trees or other fixed objects. Another area of concern with the BFV 25mm gun is the length of time required to reload.

Tactics and Techniques

Observations of units in field operations brought concerns about local security, squad firepower, and BIFV missions and frontages. Tactical separation of the mounted and dismounted element are important, especially when the dismounted element is in an area separate from that of the vehicle. Tactical positions of BFVs were evaluated, in movement to contact, and the mounted attack, especially in assessing the tradeoffs between keeping the infantry squad mounted for mobility and suppressive firepower, versus the danger to occupants of the Bradley.

The commander must weigh the momentum, shock and speed of attack with infantry protected from small arms and indirect fires against the extreme vulnerability of the BFV to antitank weapons and the casualties that will be produced if a vehicle is destroyed. Because of potential for casualties, crew substitution drills need to be practiced. Additionally important is the need to understand both deliberate and hasty defense in depth. Another area of concern is the number of persons available to serve as the dismount element, in a vehicle which often carries less than the full complement of troops.

Equipment and Vehicle Changes

Observations of Bradley squads, from the perspective of inside the vehicle, brought concerns about the configuration of the BIFV's troop compartment which is presently very crowded. In field exercises, the compartment rapidly becomes very littered and finding equipment becomes difficult even with frequent reorganization and restowage. A human engineering restudy of the entire troop compartment, to include ammunition relocation and redesign of the bustle rack might help to alleviate this problem.

There was equipment failure, including the personnel heaters. The integrated sight units and turrets had electrical and water-based failures and the browpad was inadequate. The sponson boxes suffered from contact damage with fixed objects; the turret shield doors were equally fragile. Communications were a problem, both with respect to the radios, and within the vehicle on the intercom, particularly in driver/commander communications.

Training

Observation of field tactical exercises showed that personnel in the BFV troop compartment had little knowledge of the terrain, tactical situation, enemy location or squad mission and few instances of squad dismount were

observed. This is probably due to the almost total precoccupation with weaponry, speed, and cross country mobility of the BIFV. Practice of such skills must not be at the neglect of dismount skills. Night exercises consisted of delay, withdrawal and other mounted retrograde operations, leaving little opportunity for practice of skills involving night vision devices or dismounted tactics at night.

CONCLUSIONS

This portion of the research project identified many issues which will constitute the basis for research, test and evaluation over the next years. Major areas identified as meriting further examination or test constituted a larger group of subjects than could be pursued with resources available. Therefore, a number of the areas were deferred until time, personnel, and funds can be made available for such effort.

The issues which will be examined in the next phase of the project are divided into several categories: Target detection, and recognition of friend or foe; night, limited visibility and continuous operations; and use of the thermal mode of the ISU. Additional areas include range determination and target engagement, to include prefire gunnery training, tactical gunnery techniques and range operations and techniques. Further work will investigate reload of the 25mm gun and reconfiguration of the internal BIFV compartment. Tactical issues will involve analysis of the BFV commanders course, and the test of several tactical issues to be selected by the Infantry School.