



**U.S. Army Research Institute  
for the Behavioral and Social Sciences**

**Research Product 2009-07**

**Annotated Bibliography of the Army Research  
Institute's Training Research Supporting the  
Land Warrior and Ground Soldier Systems:  
1998 - 2009**

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**July 2009**

**Fort Benning Research Unit**

**U.S. Army Research Institute  
for the Behavioral and Social Sciences**

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# ANNOTATED BIBLIOGRAPHY OF THE ARMY RESEARCH INSTITUTE'S TRAINING RESEARCH SUPPORTING THE LAND WARRIOR AND GROUND SOLDIER SYSTEMS: 1998 - 2009

## EXECUTIVE SUMMARY

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### Research Requirement:

The Land Warrior (LW) and Ground Soldier System (GSS) are Soldier/leader systems that have a wearable computer with special software, linked to a network, a global positioning system which tracks the location of every individual with the system, a helmet-mounted display, and a radio which is also linked to the network. From 1998 to 2009, the Army Research Institute (ARI) at Ft. Benning, GA conducted training research, analyses, and assessments that provided input to Army decisions regarding equipping and fielding the Land Warrior (LW) system and the Ground Soldier System (GSS). The efforts covered the training of Soldiers to operate and employ the LW system during the period from 1998 to 2006. The GSS analyses followed the Land Warrior work. Much additional ARI training research was stimulated by the training issues and questions surrounding Soldier systems with a wearable computer, such as the LW system and GSS. The annotated bibliography summarizes this body of work and documents its impact.

### Procedure:

Many ARI projects were assessments of training conducted on different prototypes of the LW system. This training was conducted under the auspices of the TRADOC Systems Manager/TRADOC Capabilities Manager (TSM/TCM) Soldier, Project Manager (PM) LW, and US Army Infantry School. The assessments involved on-site observations of training, data collection on Soldier performance, and interviews and surveys with the Soldiers and leaders participating in the training. Additional analytic efforts were conducted as part of analysis of alternative efforts that supported milestone decisions for the LW system and the GSS.

The projects used a variety of research methods. Some were experiments, some were surveys, some involved product development of training materials, and some were conceptual efforts supporting training plans for digital systems and embedded training features. Major efforts included multi-year surveys of Soldiers' and leaders' computer skills, development of concepts for automated After Action Review tools for dismounted Soldier systems, the application of computer-based interactive multi-media instruction (IMI) for training prototype LW system interfaces in conjunction with experiments examining the effectiveness of different instructional approaches, and development of IMI for prerequisite skills required by the LW system. Other research focused on the LW weapon subsystem, specifically training on the proposed day and night sights to be used with the LW weapon system and the effectiveness of these sights plus a major experiment on reduced exposure firing with the LW system.

## Findings:

In general, the cumulative findings from this body of research provide a comprehensive picture of the training requirements for ground Soldier systems with an embedded computer system for Soldiers, leaders, and the small-unit. The findings showed that more unit training was required to obtain proficiency than initially expected, and that training should be developed to specifically address leader employment of these systems. In addition, the research illuminated and clarified some training issues. For example, the surveys of Soldier computer skills dispelled the commonly-held opinion that young Soldiers were more computer savvy than senior noncommissioned officers. The research also clearly showed how important it was for Soldiers and leaders to possess the prerequisite skills required by such systems. We determined how proficient Soldiers could be using reduced exposure firing techniques. Training concepts and approaches that leveraged the computer capabilities of the system were developed.

## Utilization and Dissemination of Findings:

The research reports and products were disseminated to project sponsors and users after their completion. Findings were incorporated in Army documentation that supported system milestone decisions. Research results were provided to other Army agencies for their simulation data bases and for training requirement documents for the LW system. Research on firing with night vision goggles and aiming lights impacted the qualification standards for night fire. The multi-media training CD-ROM developed during the early research for the core skills of sending messages, reading maps, developing orders, and identifying graphic control measures was provided to Soldiers participating in LW training that was conducted later. Some research findings have applications beyond ground Soldier systems per se. For example, the research on the training different target populations on digital systems showed how training can be tailored to other systems where the user population comes from distinct user groups. Training analysts who must estimate training resources for new systems could benefit from applying the techniques and procedures developed in the analysis of alternatives efforts.

ANNOTATED BIBLIOGRAPHY OF THE ARMY RESEARCH INSTITUTE'S  
TRAINING RESEARCH SUPPORTING THE LAND WARRIOR AND  
GROUND SOLDIER SYSTEMS: 1998 – 2009

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# ANNOTATED BIBLIOGRAPHY OF THE ARMY RESEARCH INSTITUTE'S RESEARCH AND ANALYSES SUPPORTING THE LAND WARRIOR AND GROUND SOLDIER SYSTEMS: 1998 – 2009

## Land Warrior History

The Land Warrior (LW) system is a ground Soldier system that has a wearable computer with special software, linked to a network, a global positioning system which tracks the location of every individual with the system, a helmet-mounted display, and a radio which is also linked to the network. The LW system has evolved with time, but started with a Mission Need Statement in 1993, followed by a system requirement document in 1994. Since 1994, LW requirement documents have been updated, and different versions of the LW system have been built as technology and user requirements have evolved. LW systems have been examined in Army experiments, and some Stryker units have been equipped with the system. From a historical perspective, the different LW systems have served as prototypes for the objective the Ground Soldier System (GSS), and as a lessons-learned test bed for the GSS. Currently, there is a requirement document for the GSS, but there is no actual system as the GSS is in its initial research and development phase. The initial requirement document was written in 2006 (Training and Doctrine Command [TRADOC], 2006). The GSS requirements are similar to those for the LW system.

Other features of the LW system include a helmet-mounted display enabling the Soldier/leader to see maps, graphic control symbols, messages, his own position and the position of others, and mission orders. Soldiers and leaders with a system can create, send, and receive messages, orders, and graphics. Earlier versions of the system also had an integrated weapon subsystem which allowed Soldiers to fire their weapon via a projected image of a target transmitted from either a daylight or thermal weapon sight to their helmet-mounted display. The exact LW system configuration, weight, and location and size of major components have changed with system evolution. [See Copeland (2007) for a description of one version of the LW system.]

## Scope of the Training Research

From 1998 through 2009, the Army Research Institute's (ARI's) Research Unit at Ft. Benning conducted research and analyses that directly supported the LW system and GSS, primarily LW. This report is an annotated bibliography that summarizes that body of research and analyses. Collectively, the documents provide a historical picture of LW training and system changes since 1998, describe initial analyses and research related to the GSS, specify additional ARI research generated by training issues and questions associated with the LW system, and describe the short-term and longer-term impacts of the research. The reports also provide a perspective on system development and what was learned about the fundamentals of effective training on these important ground Soldier systems.

The annotated bibliography includes both formal ARI reports as well as special reports that were transitioned to the TRADOC Systems Manager (TSM)-Soldier, TRADOC Capabilities

Manager (TCM)-Soldier, Project Manager (PM) Land Warrior/Soldier, and the US Army Infantry School (USAIS). These efforts, some of which were supported by PM-Land Warrior/Soldier, covered the training of Soldiers to operate and employ the LW system during the period from 1998 to 2006, as well as a major training analysis conducted on the GSS in 2007.

Other ARI training research stimulated by the training issues and questions related to Soldiers and leaders employing such systems is summarized. These efforts included multi-year surveys of Soldiers' and leaders' computer skills, automated After Action Review tools for dismounted Soldier systems, the application of computer-based interactive multi-media instruction (IMI) for training prototype LW system interfaces, training of weapon system day and night sights proposed to be used with the LW system and the effectiveness of these sights, a major experiment on reduced exposure firing with the LW system, and IMI training for prerequisite skills required by the LW system. Much of this research has training applications beyond Soldier systems per se.

The bibliography is organized by the major time periods linked to the evolution of the LW system and emergence of the GSS. Headings indicate the time periods when the research or analysis was conducted. The report publication date often follows the research period. The report citation is presented first followed by a report summary. Discussion points and comments are inserted that address how training findings and lessons learned in the research continued to apply as the Soldier systems evolved and the research had other unanticipated impacts.

## Annotated Bibliography

### *Land Warrior (1998-1999)*

*Background.* From 1998-1999 a version of the LW system was developed for technical testing prior to the conduct of the system's operational test at Ft. Bragg NC. Training was executed prior to this planned operational test. The test was cancelled as the system experienced technical difficulties and failed to meet some critical requirements. However, both the baseline and LW platoons scheduled to participate in the test received weapon system-related training. The next two reports document the research associated with this training.

Dyer, J. L., Reeves, J., & Wampler, R.L. (1998). *Training effectiveness analysis (TEA) of the Land Warrior (LW) System: Phase I - The baseline platoon.* Ft. Benning, GA: Infantry Forces Research Unit, U.S. Army Research Institute.

This report documents the training given to the baseline platoon from Ft. Bragg, NC scheduled to participate in the LW operational test. The baseline platoon was trained on four sights and devices: the M68 close combat optic (CCO), two aiming lights (AN/PAQ-4C and AN-PEQ-2A) which were used in conjunction with night vision goggles (NVGs, AN/PVS-7B), the thermal weapon sight (TWS, AN/PAS-13), and a bore light. The CCO, AN/PEQ-2A, TWS and borelight were new to the Soldiers. These sights and devices were to be part of the LW weapon subsystem. However, since these sights and devices would have been fielded to the Army by the

time of LW system fielding, the decision was made to train-up the baseline platoon on this government-furnished equipment.

The performance results on live-fire exercises and qualification courses of fire with the M4 carbine, M249 Squad Automatic Weapon, and M240B machine gun are presented in the report. The night firing findings with NVGs and aiming lights clearly showed that the level of ambient illumination and the configuration of the range must be considered when the LW system is evaluated, as these uncontrollable factors strongly impacted the ability of the Soldier to hit targets regardless of marksmanship expertise. A major recommendation was that the training package given to the unit for sustainment training on these devices be revised to include structured practice exercises that focused on the critical teaching points and included enhanced visual training materials. In addition, it should be “instructor proof” to enable unit leaders to present the correct technical information as well as enable them to train new Soldiers to employ the sights/devices to their advantage and to understand the operational considerations of the different technologies.

Dyer, J. L. (1999). *Training lessons learned on sights and devices in the Land Warrior (LW) weapon subsystem* (ARI Research Report 1749). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A371 583)

This report followed the Dyer, Reeves and Wampler (1998) report. It documents the training given to both the baseline and LW platoons at Ft. Bragg NC on the weapon sights and devices cited in the Dyer et al. (1988) report. Thus the performance data for the baseline platoon in this report are the same as the data presented in the Dyer et al. (1998) report. When the research was conducted, the LW system consisted of five subsystems: Weapon, Integrated Helmet Assembly, Computer-Radio, Protective Clothing and Individual Equipment, and Software. However, the weapon subsystem was the focus of the research. Soldiers in the LW platoon did not wear the LW system but did use the components of the weapon subsystem. Formal observations were made of training received by the two platoons, and all weapon performance data were collected.

Both platoons were trained on the same weapon sights and devices as presented in Dyer, et al. (1998): M68 close combat optic (CCO), two aiming lights (AN/PAQ-4C and AN-PEQ-2A) which were used in conjunction with night vision goggles (NVGs, AN/PVS-7B), and the thermal weapon sight (TWS, AN/PAS-13), plus a bore light. The training objective was for all Soldiers to qualify with each sight/device using the Army’s qualification course-of-fire (20 rounds from foxhole position and 20 rounds from prone unsupported position per Field Manual 23-9 [Department of the Army, 1989]). The M4 carbine, M249 squad automatic weapon, and M60 machine gun were the platoon weapons. The training adequately prepared the Soldiers to qualify on the M4 carbine with the CCO and the TWS. However, qualification standards were extremely difficult to achieve with the aiming lights, a result of environmental conditions typical of Army ranges, in combination with the inability of Soldiers to detect targets at distance due to limitations of NVGs under varying illumination conditions at night. A standardized technique for boresighting all the devices was developed and applied to the LW platoon.

As part of the analysis, diagnostic skills needed by trainers to help Soldiers to effectively hit targets with each sight/device were identified. The report describes what contributed to quality training on the sights/devices, and what should be integrated into marksmanship programs of instruction, technical manuals, and the training and doctrine literature. The findings had immediate applicability to the Army, as initial fielding of the sights/devices started during the research period.

*Supplementary note.* Follow-on work was conducted with marksmanship experts assigned to the 29<sup>th</sup> Infantry Regiment at Ft. Benning, GA on determining the qualification standards for aiming lights. ARI's data with the LW system as well as later data collected by the 29<sup>th</sup> Infantry Regiment personnel confirmed that the day qualification standard was not appropriate for night firing with NVGs and aiming lights because of the limitations of NVG image intensification technology. The result of this joint effort was a modified record night fire course of fire for aiming lights in the rifle marksmanship Field Manual 3-22.9 (Department of the Army, 2003, 2008). Compared to the existing day record fire scenario in the 2003 FM, the distribution of targets shifted to closer distances; there were no 300 meter targets and only one 250 meter target. In addition, the qualification standards for marksman and sharpshooter categories were changed.

Centric, J. H., Wampler, R. L., & Dyer, J. L. (2000). *Observations of Infantry courses: Implications for Land Warrior (LW) Training* (Research Note 2000-04). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD-A372 853)

The research examined the potential impact of the Land Warrior (LW) system on the Infantry courses that would be most affected by introducing this system into the force. These courses were the Infantry Officer Basic Course (IOBC), Basic Noncommissioned Officer Course (BNCOC), and Infantry One-Station Unit Training (OSUT). The areas investigated within each course were weapons training including use of the target acquisition capabilities of the LW, communications training, land navigation, operational techniques and tactical operations, field exercises, and computer skill training. Formal observations were made of these blocks of instruction in each course. The report described both major and minor impacts upon course content and training resources. In addition, different options were presented on how to integrate LW training into the courses. Because the LW system was evolving during the research period, the training impacts represented the best estimate at the time. Future changes to the LW system and general changes to institutional courses were acknowledged as major factors that could affect future training within the institution. Other factors identified were decisions regarding which LW tasks should be taught, the scope and depth of the training, and the performance standards required for the tasks.

*Joint Contingency Force Advanced Warfighting Experiment (JCF AWE):  
LW Version 0.6 (2000)*

Dyer, J. L., Fober, G. W., Wampler, R., Blankenbeckler, N., Dlubac, M., & Centric, J. (2000). *Observations and assessments of Land Warrior training* (Special report to TSM-Soldier and PM-LW). Ft. Benning, GA: Infantry Forces Research Unit, U.S. Army Research Institute.

The report presents the results of an assessment and description of training on the Land Warrior (LW) system given to a platoon prior to its participation in the Joint Contingency Force Advanced Warfighting Experiment (JCF AWE) in September 2000 at the Joint Readiness Training Center (JRTC) at Ft. Polk, LA. The platoon using the LW system was from Ft. Bragg, NC, and trained at both Ft. Bragg and Ft. Benning prior to the JCF AWE. The report covers a four-month train-up period prior to JCF AWE as well as interviews with Soldiers and leaders after their participation in the JCF AWE. The scope of the report is outlined below.

- Demographic and computer experience/background on platoon members.
- Summary of government furnished equipment marksmanship results.
- Detailed description of training, by course, week, and day. The Operator, Leader, and Tactics Courses are described, plus the follow-on training at Ft. Benning and Ft. Bragg. Soldier performance data on tasks (e.g., time and errors) were recorded wherever possible and were documented.
- Comments on and assessments of the training for each course and phase of training.
- Findings from interviews with platoon members after their return from the JCF AWE. Interviews focused on Soldier use of different components and capabilities of the LW system throughout training and at JRTC; their individual and collective expertise with the system, prerequisite skills needed for the system, the training they received, and suggestions for future training.
- Discussion of the training media and equipment used during the JRTC train-up, to include the Delta Force 2 simulation assessment, and future training device/media requirements.

Factors to consider in future LW designs, based on the training observations and Soldier comments were considered. Design issues were cited throughout the report, and were consolidated in an Appendix.

One of the primary lessons learned from this effort was that skill with individual tasks did not automatically transfer to collective or unit skill. There was an individual to collective skill gap as individuals frequently made limited use of the LW system's capability in the field. Training must be designed to fill this gap. Confidence ratings indicated that the learning curve for collective proficiency was flatter than that for individual proficiency. The percentage of Soldiers confident in their individual skills was fairly high at the end of the four weeks of training, while confidence in squad skills was at an equivalent level at the end of about twelve weeks. With the culminating phase at JRTC, all Soldiers indicated confidence in their individual skills, but not all were confident in their squad's skills.

In addition, the system was characterized as a “thinking Soldier’s system.” Thinking Soldiers used the system smartly; others were more likely to use it “routinely.” Incorporating a problem-solving approach to training and field exercises that requires use of system features was recommended.

U.S. Army Research Institute. (2003). *Land Warrior prerequisite skills training, v 1.0* (CD-ROM). Ft. Benning, GA: Infantry Forces Research Unit. [Transitioned to the Infantry School, TCM-Soldier and PM Land Warrior]

The multi-media training program (on a CD-ROM) was produced after the JCF AWE to address prerequisite skills needed by Soldiers using the LW system. During training observations of the rifle platoon who participated in the JCF AWE in 2000, it was clear that to effectively operate and employ the LW system, Soldiers needed to possess knowledge in four major domains: messages, orders, graphic control measures, and map reading. However, new Soldiers were often deficient in each area, and senior noncommissioned officers who had not been to the Advanced Noncommissioned Officer Course (ANCOC) had not been trained in orders and graphic control symbols. Consequently, they were not able to fully leverage system capabilities and the LW trainers had to take additional time to remedy these training gaps. The prerequisite skills training program was developed to address these weaknesses. The topics covered in the CD-ROM are listed below.

- Messages: Spot Report, MEDEVAC, Call for Fire, and NBC-1
- Map Reading: Colors; Directions & Azimuths; Scale, Grids, Distance; and Terrain Features
- Orders: Plans and Orders; Field Orders; Types of Orders; Techniques for Issuing Orders
- Graphic Control Measures: Lines (linear graphic control measures e.g., boundary, phase line, forward line of troops); Offensive and Defensive Areas (e.g., assault position, objective, strong point, engagement area); Points (e.g., casualty collection point, checkpoint, waypoint, target reference point); Arrows (e.g., axis of advance, main attack, supporting attack); and Units (e.g., Infantry, Engineer, Armor, unit size)

The CD-ROM is available from the Ft. Benning Research Unit of the Army Research Institute.

*Supplementary note.* The CD-ROM was provided to the PM LW for distribution to Soldiers participating in some of the LW training that followed the JCF AWE. The importance of ensuring Soldiers and leaders possess the appropriate prerequisite skills in the training program was demonstrated again during training observations with the LW version 1.0 system (2002-2003) prior to system technical testing and with the LW version fielded to the Stryker Battalion (2005-2006). In addition, lack of some prerequisite weapon-sight skills negatively impacted these Land Warrior training events. These findings reinforce the more general principle of ensuring individuals possess the necessary prerequisite skills in order to have a more valid assessment of the effectiveness of a system during system acquisition and to maximize employment of a system once it is fielded.

*Technical Testing: Land Warrior Version 1.0 (2002-2003)*

Dyer, J. L., & Wampler, R. L. (2002). *Observations of the Land Warrior Tester Trainer Course #1 Conducted Prior to Safety Testing*. Fort Benning, GA: U.S. Army Research Institute for the Behavioral and Social Sciences, Infantry Forces Research Unit.

Wampler, R. L., Beal, S. A., & Dyer, J. L. (2003). *Observations of the Land Warrior Tester Training Course #1A conducted during Safety Training*. Fort Benning, GA: U.S. Army Research Institute for the Behavioral and Social Sciences, Infantry Forces Research Unit.

Dyer, J. L., & Wampler, R. L. (2002). *Observations of the Land Warrior Tester Trainer Course #3 Conducted Prior to Reliability Growth Phase I*. Fort Benning, GA: U.S. Army Research Institute for the Behavioral and Social Sciences, Infantry Forces Research Unit.

These reports, listed in the order in which the research was conducted, document training observations made during training in preparation for technical testing conducted in 2002 and 2003 with LW version 1.0 prior to an anticipated Initial Operational Test and Evaluation (IOTE). Because of reliability problems with the system, the IOTE was cancelled.

Each report describes the Soldier population, the scope of the training with a detailed description of the tasks trained, difficulties Soldiers had in performing the tasks during training, and Soldier proficiency associated with hands-on exercises and live-fire performance. Training procedures and techniques were documented, and in some cases recommendations were made for improving training. System design features that interfered with Soldier performance were also identified. The reports were transitioned to TRADOC Systems Manager-Soldier and Project Manager-LW.

*Reduced Exposure Firing: Land Warrior Version 1.0 (2003)*

Dyer, J. L., Salvetti, J. D., Vaughan, A. W., Beal, S. A., Blankenbeckler, P., & Dlubac, M. (2005). *Reduced exposure firing with the Land Warrior system* (ARI Research Report 1834). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A435 129)

Dyer, J. L., & Goodwin, G. (2005). Training for reduced exposure firing with the Land Warrior system. *ARI Newsletter*. 15(2), 7-10.

The LW version 1 system provided the Soldier with the ability to conduct surveillance and to fire from a reduced exposure posture. The day capability was achieved with what was called the daylight video sight; the night capability with the thermal weapon sight (TWS). These sights were linked via a cable to the Soldier's helmet mounted display. This enabled Soldiers to see their sectors of fire without exposing themselves to the enemy as is the case with direct fire engagements.

ARI conducted an experiment to determine the relative lethality of the reduced exposure capability versus standard direct fire techniques. Direct fire techniques during the day were conducted with the close combat optic (CCO); direct fire techniques at night were conducted by using the TWS in

its normal mode. The Soldiers who participated in the experiment represented a cross-section of military occupational specialties. Each fired all conditions specified in the experimental design, that is, all direct fire conditions with the CCO and TWS and all reduced exposure fire conditions with the CCO and the TWS. All firing was conducted on a Location of Miss and Hit (LOMAH) range which allowed documentation of the radial distance of each round from the target's center of mass for both hits and misses.

Soldiers were trained on acquiring targets, firing at known-distance targets, and firing at timed single and multiple exposure targets prior to the final criterion firing scenarios. Data were obtained on probability of hit, round dispersion, target acquisition, and Soldier exposure to the enemy. Over all the experimental conditions, marksmanship accuracy with reduced exposure fire was reduced somewhat compared to direct fire techniques, an 18% decrease. However, Soldier exposure decreased by 75% compared to direct fire positions and the absolute amount of exposure was small. A training plan was developed that identified the required skills and incorporated the training lessons learned on techniques and firing exercises that facilitate skill acquisition for firing via an indirect sight capability while maintaining a reduced exposure posture..

*Supplementary note.* To date, this reduced exposure firing experiment is the only experiment that has systematically examined the reduced exposure capability of the LW system using both day and night weapon system capabilities. Poor imagery, plus the weight and cost associated with the daylight video sight resulted in less emphasis on this reduced exposure firing capability over time. However, the wireless capability shown in Future Force Warrior Advanced Technology Demonstration in 2007 reduced the weight and Soldiers reacted positively to the wireless configuration.

In addition, all experimental data were provided to the US Army Materiel Systems Analysis Activity (AMSAA) for incorporation in their weapon simulation models.

#### *Rapid Fielding Initiative Comparison (2004)*

Dyer, J. L. (2004). *Soldier survey results: Land Warrior-Rapid Fielding Initiative comparison.* (Special report to TRADOC Systems Manager-Soldier). Ft. Benning, GA, U.S. Army Research Institute for the Behavioral and Social Sciences, Infantry Forces Research Unit.

The Commanding General, US Army Infantry Center (2004) requested a comparison of the effectiveness of Infantrymen using the LW system versus the Rapid Fielding Initiative (RFI) equipment. This effort was also part of the Analysis of Alternatives (AoA) for the LW Block II system being conducted by the TRADOC Analysis Command – White Sands Missile Range (TRAC – WSMR). The Soldier Battle Lab at Ft. Benning GA executed the trials. Soldiers from the Experimental Force at Ft. Benning formed the Infantry squad that used both the LW system and the RFI equipment.

The essential elements of analysis (EEA) addressed in the AoA were used to determine measures of individual and squad performance with the LW system and the RFI equipment. The Infantry

Forces Research Unit of the ARI was asked to develop the Soldier surveys to address the EEA cited below:

- Situational understanding of friendly and enemy forces, terrain, and the mission
- Voice communications: intrasquad and leader
- Leader planning ability: receive and issue orders and instructions with overlays, confidence in plan and execution of plan
- Unit formation discipline
- Soldier ability to move under direct fire
- Soldier ability to conduct surveillance
- Ability to kill or suppress the enemy with direct fire without being suppressed or wounded, specifically reduced exposure firing with the LW system

In addition, ARI was asked to query Soldiers on the basis of issue for the LW system.

The report cited above documents that effort and the results. Results were limited because only one squad was equipped with the LW system. However, in general, Soldiers reacted positively to the digital map and the situation awareness features. Soldiers and leaders also found the LW system enhanced their capability to successfully execute night missions.

#### *Land Warrior - Block II (2005)*

Dyer, J. L., Centric, J., & Dlubac, M. (2006). *Training impact analysis for Land Warrior Block II* (ARI Research Report 1846). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A443 795)

A Training Impact Analysis was conducted to support the Analysis of Alternatives (AoA) for the LW Block II system. Three LW alternatives were compared to a rapid fielding initiative baseline. The three alternatives varied the basis of issue for the LW system: down to squad leader, to fire team leader, and to all Soldiers. Training time, number of instructors and LW systems, and ammunition were estimated for each alternative. The greatest training impact was with the alternative where all Soldiers had a system, due to the substantial increase in number of individuals to be trained as compared to alternatives that involved only leaders. The courses examined were Infantry One Station Unit Training (OSUT), Basic Noncommissioned Officer Course (BNCOC), Advanced Noncommissioned Officer Course (ANCOC), and Basic Officer Leader Course (BOLC) III-Infantry. These Infantry courses increased in length as core subjects and prerequisite skills could not be deleted from the programs of instruction. Marksmanship and land navigation training were the two individual tasks that had the greatest impact, due to the high proficiency level desired by the Infantry School and constraints on throughput created by restrictions in training areas/ranges. The results were included in the February 2005 AoA briefing to the Study Advisory Group. The analysis provided a solid base for estimating future training impacts if the LW system is modified, additional data on training times are obtained, or programs of instruction are changed. The approach also provided a generic model for conducting training impact analyses for other systems.

*Land Warrior - Stryker (2005-2007)*

Dyer, J. L. (2006). *Land Warrior master trainer course: Implications for new equipment training* (Special report to TRADOC Systems Manager Soldier). Ft. Benning, GA: US Army Research Institute for the Behavioral and Social Sciences, Infantry Forces Research Unit.

This report describes the LW training course conducted for squad and team leaders in 2005 at Ft. Lewis WA. The leader training was executed approximately five months prior to the start of the LW new equipment training (NET) for the Stryker Battalion in 2006. Two-weeks of training enabled these small-unit leaders to become familiar with the LW system so they could facilitate the NET that was to follow. Training procedures and techniques applicable to NET were identified, as well as areas in which more training would be required in NET in order to obtain the desired level of proficiency. The need to include more employment training for leaders and units was stressed.

Dyer, J. L. & Tucker, J. S. (2007). Land Warrior New Equipment Training (NET) assessment. In J. L. Dyer & J. S. Tucker (2009). *Training analyses supporting the Land Warrior and Ground Soldier Systems, Appendix A*. (ARI Research Report). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences.

The LW NET assessment was conducted in 2006. It supported a LW Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) Assessment to inform a March 2007 LW Milestone C Decision.

The assessment included formal, on-site observations of the LW training given to a Stryker Battalion at Ft. Lewis WA which was scheduled for deployment to Iraq. This unit was the Army's first unit equipped with this system. The other primary data sources were Soldier and leader surveys plus focus group sessions with the three Stryker companies equipped with the LW system. In addition to assessing NET, another purpose of the analysis was to recommend what should be included in future NET and to estimate the associated training resources for future NET programs. These analyses were conducted for two basis of issue alternatives: one where team leaders and above had the LW system and one where all Soldiers had the system. The NET observations plus historical training projections for the LW system served as the primary bases for the recommended NET and estimated training resources.

The LW NET conducted for the Stryker battalion was assessed to be inadequate. In general, as executed the NET was not sufficient in terms of time, tasks addressed, and training strategy and methods. Consequently, individuals were not fully trained to operate, maintain, and employ the system; units had limited collective training on system employment techniques; unit leaders were not fully enabled to conduct sustainment training. Suggestions on how to more fully train Soldiers, leaders, and units were made and on how training on future ground Soldier systems can be enhanced. For example, it was recommended that specific field exercises be designed to facilitate Soldier and leader employment of system features.

The recommended NET specified leader and non-leader tracks in order to tailor the training. The recommended training time for a company doubled, from 9 to 18 days. In addition, the collective training phase of NET was designed to leverage the capabilities of the system, to progress systematically from squad to platoon to company to gain the necessary employment skills at different echelons, to instill confidence in all individuals with the system, and to provide the conditions whereby Soldiers and leaders could recognize and experience the value of the system. A layout of the resources, including time, necessary to conduct a Battalion-size NET was provided, with the estimated training resources greater for the all Soldier alternative than the team leader and above alternative. The recommended training strategy and resources were incorporated in the System Training Plan for the LW, developed by the US Army Infantry School.

### *Ground Soldier System: 2007*

Dyer, J. L. (2007). Ground Soldier System training impact analysis: Institutional training and New Equipment Training. In J. L. Dyer & J. S. Tucker, (2009). *Training analyses supporting the Land Warrior and Ground Soldier Systems, Appendix B*. (ARI Research Report). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences.

The Ground Soldier System (GSS) analysis was conducted in 2007. It was one component of the GSS DOTMLPF assessment, which in turn was part of a larger GSS Analysis of Alternatives, which informed a GSS Milestone B decision.

The GSS analysis focused primarily on the impact on institutional training with the fielding of this system, and secondarily on NET for the GSS. Two alternatives were examined: one where team leaders and above had the GSS and one where squad leaders and above had the GSS. A front-end analysis identified the tasks required by the GSS, as indicated by the requirements document, and any differences between the LW system and GSS. The recommended training programs of instruction leveraged the findings from the Stryker NET assessment and applied analytic procedures developed in the 2005 analysis conducted by ARI on the impact of the LW Block II system on institutional training (reference Dyer, Centric & Dlubac, 2006).

Few differences were found in the individual tasks associated with the LW system and GSS. Leader (platoon level and above) and non-leader training tracks were identified, with the non-leader tracks emphasizing weapon system skills, day and night navigation and day and night situational awareness, with particular emphasis on system employment in field exercises. Leaders were to receive more training on planning, orders and communication processes. Regardless of alternative, time requirements were the same: recommended institutional training time was 14 days. A layout of the resources, including time to conduct a Brigade NET was provided. The time requirement for each alternative was the same (4 weeks), but other training resources, such as number of instructors, were less for the squad leader alternative than the team leader alternative.

### *Related Ground Soldier System Reports*

Dyer, J. L., & Wampler, R. L., & Blankenbeckler, P. N. (2005). *After action reviews with the Ground Soldier System* (ARI Research Report 1840). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A438 040)

The origin for this research was the LW JCF AWE. The research explored the potential of improving After Action Reviews (AARs) by using the computer capabilities in the LW system. The observer/controllers (OCs) at the Joint Readiness Training Center (JRTC) who had observed the LW platoon during the JCF AWE were interviewed to elicit their reactions as to what system capabilities might be used to enhance AAR aids and displays for small unit leaders. Findings showed that the actual operational capabilities of a Soldier system such as the LW could be used to provide aids that support the trainer's discussion of mission planning and preparation, plus some aspects of mission execution. The addition of embedded AAR capabilities in the system's software could expand this pool of potential aids, and more closely approximate the aids found to be of value in constructive and virtual simulations. It was also determined that existing automated aids in simulations typically do not address mission planning and preparation. The OCs commented on proposed displays that could be generated by an embedded AAR capabilities in a future Soldier system. The OC interviews reinforced the tenet that the trainer is key to a successful AAR dialogue to help the unit understand what happened, why it happened, and what to sustain and improve. The findings from the OC interviews have general applicability to future dismounted Soldier systems which incorporate a wearable computer.

Blankenbeckler, P. N., Wampler, R. L., Dlubac, M. D., & Dyer, J. L. (2008). *After action review tools for dismounted Soldier systems* (ARI Research Product 2008-02). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A483 160).

This research was a follow-on effort to the earlier research with the LW system and OCs at JRTC, and leveraged some technology gains made in embedded training during the Future Force Warrior Advanced Technology Demonstration in 2007. It examined the software tools required to implement an embedded after action review (AAR) support system in future dismounted Soldier system requirements such as the Ground Soldier System (GSS) to enhance the training of squads and platoons. The context was tools to assist the leader/trainer in conducting small-unit AARs. Specific interfaces were proposed for leader systems that would generate AAR aids related to situation awareness and understanding, fire effects, and battle command. Concepts for interactive system controls integrated into menus to facilitate the AAR process were developed. The findings also provided tools to facilitate the integration of realistic firing engagements and casualty play during training. A suite of flexible tools was recommended which addressed the AAR embedded training requirement for the GSS.

Blankenbeckler, P. N., Livingston, S. C., Dlubac, M. D., Riffe-Seckinger, N. C., Swinson, D. N., & Dyer, J. L. (2006). *New skills training plan for map functions and passage of lines on a Soldier system*. (ARI Research Product 2006-09). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A452 855)

The training products in this report bridge gaps between training digital and non-digital forces. The new skills training plans present ways to teach digital skills associated with new computer-based technologies, but also relate these skills to current procedures and techniques used without these technologies. Consequently, these products help Soldiers learn and retain the new digital skills, and also to retain the associated non-digital skills required to perform the same tasks. Training plans for two sets of skills were developed: map functions (individual) and the conduct of a passage of lines as the stationary unit (collective).

For map functions, the training plan described the digital map functions themselves and explained how they enhance capabilities on the battlefield. It included assessing Soldier status on specified prerequisites, such as terrain association and distance measurement. It specified training exercises in which Soldiers applied the learned skills or completed task using both paper and digital maps. The exercises increased in difficulty, were put in context of mission execution, and ended with a field training exercise. Teaching points for each map function were identified. A highly recommended training technique was to compare how tasks are accomplished with and without digital systems.

The training plan for passage of lines was similar in concept. The advantages of the digital system functions were presented, and prerequisite skills such as using an overlay and conducting a passage of lines without a digital system were identified. The training plan integrated previously learned and applicable individual skills, specified testing of these skills during initial training phases, and included a series of increasingly difficult exercises as well as assessment procedures.

*Supplementary note.* The approach to training outlined in this report could be easily applied to any future New Equipment Training (NET) and institutional training for dismounted Soldier systems.

*Other ARI Related Research:  
Computer Skills of Soldiers and Training Digital Skills*

*Background.* The following research efforts were generated because of training issues identified during ARI's early work with LW version 0.6, where a platoon trained with the LW system participated in the JCF AWE. A primary MANPRINT (Manpower Personnel and Integration) issue at the time was the level of computer skills possessed by the individuals who would use the LW system.

Another issue that arose was how best to train the skills required of the LW system. At the time it was assumed that many skills could be trained via Interactive Multi-Media Instruction (IMI).

A series of experiments examined the best ways of using IMI technology to train a set of digital skills.

*Computer Skills of Soldiers (1999-2001)*

Dyer, J. L. & Martin G. H. (1999). *The computer background of Infantrymen: FY99* (ARI Research Report 1751). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A372 716)

Fober, G. W., Bredthauer, J. L., & Dyer, J. L. (2000). *The computer background of Soldiers in Infantry courses: FY99-00* (ARI Research Report 1762). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A381 507)

Singh, H. & Dyer, J. L. (2001). *The computer background of Soldiers in Infantry courses: FY01*. (ARI Research Report 1784). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A399 394)

Fober, G. W., Bredthauer, J. L., Dyer, J. L. (2001). *Computer backgrounds of Soldiers in FORSCOM units: FY00*. (ARI Research Report 1778). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A399 393)

Singh, H. & Dyer, J. L. (2002). *The computer background of Soldiers in Army units: FY01*. (ARI Research Report 1799). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A409 024)

Dyer, J. L. (2002). The computer backgrounds of Soldiers. *ARI Newsletter*, 12, 1-5.

In 1999, ARI initiated a series of surveys, ending in 2001, that examined whether different segments of the Soldier population have distinctly different computer backgrounds. At that time it was widely believed that senior noncommissioned officers had weaker computer backgrounds than the young enlisted Soldiers. The findings showed this opinion to be invalid --- that just the opposite was typically the case. The reports cited above document this finding and the supporting research.

Each year from 1999 through 2001, Soldiers attending four Infantry courses were surveyed: Infantry One Station Unit Training (OSUT), the Basic Noncommissioned Officer Course (BNCOC), the Advanced Noncommissioned Officer Course (ANCOC), and the Infantry Officer Basic Course (IOBC). A total of 2135 Infantrymen participated. In addition, in 2000 and 2001 Soldiers in non-mechanized and mechanized Infantry battalions within Forces Command (FORSCOM) were surveyed. The survey concentrated on computer use, ownership, and indicators of skill to include a short test on 18 common MicroSoft Windows-based icons such as “save”, “print”, “copy” and “spell-check.”

The Infantry course surveys showed an average yearly increase of 5% in computer ownership, going from 67% in 1999 to 77% in 2001. Ownership rates were highest for IOBC (81%) and

ANCOC (78 to 90%), followed by BNCOC (60 to 79%), and then OSUT (49 to 59%). In the FORSCOM sample, computer ownership also showed an average yearly increase of 5%, 52% to 57% from 2000 to 2001. Privates were the least likely to own computers (36%). Of the senior NCOs (staff sergeant through sergeant major), 87% owned computers. Of the officers, 96% owned computers.

Use of computers in high school was strongly related to the time period when the Soldiers attended high school. We estimated the year when the Soldiers in each Infantry course would have been in high school at age 17. Results showed that when the ANCOC Soldiers were in high school in the early 1980s, only 20% to 25% said they used computers. On the other hand, for the Soldiers who attended high school in the late 1990s, typically at least 80% used computers. Moreover, Soldiers who recently attended college used computers. For instance, of the lieutenants in IOBC, at least 85% used computers in college.

In contrast to using computers in high school, which varied with Soldier age, current use of computers was relatively high. In the last year of the Infantry course surveys (2001), 96% of the Soldiers in BNCOC, ANCOC, and IOBC stated they used a computer, while 86% of OSUT cited usage. In each year, the percentage of Soldiers indicating they used a computer was greater than the percentage saying they owned a computer. Home use was very common.

Of special interest was a finding from the FORSCOM surveys conducted in 2000, which showed the impact of the Soldiers' work environment on their computer background and experience. We compared corporals/specialists on the battalion staff to those in the maneuver company. These groups had similar backgrounds. They were the same age and the percentage that used computers at home was the same. Over half the corporals/specialists in the battalion staff were Infantry. Despite these similarities, 84% in the battalion staff said they used a computer at work, while only 16% within the Infantry company indicated such use.

We found that Soldiers used certain computer features or capabilities more frequently than others. The major trend over time was an increase in Internet and e-mail use.

Results on the indices of computer expertise, self-ratings and the icon test, were similar. The self-rating scale ranged from being a computer novice to have software programming skills. For both measures of computer expertise, the courses ordered from high to low, each year, as follows: IOBC, ANCOC, followed by BNCOC and OSUT. The second major trend was that the lowest groups improved most on these indices. The OSUT Soldiers improved on both indices. The BNCOC Soldier self-ratings increased in 2001, but their icon scores remained relatively constant over the three years.

For FORSCOM Soldiers, the higher the enlisted rank, the higher the self-ratings and the higher the icon scores. In addition, officers had the highest self-ratings and highest icon scores. These results were consistent with the Infantry course profiles.

Special mention was made of differences in computer use by corporals/specialists on the battalion staff and the corporals/specialists in the maneuver units, a difference that was probably a correlate of the opportunity to use computers as a staff member. This difference carried over to

the self-ratings and icon scores, with those in the battalion staff scoring higher. In the battalion staff, 74% rated themselves above the novice level, while only 42% did so in the maneuver companies. Similarly, those in the battalion staff averaged 60% correct on the icon test; those in the maneuver companies averaged 40% correct.

One of the remarkable outcomes of the trend analysis was the consistency in the findings.

- Consistent ordering by Soldier rank on computer ownership, and on both self-perceptions of skill and an objective index of computer expertise.
- Linear increase in percentage of Soldiers using computers in high school over a 25-year time span.
- Gradual increase in e-mail and Internet use.
- Gradual increase in computer experience – reflected in upward changes in self-perceptions and an objective index of expertise.
- Positive impact of the opportunity to use computers in a military environment upon perceived and actual expertise.

The conclusion at the end of the research in 2001 was that the Soldier population was becoming more computer literate, and that the ability to use the LW system would not be limited by Soldiers' computer skills. But it would be erroneous to conclude that all subgroups within this population were equally proficient with computers, or that the youngest Soldiers were the most proficient.

#### *Interactive Multi-Media Experiments on Training Digital Skills (1992- 2003)*

In 1999, ARI initiated a series of experiments examining how to apply interactive multi-media instruction in training Soldiers to interact with the LW system. A prototype interface was developed which served as the basis for the first experiments. Although based on exploring a prototype LW map interface, the research findings have general applicability to the training of digital skills. Another experiment examined how the message module within the prerequisite skill CD-ROM impacted a test of message skills.

Dyer, J. L., & Salter, R. (2001). *Working memory and exploration in training knowledge and skills required of digital systems*. (ARI Research Report 1783). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A399 507)

Dyer, J. L. (2001, Fall). Learning digital skills via computer-based training. *ARI Newsletter*, Volume 11 (4), 11-13.

Variations in computer-based training (CBT) procedures were compared in training the skills and knowledge required of a prototype map interface for the LW system. Soldiers from four Infantry courses participated, representing the chain of command within an Infantry platoon, from platoon leader to rifleman. These courses were the Infantry Officer Basic Course (IOBC), Advanced Noncommissioned Officer Course (ANCOC), Basic Noncommissioned Officer Course (BNCOC), and Infantry One Station Unit Training (OSUT).

Soldiers were first trained on codes that uniquely identified individuals and units on the map. Then they learned how to use map functions such as pan, zoom, determine range, and find individuals and units. Lessons that contained a large volume of information before Soldiers could apply that information and commit it to memory resulted in low scores on both the code and map exercises. Breaking the content into smaller chunks of information tended to be more effective. Although Soldiers who learned the map on their own via an exploratory condition had the lowest map performance, exploratory learning may have potential as these Soldiers spent relatively little time “exploring.” The results demonstrate the importance of adapting to individual differences in the learning rate of Soldiers. They also provide insights regarding how to design effective and efficient CBT for digital systems.

Dyer, J. L., Singh, H., & Clark, T. L. (2005). *Computer-based training approaches for training interactive digital map displays* (Research Report 1842). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A440 171)

Five computer-based training approaches for learning digital map skills were compared using Infantry One Station Unit Training (OSUT) and Infantry Officer Basic Course (IOBC) Soldiers. The map skills trained were the same (pan, zoom, find units) as in the Dyer and Salter experiment cited above. In general, the five training variations had similar effects for IOBC Soldiers, but differential effects for the OSUT Soldiers. Two conditions were effective for all: a traditional lesson followed by training exercises with feedback condition, and a guided-exploratory condition, where Soldiers solved problems using the map and were provided feedback on their performance. There were no formal lessons in this condition.

In the three other conditions, IOBC Soldiers performed significantly better than OSUT Soldiers. The difference between the two Soldier groups was greatest in the pure exploratory condition where no guidance and feedback were provided, and Soldiers simply “explored” the map to learn the different map functions. The other conditions where IOBC Soldiers performed better than OSUT Soldiers were a condition with lessons followed by letting Soldiers explore the map but no exercises were provided, and a condition where Soldiers could select their modes of training (lessons, exercises, exploration, and any combination of these training approaches).

The findings showed that OSUT Soldiers benefited from the more structured training environments which provided lessons and/or exercises with performance feedback. They also preferred the traditional lesson with exercise approach. OSUT Soldiers did not do well in conditions with less structure and conditions where they did not receive feedback on how they were doing. In addition, they did not prefer these training conditions. On the other hand, the findings showed that IOBC Soldiers did not necessarily require exercises, but did benefit from

them as well as from the lesson information, and performed well when they were able to control their training strategy.

Of interest was that the condition where Soldiers could select their own mode(s) of training produced different training strategies on the part of the OSUT and IOBC Soldiers. When able to select the mode of training, IOBC Soldiers used more consistent and fewer training strategies than did OSUT Soldiers. In fact, this condition was preferred by IOBC Soldiers.

The findings reinforce the need to tailor training when the Soldier target population is diverse, yet common skills and knowledge must be acquired. The results also suggested that giving the same training to all is not the most efficient, nor the most effective, nor the most motivating.

Dyer, J. L., Vaughan, A., & Blankenbeckler, P. (2004). *Training on Common Military Messages* (ARI Research Report 1817). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A419 918)

The experiment examined what inexperienced Soldiers learned from a computer-based training program on four common Army messages: spot report, nuclear/biological/chemical, call for fire, and medical evacuation. It also examined the ability of Soldiers to complete tactical messages based on hypothetical combat scenarios and a prototype digital interface for the LW system. The message training focused on the doctrinal requirements for messages, not how to use the software interface. Soldiers were from the Infantry One Station Unit Training (OSUT). The findings showed that inexperienced Soldiers have limited knowledge of common Army messages. Although the Soldiers learned from the message training, the doctrinal training per se was shown to be a necessary, but not a sufficient, condition for determining appropriate message content in hypothetical tactical situations. Soldiers also need training on digital message formats and menu selections, must possess the requisite military knowledge and experience, and have the ability to understand the battlefield situation and integrate critical elements of information. Additional research is needed on the types and length of training needed to prepare Soldiers to generate appropriate military messages.

*Work in Progress:*

*Embedded Training Rationale for the Ground Soldier System (2009)*

Embedded training was a key performance parameter in the Ground Soldier System (GSS) Capability Development Document CDD) (TRADOC, 2006). In the current GSS CDD (TRADOC, 2009), embedded training is not a requirement for Increment 1, but is cited as an attribute for Increment 2. The work to be presented in this report is a rationale for identifying which individual skills within the GSS are appropriate for embedded training. Although the analysis is not complete, it is cited here to provide a complete bibliography of ARI's work on dismounted Soldier systems with wearable computers. The rationale focuses on using embedded training as a means of sustaining GSS skills and tasks, not necessarily on using embedded training features to learn the skills and tasks initially. The prototype rationale includes two sets of questions. The first set of questions identifies which GSS skills warrant embedded training,

and the second set identifies the subset of those skills which are top priority for embedded training. The first questions focus on human performance and learning dimensions to narrow the possible set of skills for embedded training. For example, questions on skill decay, the frequency with which a task is performed, whether the task is self-cueing, and whether the task must be executed quickly and accurately are included. The subset of top priority skills/tasks are determined by their combat-relevance. To fall in this category, a task/skill must contribute to a Soldier's lethality, survivability, or both.

## Summary

Primary impacts of the research are summarized below.

- The early marksmanship work with prototype LW systems and night vision goggles and aiming lights led to a modified qualification course of fire for night firing in the marksmanship Field Manual (FM 3-22.9, Department of the Army, 2003, 2008).
- Research in 2000 with a platoon equipped with LW showed the importance of collective training, as individual skills did not automatically transfer to collective proficiency, with Soldiers and leaders not fully using the system's capability in the field. Also the time required for collective training was underestimated. These findings were replicated during NET with the Stryker Battalion in 2007. The training recommendation made at both time periods was to develop specific "problem-solving" field exercises that ensured Soldiers and leaders would apply system features to successfully complete a collective task or to overcome problems in executing collective tasks.
- All the research with units equipped with a LW system reinforced the need to systematically address leader training; to create a training program that enables leaders to effectively employ such systems and that provides them the necessary tools to conduct sustainment training.
- The identification of prerequisite skills required for Soldiers and leaders employing the LW system led to the creation of a multi-media training program on prerequisite skills and to more formal consideration of this requirement in later LW test events. This work also showed the importance of identifying the prerequisite skills for any new system and checking Soldier status on those skills.
- Research on training young Soldiers on sending digital messages showed that their limited military knowledge and experience inhibited performance, not the digital interface itself.
- The reduced exposure firing experiment is the only experiment that has systematically examined the potential of this LW capability, as well as the training required to execute these marksmanship skills successfully.

- The strategy developed for training computer-related map functions can be easily applied to future New Equipment Training and institutional training for dismounted Soldier systems. The strategy related non-digital knowledge of and skills with maps to digital versions of maps and map-related functions, increased the complexity of skills learned, and put skills in context of mission execution.
- Surveys of the computer skills of Soldiers conducted from 1999 to 2001 dispelled the widespread belief at the time that senior noncommissioned officers had weaker computer backgrounds than young enlisted Soldiers. Just the opposite was found to be the case.
- The computer-based training experiments, which varied the extent to which Soldiers had a structured environment for learning digital skills, illustrated the benefit from tailoring the training on such systems. In particular, structured training approaches worked best for young Soldiers where as officers benefited from less structured approaches.

## REFERENCES

- Copeland, D. (2007, May-June). Stryker unit deploys with Land Warrior: Getting dismounted Soldiers in the future network. *Infantry*, 96, 18-22.
- Department of the Army. (1989, July). *M16A1 and M16A2 Rifle Marksmanship* (FM 23-9). Washington, DC: Author.
- Department of the Army. (2003, April). *Rifle Marksmanship M16A1, M16A2/3, M16A4, and M4 Carbine* (FM 3-22.9). Washington, DC: Author.
- Department of the Army. (2008, August). *Rifle Marksmanship M16-/M4-Series Weapons* (FM 3-22.9). Washington, DC: Author.
- U.S. Army Training and Doctrine Command (TRADOC). (2006, September). *Capability Development Document (CDD) for the Ground Soldier System (GSS), Version 1.1*. Ft. Monroe, VA: Author.
- U.S. Army Training and Doctrine Command (TRADOC). (2009, April). *Capability Development Document for Ground Soldier System (GSS), Increment I*. Ft. Monroe, VA: Author.

## ACRONYMS

AAR	After Action Review
AMSAA	Army Materiel Systems Analysis Activity
ANCOG	Advanced Noncommissioned Officer Course
AOA	Analysis of alternatives
ARI	Army Research Institute
BNCOC	Basic Noncommissioned Officer Course
CBT	Computer based training
CCO	Close combat optic
CD	Compact disc
CDD	Capability Development Document
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities
EEA	Essential elements of analysis
FM	Field Manual
FORSCOM	Forces Command
GSS	Ground Soldier System
IMI	Interactive multi-media instruction
IOBC	Infantry Officer Basic Course
IOTE	Initial Operational Test and Evaluation
JCF AWE	Joint Contingency Force Advanced Warfighting Experiment
JRTC	Joint Readiness Training Center
LOMAH	Location of Miss and Hit
LW	Land Warrior
MANPRINT	Manpower and Personnel Integration
NET	New equipment training
NVGs	Night vision goggles
OC	Observer Controller
OSUT	One Station Unit Training
PM	Project Manager
RFI	Rapid Fielding Initiative

TCM	TRADOC Capabilities Manager
TRAC-WSMR	TRADOC Analysis Command-White Sands Missile Range
TRADOC	Training and Doctrine Command
TSM	TRADOC Systems Manager
TWS	Thermal weapon sight