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Assessment of New Marksmanship Strategies in 2010

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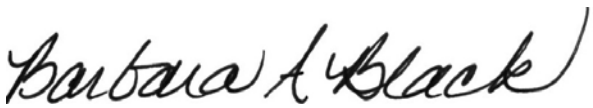

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14. ABSTRACT *(Maximum 200 words)*: In response to the Deputy Commanding General for Initial Military Training, new marksmanship strategies for Infantry One Station Unit Training (OSUT) and Basic Combat Training (BCT) were compared. OSUT Soldiers scored significantly higher than BCT Soldiers on Record Fire and Combat Field Fire (CFF) with the difference being substantial on CFF. The OSUT CFF scores supported the advanced rifle marksmanship (ARM) strategy which included different scenarios and more ammunition than the BCT ARM strategy. Results also supported the use of combat gear by OSUT in basic rifle marksmanship (BRM). Round allocation for grouping and zeroing was inadequate with 5-round shot groups. Overall, the Practice Record Fire and Record Fire patterns showed that Soldiers benefitted from Practice Record Fire. Equipment and time limitations hindered the ability to fully train optics for BCT Soldiers, and to train night fire with aiming lights and night vision goggles for both BCT and OSUT Soldiers. Soldiers also indicated they needed more training with this equipment. The CFF hit standard in the marksmanship FM was validated. Current and prior research on 3-and 5- round shot groups showed that similar numbers of shot groups were required to group and zero regardless of shot group size.

15. SUBJECT TERMS
rifle marksmanship, record fire, combat field fire, grouping, zeroing , combat equipment , basic rifle marksmanship, advanced rifle marksmanship, shot group size

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ASSESSMENT OF NEW MARKSMANSHIP STRATEGIES IN 2010

EXECUTIVE SUMMARY

Research Requirement:

In 2010, two new marksmanship strategies were developed, one for Infantry One Station Unit Training (OSUT) Soldiers and one for Basic Combat Training (BCT) Soldiers. The Infantry OSUT and BCT strategies in basic rifle marksmanship (BRM) were quite similar, but differed substantially in advanced rifle marksmanship (ARM). The major changes to the BRM program from the previous strategy involved switching from three-round to five-round shot groups and modifying Field Fire scenarios to include the kneeling position. OSUT Soldiers also started wearing their combat gear during BRM Field Fire, whereas that occurred for BCT Soldiers in the first period of ARM. In ARM, the OSUT and BCT live-five exercises differed and OSUT had substantially more ammunition. Combat field fire (CFF) was introduced in both strategies as the culminating event in ARM, with OSUT firing it twice and BCT firing it once. The Deputy Commanding General for Initial Military Training (DCG-IMT) requested the Army Research Institute conduct an assessment of the new strategies to determine Soldiers' performance on Record Fire and CFF, whether the allocation of ammunition for each marksmanship period was appropriate, and whether the time for each period was appropriate.

Procedure:

Six companies, three OSUT and three BCT, participated in the assessment, for a total of 598 OSUT Soldiers and 548 BCT Soldiers. Two BCT companies were gender integrated; the other four companies were all male. Every training period in each company was observed in its entirety. Formal data were obtained on grouping, zeroing, and confirmation of zero, Engagement Skills Trainer (EST) Field Fire scenarios, Practice Record Fire, Record Fire, and CFF. Data on live-fire Field Fire exercises were obtained on some, but not all, companies. Soldiers were given two questionnaires, one at the end of BRM and one at the end of ARM. Archival data from prior marksmanship research enabled a comparison of three- and five-round shot groups and an examination of whether the correlations among marksmanship performance measures were consistent over time.

Findings:

Infantry OSUT Soldiers scored significantly higher than BCT Soldiers on both Record Fire and CFF. The difference was substantial on CFF, supporting the additional rounds allocated to ARM exercises in the Infantry OSUT strategy. An unexpected finding was that the number of rounds allocated for grouping, zeroing, and confirmation of zero was insufficient for each strategy, yet the problem was more serious for BCT companies. Two other resource constraints also negatively impacted the strategies: insufficient time was allocated for OSUT to group and zero with both the back-up iron sight and the close combat optic, and night equipment quantities were insufficient for both OSUT and BCT. As the infrastructure was not in place for all changes in the new strategies, work-arounds were required on some installations in selected

marksmanship periods. These work-arounds were close to the strategy but not identical. Additional analyses showed that Soldiers benefited from firing two Practice Record Fire iterations; very few Soldiers scored in a lower marksmanship category in Record Fire than in Practice Record Fire. The CFF standard for successful hit performance as documented in the marksmanship field manual was verified. Comparison of three- and five-round shot groups showed consistencies in the data regarding the number of shot groups required to group and zero regardless of the number of rounds in the shot group (i.e., 3 or 5 rounds). Correlations among measures of performance in the major marksmanship periods showed the difficulty in predicting marksmanship performance, as early measures of performance did not correlate with later performance measures.

Utilization and Dissemination of Findings:

The findings were briefed to the DCG-IMT, the Commander of the Maneuver Center of Excellence, Commandant of the Infantry School, Commandant of the Armor School, each Battalion Commander, and the company leaders. The decision was made to continue with the Infantry OSUT strategy which involved more rounds, primarily in ARM, and had Soldiers fire in combat gear in BRM. Initiatives were initiated to upgrade firing range and EST capabilities to enable full execution of the strategies. The historical comparisons of shot group size and correlations between measures of performance throughout marksmanship training provide a basis for comparison with future marksmanship research which may address these issues.

ASSESSMENT OF NEW MARKSMANSHIP STRATEGIES IN 2010

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Assessment of New Marksmanship Strategies in 2010

From a historical perspective, it is not unusual to make changes in marksmanship training programs. Such changes can involve courses of fire, targetry systems, and training devices. For example, the report by Dyer, Schaefer, Bink, James, Wampler and Dlubac (2010) described the changes over a period of 70 years, from 1940 through 2008, in the course-of-fire used for marksmanship qualification. Other examples of changes to marksmanship training over time include the incorporation of the Engagement Skills Trainer 2000 (EST 2000, a marksmanship simulator) for portions of marksmanship training, moving target exercises for Infantry One Station Unit Training (OSUT), transition to use of night vision goggles and aiming lights for night firing, use of the location of miss and hit (LOMAH) technology on live-fire ranges, and introduction of advanced rifle marksmanship (ARM) in Basic Combat Training (BCT).

The research reported in this document represents an assessment of revisions to the marksmanship strategies for Initial Entry Training (IET) Soldiers instituted in 2010. The report also documents unexpected issues that arose in the initial implementation of these strategies. Lessons learned during the assessment impacted recommendations for revising the strategies. Both the Infantry OSUT strategy and the BCT strategy for non-Infantry Soldiers were examined. Although marksmanship is a common skill for all Soldiers, historically, Infantryman in Infantry OSUT have received more and/or different marksmanship training than other IET Soldiers. The two strategies examined in the assessment continued to reflect these differences.

Overview of New Marksmanship Strategies

The Army instituted new marksmanship strategies in BCT and Infantry OSUT in July 2010 that modified the existing strategies. The changes reflected several initiatives that had emerged since approximately 2003. Some changes were implemented in a few training companies prior to 2010, but had not been formally approved for use in all companies. The marksmanship strategies proposed in 2010 were intended to "standardize" the marksmanship training programs for BCT and Infantry OSUT.

The major changes common to both the BCT and Infantry OSUT strategies were:

- Change to 5-round from 3-round shot groups for grouping and zeroing in basic rifle marksmanship (BRM).
- Inclusion of kneeling position in Field Fire scenarios (EST 2000 and live-fire).
- Inclusion of Combat Field Fire (CFF, see FM 3-22.9, Change 1, Department of the Army [DA] 2011) in ARM; BCT companies fired CFF once and OSUT Soldiers fired CFF twice.
- Inclusion of barrier shoots in ARM, but with more in Infantry OSUT than in BCT.

Major differences in the two strategies, which also reflected differences from the prior strategies, were:

- In BRM, Infantry OSUT used a 200m zero; BCT used a 300m zero.
- Infantry OSUT Soldiers put on their combat gear (helmet, body armor, MOLLE [Modular lightweight load-carrying equipment] elbow and knee pads) during Period 7 (Field Fire II – EST) in BRM and wore it through all remaining periods in BRM and ARM, whereas BCT Soldiers put on their gear later, during the first period of ARM.

- The primary sight for Infantry OSUT Soldiers was the CCO (Close combat optic, M68); the primary sight for BCT Soldiers was iron sights (either carrying handle M16A2 or backup iron sight [BUIS] for the M16A4 or M4MWS [modular weapon system]). OSUT Soldiers grouped and zeroed with both the CCO and BUIS, but used the CCO throughout the remainder of BRM (including qualification) and ARM, while BCT Soldiers fired with iron sights throughout BRM and received some training on the CCO during ARM.
- The ARM strategies differed considerably, with Infantry OSUT focusing on skills that supported CFF (e.g., multiple barrier shoots, rapid magazine changes, and malfunction drills), the culminating exercise in ARM, as well as moving targets, reflexive fire, and night fire. BCT ARM included a variety of training periods including exposure to optics and barrier shoots. CFF was also the culminating exercise in BCT ARM.
- Lastly, Infantry OSUT had substantially more ammunition per Soldier in ARM than did BCT. The ammunition allocations per Soldier were as follows:

BCT BRM:	310 rounds	OSUT BRM:	370 rounds
BCT ARM:	190 rounds	OSUT ARM:	360 rounds
BCT Total:	500 rounds	OSUT Total:	730 rounds

The BRM ammunition differences simply reflect the fact that the Infantry OSUT strategy called for zeroing and grouping with two sights, whereas BCT Soldiers used only one sight. However, the ARM ammunition differences resulted from the different training strategies for OSUT and BCT. During 2010, ammunition costs had increased and there was considerable interest in whether the ammunition allocations were appropriate in the two strategies.

For Practice Record Fire and Record Fire, the two strategies were the same and did not change. Soldiers fired the Record Fire course as specified in the current marksmanship FM (DA, 2008). In addition, consistent with prior strategies, two Practice Record Fires were executed.

Purpose of the Assessment

The Deputy Commanding General for Initial Military Training (DCG-IMT) requested the Army Research Institute (ARI) examine the new marksmanship strategies. The three primary questions were:

- Whether there were differences between BCT and Infantry OSUT Soldiers on the first attempt at Record Fire (qualification) and on CFF,
- Whether the ammunition allocated for each marksmanship period was appropriate, and
- Whether the time allocated for each period was appropriate.

The participating companies were among the first to implement the strategies. Since there was no opportunity for these training companies to execute the strategies prior to the start of the assessment, a secondary, yet critical, objective was to identify execution problems associated with the new strategies. These problems could reflect misinterpretation of new scenarios and training objectives, resource issues other than ammunition and time, sequencing issues, failure to train skills or insufficient training of skills, issues with new scenarios/courses of fire, etc.

The marksmanship effort also enabled an examination of other marksmanship questions. One question was whether five-round shot groups for grouping and zeroing were more efficient than three-round shot groups. One of the assumptions behind the change in the number of rounds was that it would be easier for a Drill Sergeant to determine where a Soldier was aiming with five rounds than with three rounds. Another view was that the number of attempts to group or zero (i.e., the number of shot groups) was the more important factor. The standards for grouping and zeroing in the program of instruction (POI) had not been validated, so it was important to examine the percentage of Soldiers who achieved the standards. These data were compared to some available historical data to provide insights to these issues.

A second question was the extent to which the marksmanship category of a Soldier changes from practice record fire to record fire. Does the "pressure" to qualify negatively impact a Soldier's performance? We could find no prior marksmanship research that addressed this question, but were able to do so in the current research as results on both iterations of Practice Record Fire and Record Fire were obtained. A third question was whether the standards developed for CFF in the prior Dyer et al. (2010) research would be replicated with this sample of Soldiers. A fourth question related to Soldier's reaction to firing in combat gear. A controlled experiment of the effects of combat gear on marksmanship performance was not possible, so this question was investigated with Soldier surveys and semi-comparable performance data. Confounding factors were that the BCT and OSUT samples represent different Soldier populations and different rifle sights were used (iron sights with BCT Soldiers and CCO with OSUT Soldiers).

Method

Participants

Three IET companies from Infantry OSUT and three IET companies from BCT participated. The Infantry OSUT companies were from Ft. Benning, GA. The BCT companies were from Ft. Benning, GA, Ft. Jackson, SC, and Ft. Leonard Wood, MO. All Infantry OSUT Soldiers were male. Two BCT companies were gender integrated; the third was all male.

In BRM, OSUT company sizes ranged from 189 to 215 Soldiers for a total of 598; BCT company sizes ranged from 159 to 182 for a total of 548. The number of Soldiers participating in ARM from each company was smaller. In ARM, OSUT company sizes ranged from 167 to 197 for a total of 544; BCT company sizes ranged from 125 to 187 for a total of 478.

Research Design

Given that IET marksmanship training is 16 to 17 days in length and the companies typically conduct BRM and ARM as a single block of training, the plan was to have one OSUT and one BCT company execute marksmanship training each month, for a total of three consecutive months. This plan was executed, with one exception - the third BCT company distributed its marksmanship training over two months (see Table 1). The training was conducted in the summer, and the weather was extremely hot and humid.

Table 1
Assessment Time Line

Unit	July	August	September
OSUT	OSUT Co #1	OSUT Co #2	OSUT Co #3
BCT	BCT Co #1	BCT Co #2	
		BCT Co #3	

BCT s

trategy.

The BCT strategy is shown in Table 2 by each period, day(s) of instruction and number of rounds allocated. For example, BRM Period 4, grouping and zeroing at 25m, was scheduled to be completed in three days. Confirm zero (BRM Period 5) at 175m and at 300m was to be conducted in two days. Night shooting was done with aiming lights and night vision goggles. Once Soldiers donned their combat equipment in the first ARM period, they remained in this gear for the remaining ARM periods.

Table 2
BCT Marksmanship Strategy

BRM (13 days)			ARM (7 days)		
Period/ Day	Description	Rounds	Period/ Day	Description	Rounds
1/1	Introduction/Fundamentals	0	1/1	EST – in combat equipment – FFII scenario	0
2/2	Range Procedures & Fundamentals	0	2/2	Introduction to Optics and Lasers	0
3/3	Range Procedures & Fundamentals and EST 2000 grouping	0	3/3D	Zero CCO	20
4/4-6	Group / Zero BUIS (backup iron sight)	15/15	3/3N	Zero aiming light	20
5/7-8	Confirm Zero at 175m / at 300m	20/20	4/4D &4N	Engage targets (new scenario)	20/20
6/9	Field Fire I (revised scenario)	40	5/5D &5N	Reflexive fire	30/20
7/10	Field Fire II (EST) – revised scenarios for single and multiple target tables	0	6/6	Barrier Shoot (new scenario)	30
8/11	Field Fire II – revised single and multiple target tables- 40 rds each	80	7/7	CFF (new)	30
9/12	Practice Record Fire – execute twice 40 rds each	80			
10/13	Record Fire	40			
Total Rounds		310	Total Rounds		190

Note. The periods labeled 3D and 3N, 4D and 4N, and 5D and 5N specify day and night training and indicate that the Soldiers had three consecutive days of day-night firing.

Infantry OSUT strategy.

The Infantry OSUT marksmanship strategy is shown in Table 3. Once Soldiers donned their combat equipment in the BRM Period 7, they remained in that gear for the remainder of marksmanship training. The numbers in parentheses after the title for some periods indicate the rounds allocated for different firing tables or distances. In some cases, two numbers are cited when Soldiers had to execute a firing table or course-of-fire twice.

Table 3
Infantry OSUT Marksmanship Strategy

BRM (13 days)			ARM (6 days)		
Period/ Day	Description	Rounds	Period/ Day	Description	Rounds
1/1	Introduction/Fundamentals (w/ CCO)	0	1/1	EST Rapid Aim Fire	0
2/2	Range Procedures & Fundamentals	0	2/2D	Rapid Aim Fire (14/16/30)	60
3/3	Range Procedures & Fundamentals and EST 2000 grouping	0	2/2N	Rapid Aim Fire (20/20)	40
4/4-6	Group/Zero BUIS (15/15)	30	3/3D	Barrier Shoot (30/30)	60
	Group/Zero CCO (15/15) 10 additional rounds	30 (10)	3/3N	Barrier Shoot (20/20)	40
5/7-8	Confirm Zero – BUIS at 100 and 200m (15/15)	30	4/4	Moving Targets	40
	Confirm Zero – CCO at 100 and 200m (15/15)	30	5/5	Barrier Shoot (30/30)	60
6/9	Field Fire I (revised scenario)	40	6/6	CFF (new) – execute twice (30/30)	60
7/10	Field Fire II (EST) – revised scenario for single and multiple target tables; in combat equipment	0			
8/11	Field Fire II – revised single and multiple target tables, 40 rds each	80			
9/12	Practice Record Fire – execute twice, 40 rds each	80			
10/13	Record Fire	40			
Total Rounds		370	Total Rounds		360

Note. The periods labeled 2D and 2N, and 3D and 3N indicate that the Soldiers had two consecutive days of day-night firing.

Comparison of the BCT and OSUT strategies.

Table 4 compares the sequence and content of the two strategies. Although the titles of some periods are the same, the conditions were not necessarily identical. For example, although BRM grouping and zeroing periods occurred at the same point in training, BCT Soldiers only had iron sights while OSUT Soldiers had both the BUIS and CCO. In BRM, the same scenarios were conducted from the EST Field Fire II period through Record Fire, but OSUT Soldiers were in combat equipment while BCT Soldiers were not. Clearly in ARM, there were fewer similarities in terms of content and sequence. For both types of units, the final training period

was CFF. The scenario was the same and all Soldiers wore combat gear, but BCT units fired CFF once while OSUT units fired it twice.

Table 4
Comparison of the Content and Sequence in the BCT and OSUT Strategies

BRM		ARM	
BCT	OSUT	BCT	OSUT
Introduction/Fundamentals	Introduction/Fundamentals (w/ CCO)	EST Field Fire II (in gear)	EST Rapid Aim Fire
Range Procedures & Fundamentals	Range Procedures & Fundamentals	Introduction to Lasers and Optics	Rapid Aim Fire (Day and Night)
Range Procedures & Fundamentals, EST grouping	Range Procedures & Fundamentals, EST grouping	Zero CCO Zero aiming light (Night)	Barrier Shoots (Day and Night)
Group/Zero BUIS	Group/Zero BUIS; Group/Zero CCO	Engage targets (Day and Night)	Moving Targets
Confirm Zero BUIS	Confirm Zero – BUIS Confirm Zero – CCO	Reflexive fire (Day and Night)	Barrier Shoots
Field Fire I	Field Fire I	Barrier Shoot	CFF - execute twice
EST Field Fire II	EST Field Fire II (in gear)	CFF- execute once	
Field Fire II	Field Fire II		
Practice Record Fire – execute twice	Practice Record Fire – execute twice		
Record Fire	Record Fire		

Firing tables.

All firing tables and standards used in both strategies are documented in Appendix A. To complete the historical record, any changes from prior firing tables are also shown, specifically the Field Fire tables.

Measures.

Soldier performance. The primary measures of Soldier performance in BRM were: number of rounds to group, number of rounds to zero, the two Practice Record Fire scores, Record Fire scores, and number of attempts to qualify. Where possible EST 2000 and Field Fire II scores (BRM 7-8) were obtained. In general, these measures provided comparative data for BCT and Infantry OSUT. The only common measure obtained in ARM was the CFF score, as the substantial differences in the ARM strategies did not provide any other comparable measure.

Soldier questionnaires. Soldiers were given two questionnaires, one after completing BRM and one after completing ARM. Each questionnaire focused on the marksmanship training just completed. The ARM questionnaire also included items that covered all marksmanship training. Wherever possible, questions were the same for OSUT and BCT Soldiers, but given the

different strategies some questions were unique to each unit. These questionnaires are in Appendixes B and C.

Many items queried the Soldiers regarding whether they needed more practice on the specific skills trained in BRM and ARM, as was done in the Dyer et al. (2010) research on CFF. In addition, there were specific questions on whether use of combat equipment interfered with shooting skills and at what point in training the Soldiers adapted to their combat equipment. In the ARM questionnaire, Soldiers were also asked to compare Record Fire to CFF in terms of difficulty and impact on their confidence levels. The next to the last question in the ARM questionnaire had Soldiers rate their level of marksmanship skill at three time points: the start of training, at the end of BRM, and at the end of ARM. The last question asked Soldiers to identify an experience or point in time in training when they had a big increase in their shooting ability.

Training observations. The POI for each strategy specified the overall training objective for each training period, the enabling learning objectives (ELOs), basic training guidance, firing tables, standards, and resources. This information was then converted into an observation form. Checklist items to tabulate what actually occurred during the training for each ELO were developed. Daily ammunition consumption and the time to execute each phase of the training periods were recorded. The number of Soldiers, number of drill sergeants, and major training conditions (weather, name of range) were also recorded. Provision was made for recording additional details that explained deviations from the POI, such as sudden closing of ranges due to computer malfunctions or lightning, and unexpected resource limitations.

One individual from the research team was the primary point of contact for each company and this individual was also responsible for maintaining the daily observation records of training for that company. To illustrate the basic record format, one of the observations forms (BCT ARM Period 6 Barrier Shoot) is in Appendix D. To account for every marksmanship period, 33 similarly formatted observation forms were developed: ten forms for each BRM period in BCT and OSUT, plus seven for BCT ARM periods and six for OSUT ARM periods.

Procedures.

Coordination was conducted with the leaders (company commander and first sergeant) and drill sergeants of each company. We explained the purpose of the research, the data we would be collecting, and how we would interface with the company throughout the research. Every period of instruction was observed as it was important to document how the training was executed and any unexpected problems occurring with the strategies.

For the initial coordination with the units, we developed a one-page summary of each period of instruction that presented the major objectives, standards, ammunition requirements, firing tables (if any), the data we would be collecting, and any assumptions made regarding how training would be executed in order to obtain the necessary data. Any scheduled training observations were also cited on this summary. This document also facilitated the day-to-day coordination with each company. An example of this form is in Table 5, which depicts Practice Record Fire and Record Fire periods. As shown, during both periods Soldier scores were obtained, but during Record Fire, a questionnaire was also administered. The number of

researchers required for each period of instruction varied from one to three depending upon the extent of the data collection requirement.

Table 5
Example of Coordination Sheets (BRM Periods 9 and 10)

Period	IN OSUT BRM Strategy		Performance Data Collection	Standards
	Training	Ammunition		
9	Practice Record Fire I / II IBA / MOLLE / ACH	20 rounds prone sandbag supported 10 rounds prone unsupported 10 rounds kneeling (fired twice)	Computer printouts per firing order for both iterations Training time	Obtain at least 23 target hits on the 40 targets exposed **<u>Questions, Assumptions & Data Collection Procedures</u>** **Assumptions** • The Company will form the Soldiers into firing orders based on number of firing points available • Companies will use computer printouts to provide feedback to Soldiers immediately after each iteration of practice record fire **Procedures** • ARI receives a computer printout per firing order • ARI will annotate Soldier's roster number on printout in conjunction with Company feedback procedure
10	Record Fire IBA / MOLLE / ACH	20 rounds prone sandbag supported 10 rounds prone unsupported 10 rounds kneeling	Computer printouts per firing order per iteration Training time Soldier Questionnaire	Obtain at least 23 target hits on the 40 targets exposed **<u>Questions, Assumptions and Data Collection Procedures</u>** **Assumptions** • Soldiers will be available for a survey **after** they have qualified **Procedures** • ARI receives a computer printout per firing order • ARI will annotate Soldier's roster number on printout in conjunction with Company feedback procedure • Questionnaire procedures (After the Soldier has qualified; participation is voluntary) o Soldiers will move by firing order to the mess area on Range X o Soldiers will be administered questionnaire (everything provided by ARI) o Upon completion Soldier will be told to report to the bleacher area

Results

Record Fire Performance

Record Fire results.

Record Fire was examined in terms of the percentage Soldiers who qualified on the first attempt at Record Fire and the mean first attempt scores (see Table 5). Table 5 also presented the percentages of Soldiers who qualified as Expert, Sharpshooter, or Marksman, and those who did not qualify on their first attempt. OSUT scores were significantly higher than BCT scores on the first attempt to qualify, although the difference was not sizeable. It is important to note that OSUT Soldiers fired in full combat gear, whereas BCT Soldiers did not. Also, due to ammunition shortages, one of the OSUT companies fired only one, not two, iterations of Practice Record Fire.

Table 6
Record Fire Results

Strategy	% Soldiers Qualified on First Attempt at Record Fire[a]	*M (SD)* [b]	*N*	95% CI
OSUT	Total: 81.4% Expert: 6.7% Sharpshooter: 36.1% Marksman: 38.6% Unqualified: 18.6%	27.77 (5.89) *SE* = 2.5	598	[27.28-28.25]
BCT	Total: 75.4% Expert: 5.3% Sharpshooter: 25.9% Marksman: 44.2% Unqualified: 24.6%	26.20 (6.24) *SE* = 2.6	548	[25.69-26.71]

Note. Maximum possible score on Record Fire is 40 hits. Expert (36-40), Sharpshooter (30-35), Marksman (23-29), Unqualified (22 and below).

[a] % qualifying: $\chi^2(1) = 6.26$, $p < .01$

[b] Mean score: $F(1, 1144) = 19.17$, $p < .000$, $ES = .24$

The percentage of Soldiers in the four marksmanship categories showed that the primary difference between OSUT and BCT was a higher percentage of Sharpshooters and fewer Marksmen and Unqualified Soldiers in OSUT. The percentage of Experts was similar.

Since we collected data on each Practice Record Fire as well as Record Fire, we examined the extent to which scores were consistent across these three firings. The correlation between actual scores on Practice Record Fire and Record Fire was .46 for all Soldiers, regardless of whether it was the first or second Practice Record Fire. For BCT the correlations with Record Fire were .49 and .54 respectively for the first and second Practice Record Fire; for OSUT the corresponding correlations were .41 and .34. The correlation between the two Practice Record Fire scores was .60 for all Soldiers (.62 for BCT and .58 for OSUT).

Practice Record Fire and Record Fire patterns.

The company means in Appendix H indicate that performance improved from Practice Record Fire to Record Fire. For each company, the Record Fire mean was higher than both Practice Record Fire means, indicating that marksmanship performance improves with practice and Soldiers continue to learn.

We also knew that decision-makers and leaders were interested in the extent to which Soldiers change marksmanship category from Practice Record Fire to Record Fire. The option of taking the highest score from the two Practice Record Fire iterations and Record Fire as the qualifying score rather than the single Record Fire period has been discussed, because of concerns that the "pressure" of qualifying (an IET graduation requirement) negatively impacts Record Fire performance and such a course of action could save ammunition. Consequently, we examined Practice Record Fire and Record Fire patterns. We were unable to find any prior research on this issue. For research purposes, and consistent with FM 3-23.9 (2008); the policy in existence during the research was that the first attempt at Record Fire determined the Soldier's score and marksmanship category. Refires were allowed on Record Fire to qualify, but Soldiers were given "Marksman" status upon refiring regardless of the actual refire score and corresponding marksmanship category.

In general, the results of the analysis showed that Soldiers benefited from having Practice Record Fire (see Table 7). It is important to reinforce the point that Soldiers are not assigned a marksmanship category until Record Fire, but in order to analyze the relationship between the two sets of measures we made such an assignment. The correspondence between the marksmanship categories for Practice Record Fire and first attempt at Record Fire was determined as follows. First, the Soldiers were divided into two groups – those who qualified on the first attempt at Record Fire and those who did not. Second, within each group, Soldiers were then divided by the period where they had the highest marksmanship category – in Record Fire or in Practice Record Fire. Third, each grouping was further subdivided to provide more detail on the Practice Record Fire and Record Fire patterns, yielding a total of 5 groups (Table 7).

Of those who qualified on the first attempt, the Record Fire category was the highest for about half, while the Record Fire category was the same as at least one Practice Record Fire for the other half. As shown, only small percentage of Soldiers who qualified on the first attempt did better in Practice Record Fire (11% in OSUT, 6% in BCT).

OSUT Soldiers who did not qualify on the first attempt were about equally split between those who had the equivalent of a qualifying score in Practice Record Fire and those who did not. In contrast, for BCT Soldiers a higher percentage did not have the equivalent of a qualifying score in Practice Record Fire. Even if Soldiers had a "qualifying score" in Practice Record Fire, further analysis showed that the qualifying score typically corresponded to the category of Marksman (87% in BCT and 74% in OSUT). Thus the failure to qualify on the first attempt at Record Fire could be perceived as being consistent with their relatively low level of marksmanship skill.

Of the five groups displayed in Table 7, a Practice Record Fire category was higher than Record Fire in only two groups, accounting for a total of 20% and 14% of the Soldiers in OSUT and BCT respectively. The percentages of Soldiers in these two groups are in italics and shaded in gray in Table 7.

Table 7
Relationship Between Practice Record Fire and Record Fire Marksmanship Categories

Practice Record Fire and Record Fire Patterns	% Soldiers	
	OSUT	BCT
Soldiers who qualified in first attempt at Record Fire	[80]	[74]
Highest category in record fire Examples[a]: MMS, UUM, SSE, MSE, SME	35	34
Record Fire category same as at least one Practice Record Fire category Examples: MMM, SSS, UMM, MUM	34	34
Practice Record Fire category higher than Record Fire Examples: MSM, SSM, SEM, USM	*11*	*6*
Soldiers who did not qualify in first attempt at Record Fire	[18]	[24]
"Had "qualifying" score in Practice Record Fire Examples: MMU, UMU	*9*	*8*
Did not have a "qualifying" in Practice Record Fire: UUU	9	16
Total number of Soldiers	[98]	[98]

Note. Percentages are the average of the company percentages, and compiled from results from 598 OSUT Soldiers and 548 BCT Soldiers. Highlighted and italicized percentages indicate where a Practice Record Category was higher than Record Fire category.

[a] Definition of patterns. Marksmanship categories assigned to practice record fire scores for analytic purposes only; Categories are officially determined in Record Fire (qualification).

"MMS" means a Soldier's score corresponded to Marksman (M) on both Practice RF1 and 2, and Sharpshooter (S) on record fire.

"UUM" means a Soldier's score corresponded to Unqualified (U) in both Practice RF1 and 2, and Marksman (M) on record fire.

"SME" means a Soldier's score on practice RF1 corresponded to Sharpshooter (S), score on practice RF2 corresponded to Marksman (M), and Expert (E) on record fire.

CFF Performance

CFF results.

For CFF, hits and kills were examined (Table 8). Both hits and kills for OSUT Soldiers were significantly higher than for BCT Soldiers. In addition, as indicated by the effect size (ES), the difference was substantial. In general, an effect size of .92 (see note to Table 8) means that about 82% of individuals in one group are below the average of individuals in the comparison group (Coe, 2002). This was confirmed in the present research, with 84% of the BCT Soldiers actually below the average OSUT Soldier. The frequency distributions for Iteration 1 CFF hits for the OSUT and BCT Soldiers graphically illustrate this difference between the two units (see Figure 1). In addition, OSUT Soldiers improved from the first to the second iteration of CFF (see last two rows in Table 8).

Table 8
CFF Results

Strategy	Iteration 1				
	Hits [a] *M(SD)*	Kills [b] *M(SD)*	% Go (16 hits, 7 kills)	95% CI	*N*
OSUT	17.64 (4.05) *SE* = .21	9.04 (2.66) *SE* = .13	Hits: 70% Kills: 82%	Hits: [17.24-18.05] Kills: [8.80-9.29]	544
BCT	12.67 (5.58) *SE* = .23	6.08 (3.27) *SE* = .14	Hits: 35% Kills: 46%	Hits: [12.11-13.12] Kills:[4.80-6.36]	433
Iteration 2 – OSUT only [c]					
OSUT	18.88 (3.63) *SE* = .16	9.83 (2.42) *SE* = .11	Hits: 83% Kills: 92%	Hits: [18.57-19.20] Kills: [9.62-10.04]	512
Iteration 1 results for the 512 OSUT Soldiers who fired Iteration 2					
OSUT	17.62, (4.03) *SE* = .18	9.03 (2.66) *SE* = .12	Hits: 70% Kills: 83%	Hits: [17.26-17.97] Kills: [8.80-9.26]	512

[a] Iteration 1: Hits – $F(1,975) = 260.15$, $p < .000$, $ES = .92$
[b] Iteration 1: Kills – $F(1,975) = 244.02$, $p < .000$, $ES = .90$
[c] Statistics based on repeated measures analysis on Soldiers who fired both iterations of CFF (n =- 512). For hits $F(1,511) = 59.07$, $p < .000$. For kills $F(1,511) = 49.27$, $p < .000$. Total of 534 Soldiers fired the second iteration for CFF: Mean = 18.85 for hits and 9.80 for kills, with 83% getting a Go on hits and 92% a Go on kills.

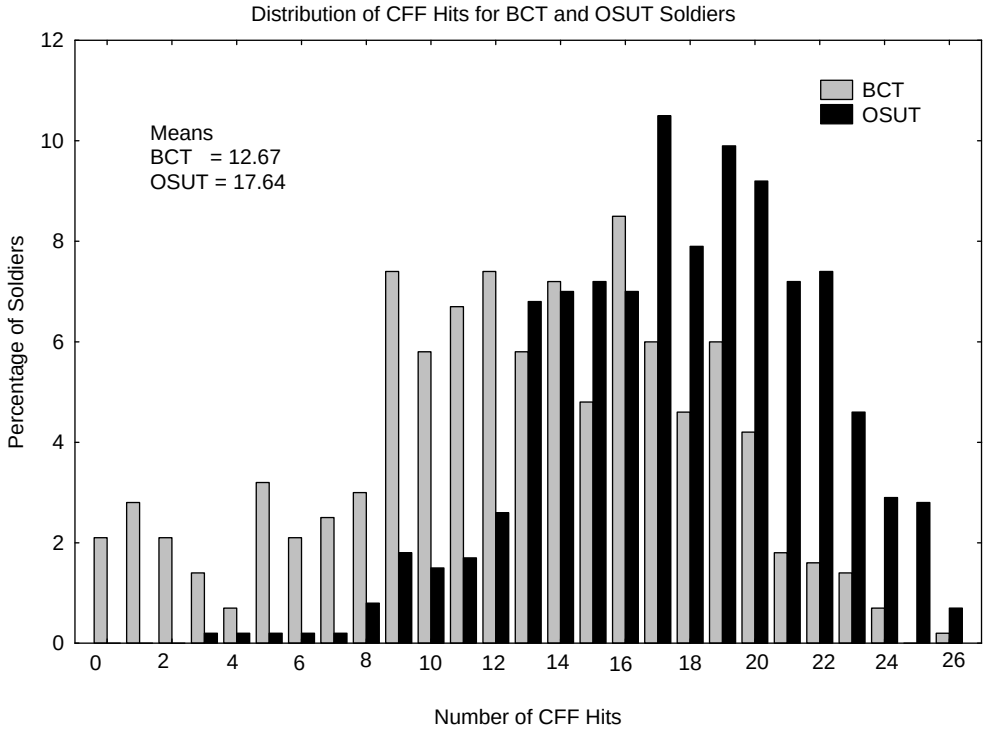

Figure 1. Frequency distribution of CFF hits (Iteration 1) for BCT and OSUT Soldiers.

Although the OSUT Soldiers scored significantly higher on Record Fire than the BCT Soldiers, the difference was not substantial (effect size of .24). However, for CFF, the effect size was very high (.90 and .92). Thus substantial differences in OSUT and BCT Soldier skill at the end of BRM were probably not the reason for the CFF differences. Prior CFF research (Dyer et al., 2010) indicated that practice in CFF-related skills was necessary to perform well. The ARM exercises in OSUT which focused on the necessary, more complex marksmanship skills required by CFF, in conjunction with more iterations of these exercises because of the greater allocation of rounds in the OSUT strategy, appeared to contribute to the substantial differences between OSUT and BCT Soldiers on CFF. Consequently, the OSUT ARM strategy appeared to be the more effective strategy for developing skills supporting the CFF scenario than the BCT strategy.

The CFF standard.

Data were also obtained on the CFF standard. The initial work on CFF (Dyer et al., 2010) specified a standard based on hits. In that research, three options were presented to decision-makers based on the degree of discrimination in performance that was desired: marksmanship categories (Expert, Sharpshooter, Marksman, Unqualified), TPU (trained, needs practice, and untrained), and "Go/NoGo." Regardless of the option, the cutpoint for "acceptable" performance was a minimum of 16 hits.

However, the new marksmanship strategy specified a "Go" on CFF in terms of kills, with a minimum of 7 kills being the requirement. On the first iteration, 82% of the OSUT Soldiers had a "Go" versus 46% for the BCT Soldiers, consistent with the statistical difference between mean kill scores (see Table 8). For OSUT Soldiers the percentage achieving a "Go" on kills for the second iteration of CFF increased to 92%.

In the original CFF research (Dyer et al., 2010), the CFF hit standards were empirically related to the scores from the first attempt at record fire. Specifically the percentage of Soldiers within each marksmanship category was applied to the CFF hit frequency distribution from the second firing iteration, as the first iteration was considered similar to a practice fire. To illustrate this approach, about 25% of the Soldiers did not qualify on Record Fire (Dyer et al., 2010). This percentage was then applied to the CFF distribution of hits to determine the cutpoint for Soldiers who would be considered unqualified on CFF. It was determined that 25% of the Soldiers had hit scores below 16 on CFF, making 16 hits the cutpoint for acceptable versus unacceptable performance. This cutpoint was accepted by the Infantry School and documented in Change 1 to FM 3-22.9 [DA 2011, CFF scorecard 7682-R where the TPU standard (trained, needs practice, untrained) was applied]. For TPU, T was 24 to 26 hits, P was 16 to 23 hits, and U was 15 hits or less.

When the same analytic methodology was applied to the current data, the cutpoint of 16 hits was replicated. Specifically, on the second CFF iteration for all OSUT Soldiers, 83% had 16 points or more on CFF, which corresponded to the 81% of OSUT Soldiers who qualified on the first iteration of record fire (see Table 6). In addition, the cutpoint of 16 hits was replicated for each of the three OSUT companies in the current research.

Because kills are not a linear transformation of hits (e.g., some targets require more than one hit for a kill, the range of possible scores is smaller for kills than hits), a direct correspondence between the two criteria does not exist. The percentage of Soldiers with a "Go" was expected to vary with the two scores. In comparing the criteria of 7 kills and 16 hits using the first CFF iteration, the cutpoint of 7 kills was shown to be an easier criterion than 16 hits, regardless of Soldier population. With 16 hits, 70% of OSUT Soldiers had a "Go," and 35% of BCT Soldiers had a "Go." The percentage of Soldiers who met the hit criterion was approximately 11 to 12% lower than the corresponding percentage for 7 kills (Table 8). Further analyses showed that 8 kills was more equivalent to 16 hits than 7 kills. If the kill criterion were raised to 8 kills, then the "Go" percentages were 36% for BCT and 71% for OSUT.

Although kills are not a linear transformation of hits, the correlation between CFF hits and kills for all Soldiers was high (r = .98). It was .96 for both the BCT and CFF Soldiers.

Ammunition Consumption

A primary question was whether the additional ammunition for OSUT Soldiers in ARM (170 rounds) was warranted. The performance results on CFF showed that the additional live-fire training exercises prepared the OSUT Soldiers for this culminating exercise and that the ammunition was warranted (see Table 8).

However, the ammunition question covered other periods as well. In the marksmanship strategy there are certain periods where the number of rounds each Soldier fires cannot be pre-determined, only estimated. These periods are grouping at 25m, zeroing at 25m, confirmation of zero, and Record Fire as the standards for these periods must be met. A Soldier must group before zeroing and must zero the rifle/sight before progressing to live-fire exercises. Soldiers must also confirm their zero at distance. As Record Fire is a graduation requirement, Soldiers must qualify and as indicated in the prior section on Record Fire, not all Soldiers qualify on the first attempt. Thus it was important to track the ammunition required to meet the standard for these periods. Although other periods have standards, the requirement to enforce the standards is not as critical as it is for grouping, zeroing, and record fire. Thus the allocation of ammunition for each Soldier is essentially "fixed" for these other periods.

Grouping and zeroing rounds.

POI standards for grouping and zeroing. Another unknown regarding the ammunition required for grouping and zeroing related to the change from three-round to five-round shot groups as well as new standards for the number of shot groups required to group and zero. The standard for grouping and zeroing was to have 8 of 10 rounds in a 4cm circle with two consecutive five-round shot groups. This contrasts with the prior standard of having 5 of 6 rounds in a 4cm circle with two consecutive three-round shot groups. This standard for five-round shot groups had not been examined prior to the current effort to determine if it was equivalent to the three-round shot group standard. The grouping and zeroing rounds allocated per Soldier in the OSUT and BCT POIs are in Table 9. As indicated in Table 9, the expectation was that Soldiers could group in three shot groups and zero in three shot groups. However, the

15-round allocation had not been examined previously to determine if most Soldiers could group or zero in this number of rounds.

Table 9
Round Allocation for Grouping and Zeroing in the Marksmanship Strategies

BRM Period	# Rounds Allocated per Soldier	
	OSUT	BCT
Rounds to group BUIS at 25m	15	15
Rounds to zero BUIS at 25m	15	15
Rounds to group CCO at 25m	15	NA
Rounds to zero CCO at 25m	15	NA
Rounds to confirm zero with BUIS OSUT: At 100 and 200m BCT: At 175 and 300m	15/15	20/20
Rounds to confirm zero with the CCO At 100 and 200 meters	15/15	NA

Note. With the prior standard for three-round shot groups, Soldiers were allocated 27 rounds to group and 18 rounds to zero.

Results for grouping and zeroing. No company had all Soldiers achieve the standards within the round allocation for grouping, zeroing, and confirming zero (except OSUT for confirm zero with the CCO at 100m). In addition, in some companies not all Soldiers were able to group and/or zero in the grouping/zeroing periods of instruction, with the reasons for this varying from company to company. Because the round allocations in the new strategies were found to be inadequate and we did not always have data on all Soldiers, we estimated what was adequate based on the data available. Although the mean number of rounds Soldiers fired was available for each company, the estimated round allocation had to be a multiple of 5, and the mean was rounded up accordingly. Specifics involved in determining the estimated round allocation per Soldier shown in Table 10 are presented next.

Several caveats are in order with regard to the round estimates in Table 10. Whenever all the Soldiers in a company grouped or zeroed, the mean number of rounds (rounded to be a multiple of 5) was used. However, when all Soldiers did not group or zero, a linear projection was made for that company. This estimate deviated only slightly (less than a round) when data were available for 95% or more of the Soldiers in a company. The final numbers in Table 10 for grouping and zeroing reflect results on the pooled samples of the OSUT and BCT companies.

The fewest problems in determining the round allocation were in Infantry OSUT for the CCO, in that 96% to 100% of the Soldiers in each company grouped, zeroed, and confirmed zero with the CCO. The priority for the OSUT companies was the CCO, as Soldiers were to use the CCO through the remainder of marksmanship training. During execution of grouping and zeroing at 25m, CCO training times were longer than expected, the training days were unexpectedly short in some cases, and the ammunition for BRM was limited. These factors greatly limited the number of OSUT Soldiers who were able to group, zero, and confirm zero with the BUIS. In fact, because of these time constraints, the data on the BUIS were limited to

approximately one platoon of Soldiers from one company (see note to Table 10). It is noted that OSUT companies used known-distance ranges for confirmation of zero where, as indicated below, that was not the case with the BCT companies.

Table 10
Estimated Round Allocations for Grouping and Zeroing

BRM Period	# Rounds per Soldier	
	OSUT	BCT
Rounds to group BUIS at 25m Rounds to zero BUIS at 25m	25[a] 35[a]	30 40
Rounds to group CCO at 25m Rounds to zero CCO at 25m	25 25	NA NA
Rounds to confirm zero with BUIS OSUT: At 100 and 200m BCT: At 175 and 300m	25/25[a]	45/*45*[b]
Rounds to confirm zero with the CCO At 100 and 200 meters	15/25	NA

[a] Rounds to group/zero BUIS for OSUT based on 67 Soldiers. Rounds to confirm zero based on 42 Soldiers.

[b] Estimate based on only one company (the most complete LOMAH data, fired at 175m only and used three-round shot groups – converted to five-round equivalent). A total of 45 rounds is cited as a "placeholder" for 300m, but may not be sufficient for this distance.

BCT units encountered problems with zeroing and confirmation of zero with the BUIS. With grouping, at least 95% of the Soldiers in each company grouped within the time allocated. However with zeroing, the percentages of Soldiers were lower: 71%, 86%, and 95%. The estimated round allocations per Soldier in Table 10 were based on a linear projection.

The results for confirmation of zero rounds in BCT units were confounded with the status of the LOMAH (location of misses and hits) systems at each installation. LOMAH is an automated supersonic projectile detection and location targetry system which provides feedback on round location, and information on target hits and misses as well as whether rounds are within a predetermined area on the target. The existing LOMAH system, at two installations, used three-round shot groups and could not be upgraded prior to assessment start, requiring Soldiers to fire three-round shot groups. In addition, these systems had no automatic means of determining when the standard had been achieved, i.e., two consecutive three-round shot groups with 5 of 6 shots in the equivalent of a 4cm circle at 175m (28cm/11in). Thus it was often the case that Soldiers fired more rounds than necessary, consuming valuable additional ammunition. We modified the data collection procedures somewhat for the second installation and managed to have less wasted ammunition. Nonetheless, Soldiers at these two installations confirmed zero only at one distance (175m), and 83% confirmed zero at this distance.

At the third BCT installation, the LOMAH system software was modified to be consistent with the new POI, i.e., 20 rounds at 175m and 20 rounds at 300m. The company was the "pilot" company for the upgraded system and some unexpected problems occurred. The upgraded

LOMAH system was programmed to automatically progress to the 300m target once the Soldier confirmed zero with the 20-round allocation at 175m. However, the LOMAH system was also programmed to progress to the 300m target once the Soldier fired 20 rounds regardless of whether the Soldier had confirmed zero at 175m. The standard for five-rounds at 175m was 8 of 10 rounds in the designated 4cm equivalent circle. The standard for five rounds at 300m was 6 of 10 rounds in the designated 4cm equivalent circle (48cm/19in). Neither standard had been examined previously. Less than 10% of the Soldiers confirmed zero at 175m and only 37% confirmed zero at 300m. The estimated number of rounds cited in Table 10 for confirmation of zero at 175m for BCT units was based on the two installations where we had the most complete data from LOMAH (three-round shot group data converted to five-round equivalent; 175m data only). The round allocation for 300m confirmation is simply a placeholder, as noted in Table 10.

There is one historical trend shown in Table 10 that bears mentioning. In all cases more rounds were required to zero than group with iron sights/BUIS. This result is consistent with historical data (Cobb, James, Graves, & Wampler, 2009; Dyer & Pleban, 2004; Dyer, Pleban, Vaughan, Salvetti, & Clark, 2004; Hagman, 2004). The assumption in the POI that the same number of rounds was adequate for both grouping and zeroing was inconsistent with these other research findings.

Record Fire rounds.

It is rare that all Soldiers in a training company qualify on their first attempt at Record Fire. Thus Soldiers are typically given a one or more additional attempts to qualify. However, if Soldiers never qualify, they are recycled and begin basic training over again with another company. Obviously the number of attempts allowed for qualification in conjunction with the number of Soldiers who must fire again impacts the ammunition which is consumed. It was important to determine how much ammunition was required to qualify most Soldiers in order to adequately address the ammunition issue in the assessment. The participating companies allowed additional attempts for those Soldiers who did not qualify initially. The minimum number of total attempts allowed was 4; the maximum was 8. With regard to individual companies, all Soldiers in each OSUT company finally qualified. For the individual BCT companies, the final qualification percentages were 84%, 95%, and 100%.

Figure 2 plots the cumulative percentage of Soldiers in the OSUT and BCT companies who qualified as function of the initial and additional attempts to qualify. Depicted in the figure are the Record Fire (i.e., RF Att1) percentages and the cumulative percentages of Soldiers who qualified as a function of the 2nd, 3rd, and 4th additional attempts (i.e., RF Att 2 through RF Att 4). It also plots the cumulative number of rounds required per Soldier as a function of these qualification attempts. As can be seen in Figure 2, the largest increment in the percentage of Soldiers who qualified occurred on the second attempt (Soldiers needed one more try after their initial firing). Approximately 9% to 12% more Soldiers qualified. The percentages were lower with additional attempts. After four attempts, 98% of the OSUT Soldiers qualified; 90% of the BCT Soldiers qualified.

However, as indicated in Figure 2, to reach these final qualification percentages would require the companies, on average, to have 51 rounds per OSUT Soldier (10,200 rounds for a

200-person company) and 60 rounds per BCT Soldier (12,000 rounds for a 200-person company). If only one more attempt is allowed, on average 47 rounds would be required per OSUT Soldier (9400 rounds for a 200-person company) and 50 rounds per BCT Soldier (11,200 rounds for a 200-person company).

In terms of percentage of Soldiers qualified, the greatest benefit from additional rounds is if one additional attempt is allowed. If refires are allowed on Record Fire, the estimated round requirements are greater than the 40 rounds allocated in the POI for each Soldier and the 8000 rounds allocated for a 200-person company.

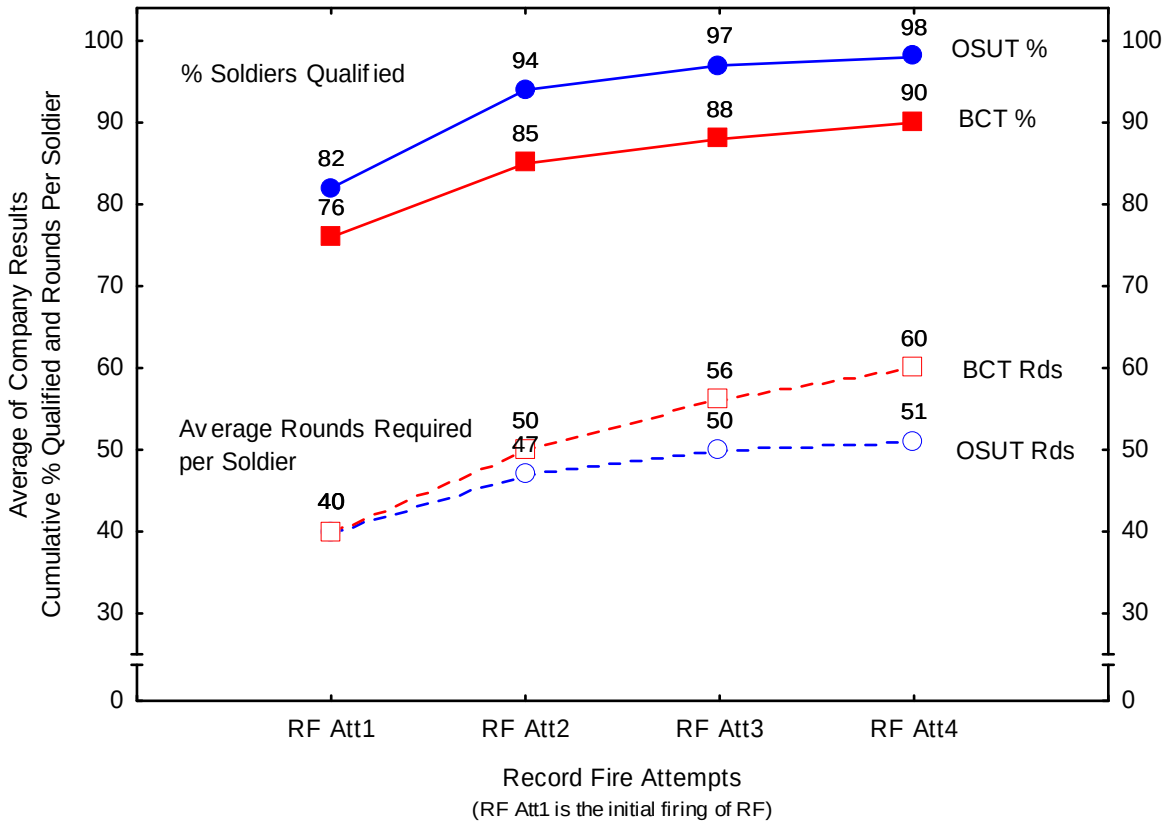

Figure 2. Cumulative percentage of Soldiers who qualified and rounds required as a function of attempts at Record Fire.

Time Allocation

The major deviations from the allocated times in the POI related to the time required to group and zero primarily in BRM for OSUT companies, but also for BCT companies. In addition, limited time for night firing given the long summer training days inhibited OSUT companies from conducting all the planned night fire in ARM.

Grouping, zeroing and confirmation of zero.

For two of the BCT companies, some Soldiers had not zeroed within the three-day period for grouping and zeroing and had to continue to fire in the following periods until they had zeroed. It was not possible to maintain exact counts of these numbers. Although the confirm zero period was scheduled for two days, due to range limitations, the BCT companies only had one day to confirm zero. Due to this time limit, they only confirmed zero at one distance. Another problem was the new standard was based on five-round shot groups and there was no pilot conducted on the associated time allocation and the appropriateness of the standard itself. As indicated previously, one company had a new version of the LOMAH software for confirmation of zero, which created unexpected problems in executing this period as the system software allowed Soldiers to go to the second distance after firing 20 rounds without first ensuring the Soldiers had zeroed at the first distance. Not all Soldiers within this company were able to confirm zero given that they only had one day on the LOMAH range.

The OSUT companies had to group, zero, and confirm zero with both the BUIS and the CCO. As indicated previously, each company did not have sufficient time for all Soldiers to fully execute the tasks with the BUIS. The priority was placed on the CCO, as it was to be used in all other marksmanship periods. Based on these results, four, not three, days is probably needed to group and zero both the BUIS and the CCO for all Soldiers in an OSUT company.

Night fire in ARM for OSUT.

The time pressures of consecutive night fires (long days with short nights in the summer) complicated the logistics associated with night fire (transportation pick-up times, required hours of sleep for Soldiers, and morning physical training). Consequently, two OSUT companies reduced the training time in the ARM 2N and 3N periods by half because of limited training time. This problem could have been reduced if night fires had not been on consecutive days. OSUT leaders were flexible and developed solutions to the time problem to ensure all Soldiers received the same training, although it was not always possible to implement all scenarios as specified in the POI. The same logistical considerations pertained to the BCT POI but were not as great because the firing tables were not as extensive for the OSUT companies.

Other Performance Indicators

The Field Fire data were of interest because OSUT Soldiers started wearing combat equipment in the EST Field Fire period (BRM 7), while BCT Soldiers donned their combat equipment later in the first period in ARM (ARM 1). The marksmanship strategy assessment was not a controlled experiment on the effects of wearing combat equipment, but did allow an examination of potential impacts. As stated previously, the Field Fire scenarios used in the new, revised strategies changed (see Appendix A). Appendix A also presents the corresponding prior tables contained in the marksmanship FM (FM 3-22.9, DA, 2008).

According to the research plan, no data were collected for BRM period 6, Field Fire I, for any company. The research plan did specify data collection for BRM period 7 (Field Fire II) in the EST 2000, as it was the first time OSUT Soldiers wore combat equipment. The research plan

did not specify data collection for BRM Period 8 (Field Fire II). But since some companies fired this scenario on a range where Soldier identification was automatically obtained it was possible to obtain data on those companies. To reiterate, the POI specified identical Field Fire II scenarios for OSUT and BCT BRM Periods 7 and 8, and for BCT ARM period 1.

Several issues compromised the data from the periods that had the Field Fire II scenario. It was not possible to update the EST field fire scenarios (BRM Period 7) at one BCT installation. In addition, only one BCT company executed the revised live-Fire Field fire II (BRM Period 8) scenarios. At the second BCT installation, the range software could not be updated in time and the prior version was used. For the third BCT company and all OSUT companies, it was possible to update the live Field Fire II scenarios which were conducted on a LOMAH range. As indicated in Appendixes A and F, interim changes were made to the LOMAH system for these companies, which enabled the multiple targets firing table to be executed as planned with only minor variations in the single target table. Lastly live-fire Field Fire II (BRM Period 8) performance data were not able to be collected for one BCT company.

Considering these issues, only general results are presented in Table 11 on Soldier performance on Field Fire II for the OSUT and BCT strategies. More detailed information is in Appendix F. Trends in this table indicate that OSUT companies were not negatively impacted by combat gear either in the EST 2000 or the following live-fire period, given the relatively high percentage of Soldiers who achieved a "Go" in Field Fire II. On the other hand for the BCT companies, switching from the EST 2000 to live-fire did have a negative impact. And wearing combat gear in the EST 2000 also impacted the BCT companies, even though they started to wear it later in their marksmanship training.

Table 11
Results on EST Field Fire II and Live-Fire Field Fire II: Company Averages for Percentage Soldiers with a "Go"

Strategy	BRM 7: EST Field Fire	BRM 8: Live-Fire Field Fire	ARM1: EST Field Fire
OSUT	83.8% (in combat gear, CCO)	82.2% (in combat gear, CCO)	Not applicable
BCT	72.2% (without combat gear, BUIS)	67.8% (without combat gear, BUIS, 2 companies)	63.5% (in combat gear, BUIS)

Note. Appendix F details the "Go" or passing standard for the specific field fire scenario used by each company

Correlations Among Measures of Performance

Examining the correlations among measures of performance in marksmanship training is a way of gauging the consistency of Soldier performance over time. Are those Soldiers who perform well initially the same as those who perform well in the middle of training and at the end of training? Does early performance predict later performance? We were fortunate to be able to examine this question as we had multiple measures of marksmanship performance, primarily on

the common BRM periods for BCT and OSUT. In general, when individuals develop skill in an area, correlations between early performance and later performance are not high (Proctor & Dutta, 1995; Regian & Schneider, 1990, Schneider, 1984). There is plasticity in skills during training, particularly in initial skill learning. Individuals learn at different rates, and additional skills are acquired throughout the training. Schneider stressed that these low relationships are typical of high-performance skills, referring to skills that require over 100 hours of training, that have substantial numbers of individuals who fail to develop proficiency (greater than 20%), and that have qualitative performance differences between experts and novices. Our findings also showed low relationships between early and later measures of performance, although there were some interesting variations to the pattern.

Correlations among the measures were examined separately for each company. Company data were kept distinct because of the idiosyncrasies in implementation of the POIs on the different Army installations. Thus the correlation tables in Appendix G (Tables G-1 and G-2) have three lines, one for each of the respective OSUT and BCT companies. Table 12 below summarizes these correlations in three ways. First, the correlations were categorized by performance measures from six major blocks of instruction. These six were:

Grouping and zeroing (BRM 4 & 5 - group at 25m, zero at 25m, and confirm zero)
EST Field Fire (BRM 7 --EST single targets, EST multiple targets)
Live Field Fire (BRM 8 -- single targets, multiple targets, data only for OSUT)
Practice Record Fire and Record Fire (BRM 9 & 10, both practice Record Fire scores and score on the first attempt at Record Fire)
EST Field Fire (ARM1 -- single targets, multiple targets, data only for BCT)
CFF (2 iterations for OSUT, 1 iteration for BCT).

Second, within each block of performance measures, the mean of the individual company correlations was calculated. In each cell in Table 12, the mean is presented on the first line. Third, the lowest and highest correlations (see Appendix G) were identified. They are presented on the second line in each cell in Table 12.

It is important to caution the reader that the mean of the company correlations is not equivalent to the correlation that would result if the data from Soldiers in all companies were pooled. The periods of instruction are ordered in accordance with the marksmanship strategy so the reader can examine whether earlier measures or performance relate to later measures. OSUT and BCT results are presented separately in the table. The diagonal cells are grayed, to highlight the degree of consistency among performance measures within each major block of marksmanship training.

Given the company sizes of approximately 200 Soldiers, correlations (*r)* around +/- .20 can be significant. However, such correlations are not strong, accounting for only 4% of the variance between the two variables. Another way of examining the strength of a correlation is through effect size (Cohen, 1988). Within the context of behavioral science research, Cohen defined a medium effect size as an *r* of .30 and a large effect size as an *r* of .50. Consequently, we considered correlations less than +/-.30 as too small to have any predictive value, reflecting "no" relationship. We described correlations between .30 and .50 as being moderate in strength, and correlations above .50 as strong relationships.

Regarding correlations over time, as shown in Table 12, the very earliest blocks of measures, rounds to group and zero (BRM periods 4 and 5), did not correlate with scores (number of targets hit) in later periods. Also the Field Fire II EST scores (BRM 7) did not correlate with later live-fire periods, including live-fire Field Fire II (BRM 8) for OSUT which was the same scenario. In addition, for BCT the two sets of EST Field Fire measures (BRM 7 and ARM 1) did not correlate with each other. The scenarios were the same, but BCT Soldiers fired the latter EST period (ARM 1) in combat gear. For OSUT, some stabilization in skill started to appear with live Field Fire (BRM period 8).

Table 12

Correlations Among Six Major Blocks of Performance Measures: Mean Company Correlations and Lowest and Highest Correlations

	Gp/Zero BRM 4/5	EST FF BRM7	Live FF BRM8	PRF& RF BRM 9/10	EST FF ARM1	CFF ARM
OSUT						
Gp/Zero	.08 .02 to .25	-.09 -.21 to .08	-.13 -.27 to .05	-.11 -.29 to .05	NA	-.05 -.21 to .08
EST FF		.67 .65 to .71	.21 .17 to .28	.13 .07 to .28	NA	.12 .04 to .22
Live FF			.43 .34 to .52	.34 .07 to .50	NA	.28 .24 to .32
PRF & RF				.44 .36 to .65	NA	.25 .10 to .34
CFF					NA	.53 49 to .61
BCT						
Gp/zero	.14 -.12 to .36	-.05 -.14 to .10	NA	-.19 -.34 to .00	-.02 -.20 to .18	-.17 -.40 to .00
EST FF		.72 .65 to .83	NA	.18 .05 to .27	.14 .04 to .24	.07 -.04 to .24
Live FF[a]			**NA**	NA	NA	NA
PRF & RF				.55 .44 to .68	.09 -.01 to .23	.31 .17 to .48
EST FF ARM1					.81 .80 to .81	.10 .04 to .21

Notes. NA means not available (not executed or no data available for the period). Each column and row represents more than one measure except for BCT CFF. Correlations within a block of measures are shaded gray.

[a] Identification of individual Soldiers not able to be recorded for BCT companies on live-fire Field Fire II, making correlations impossible to calculate.

Within each of the six major blocks of instruction, the correlations were clearly the lowest among the grouping/zeroing measures(the shaded correlations on the diagonal in Table 12. Correlations were the highest (strong effect size) when Soldiers fired the EST. For the other major blocks (the Record Fire scenarios for both types of units, and BRM period 8 and CFF), the

correlations exhibited both medium and large effect sizes. Of note is that there were no moderate or stronger relationships with CFF, the culminating event in ARM.

There are several consistencies between these results and prior research efforts. First, the rounds to group and zero results are similar to those in the Dyer et al. (2004) research on the EST 2000. Specially, rounds to group and to zero did not correlate with each other, nor did they correlate with later measures of skill in hitting targets. Yet the trend was for the relationship to be negative, as one might expect. Second, the EST scores on the single and multiple Field Fire target tables correlated, but did not correlate with live-fire. This is consistent with Dyer et al., where both EST and live-fire measures were obtained on grouping, zeroing, Field Fire, and Practice Record Fire (see Appendix G for more information). Dyer et al. found a Soldier's performance was very consistent within the EST 2000 tables, but was not indicative of live-fire performance. Third, the correlations among Practice Record Fire and Record Fire scores were similar to those in the Dyer et al. (2010) research on CFF. Also consistent with this earlier effort on CFF was that the relationship between Record Fire and CFF was lower than the relationship between Practice Record Fire and Record Fire.

Resource Issues

Limited quantities of equipment impacted the execution of ARM. In ARM, not all companies had the equipment quantities specified in the POI, and it appeared that in most instances the POI allocation was insufficient. A one-to-one ratio of equipment to Soldiers is important if the POI is to be executed efficiently as specified and for Soldiers to attain the desired skills.

For BCT companies, the number of CCOs varied: 90, 120, and 240. The large number of 240 was made possible by obtaining additional CCOs from another training company. The POI specified a 1 to 10 ratio. Even though these quantities exceeded the POI ratio, in companies where each Soldier did not have a CCO, due to time constraints each Soldier was not able to zero a CCO. Instead the first firing order of Soldiers actually zeroed the CCO and the next Soldier in line simply fired the CCO. Thus only a portion of the Soldiers learned the zeroing process. If the intent is for each BCT Soldier to learn how to zero a CCO, then more than one day may be required, based on the time to zero required by OSUT Soldiers.

The night equipment included the night vision goggles (NVG), aiming light/laser, and a borelight. The borelight is used to boresight the aiming light to the rifle. The training objective was for each Soldier to be trained on boresight procedures, but due to the limited quantities (about 24 in OSUT companies and typically 5 in BCT companies) this was not possible. With OSUT, a limited number of Soldiers could boresight while others watched. With the BCT companies, the drill sergeants and/or Soldiers mounted the optics; very few Soldiers boresighted. Limited numbers of goggles and aiming lights (approximately 120) in the OSUT companies meant that the cadre instituted hot gun/hot helmet procedures for target engagement. In other words, a Soldier who had just finished firing handed off his goggles and boresighted weapon to the next Soldier who was to fire. The same procedure was used in the BCT companies, but required even more time as there were only 20 to 35 goggles and aiming lights available.

Although some of the ratios shown in Table 13 may appear satisfactory, not all night equipment was operational.

Table 13
Equipment Status in OSUT and BCT (Ratio of equipment to Soldiers)

Item of Equipment	OSUT		BCT	
	POI Ratio	Actual Ratio	POI Ratio	Actual Ratio
CCO	1 to 1	1 to 1	1 to 10	1 to 2.6; 1 to 2, & 1 to 1
Night vision goggles	1 to 5	1 to 2	1 to 5	1 to 13 & 1 to 8
Aiming laser/light	1 to 1	1 to 2	1 to 10	1 to 13 & 1 to 8
Borelight	1 to 10	1 to 10	1 to 10	1 to 120 & 1 to 30

Note. Assumed company size of 240.

What Soldiers Said

BRM questionnaire.

In the BRM questionnaire (see Appendix B), Soldiers were asked to indicate which skills needed more practice. For these questions, Soldiers could mark any of the skills listed; they were not forced to choose between skills. Areas covered were firing positions, weapons handling, basic shooting skills, and target engagement. We identified skills which needed more practice by using a cutpoint of 40% Soldiers (i.e., average of the company percentages was at least 40%). The list of skills needing more practice is shown below. No weapon handling skills were above the cutpoint (see Appendix B).

• Kneeling Position	OSUT – 72%	BCT – 55%
• Prone unsupported position (rated high by females)	---	BCT – 46%
• Adjusting BUIS without assistance	---	BCT – 53%
• Hitting targets at 250 & 300m	OSUT – 56%	BCT – 74%

Some of the same skills were addressed in the Dyer et al. (2010) CFF research. In that research, all Soldiers were male. The kneeling position was cited by 68% as being the least comfortable position, but the prone position was only cited by 18% as being the least comfortable. Adjusting the BUIS without assistance was cited by 48% as a task that needed more practice, as was hitting targets at 250 and 300m (cited by 68%).

Soldiers in the current research were also asked about how the EST 2000 prepared them for grouping and field fire exercises. In general, 75% of the Soldiers indicated the EST helped prepare them for live fire.

In the OSUT BRM questionnaire, Soldiers were asked about the extent to which combat gear interfered with their EST 2000 and Record Fire performance. In both cases, the questions were on obtaining a stable position, seeing targets, and hitting targets from three firing positions

(prone supported, prone unsupported, and kneeling). Overall, Soldiers perceived less interference in Record Fire than in the EST (the first time they wore combat gear), with 33% indicating interference in the EST and 22% indicating interference in Record Fire. Of interest is that in both the EST and Record Fire, the highest percentage of Soldiers indicating interference occurred in two conditions: obtaining a stable position with the kneeling position (55% in EST and 39% in Record Fire) and hitting targets from the kneeling position (43% in EST and 33% in Record Fire).

ARM questionnaire.

The ARM questionnaire (see Appendix C) also addressed skills which needed more practice. The skill areas were boresighting devices, advanced firing positions, and advanced firing techniques. The list below reflects the skills cited by an average of 40% or more of the Soldiers. Soldiers in BCT indicated they needed more practice on three skills; OSUT only indicated one. The skills cited by BCT Soldiers are consistent with the limited equipment and time available for these tasks in ARM.

• Boresighting an aiming light	---	BCT – 41%
• Boresighting a CCO	---	BCT - 41%
• Engaging targets with aiming light and night vision goggles	OSUT – 45%	BCT – 76%

Regarding more advanced skills, OSUT Soldiers had a second day of barrier shooting, with the majority (73% to 91%) indicating the second day improved their proficiency in changing magazines, reacting to an induced malfunction, to move and fire from different positions, and to use to a barricade for stability. Two questions were asked of CFF – whether a Soldier ran out of ammunition before he/she could engage all targets, and whether the pace of the scenario was right (vs. too fast or too slow). These questions were asked because of the initial ARI CFF research (Dyer et al., 2010) where poorer shooters ran out of ammunition (based on formal records) and the poorer shooters who were interviewed often said the scenario pace was too fast. Of the OSUT Soldiers, 46% (mean of the companies) estimated they ran out of ammunition, compared to 37% of BCT Soldiers. These results seem counter-intuitive based on the Dyer et al. (2010) results as BCT Soldier scores on CFF were substantially lower than OSUT Soldiers. A possible explanation is that the lower percentage of BCT Soldiers indicating they ran out of ammunition may simply reflect less skill in getting into positions, changing magazines, reacting to an induced malfunction, etc. resulting in fewer rounds fired. Without lane observers it is not possible to verify the accuracy of this assumption. Regarding the other question on scenario pace, Soldiers (74% to 84%) said it was about right.

Soldiers were given the list of marksmanship periods for OSUT and BCT respectively. They were then asked to select the very first training period in which they felt they had adapted to their combat equipment. Adaptation was defined as the point where they did not have to think about their combat equipment either before or during shooting. Clearly only a small percentage of Soldiers (10% or less, see Table 14) indicated they adapted to the equipment the first time it was worn. At approximately the half-way point of wearing the equipment, only 50 to 60% of the Soldiers in each strategy indicated they had adapted to it.

Table 14
Soldier Perceptions Regarding Adaptation to Combat Equipment

Strategy	Adaptation Point	Cumulative % Soldiers Adapted
OSUT	First Time (BRM7)	5.3%
	End of BRM (RF)	52.5%
	End of ARM (CFF)	92.6%
BCT	First Time (ARM1)	10.1%
	Reflexive Fire (ARM5)	68.1%
	End of ARM (CFF)	88.4%

Note. The cumulative percentage is not 100% as the remaining Soldiers indicated they had not adapted or could not recall when they adapted.

BCT Soldiers were then asked about the extent to which combat gear interfered with shooting in different positions when they wore it for the first time in the EST (ARM1). The overall average was 39%, slightly higher than 33% of the OSUT Soldiers who indicated interference the first time they wore combat gear in the EST (BRM7). All Soldiers were asked about shooting in combat gear in CFF, the last period in ARM. The percent of Soldiers from both units who indicated interference was lower; 16% for OSUT and 18% for BCT Soldiers.

Soldiers' perceptions of the relative difficulty of Record Fire and CFF were obtained as well as their reactions to which course-of-fire increased their confidence more (see Table 15). With regard to difficulty, the most common response was that the two courses were perceived as equally difficult. However, more OSUT Soldiers perceived Record Fire as more difficult than BCT, while more BCT Soldiers perceived CFF as more difficult than Record Fire. With regard to confidence, the typical response was that both contributed about equally to an increase in confidence. Yet, fewer OSUT than BCT Soldiers indicated that Record Fire increased their confidence more than CFF (18% versus 26%). About 30% of OSUT and BCT Soldiers indicated that CFF increased their confidence more than Record Fire.

Table 15
Soldier Perceptions of Record Fire and CFF: Mean of the Company Percentages

	OSUT % Soldiers	BCT % Soldiers
Difficulty		
RF more difficult than CFF	35.7%	28.5%
RF equal to CFF	44.2%	39.6%
CFF more difficult than RF	21.0%	38.4%
Confidence		
RF increased confidence more than CFF	17.9%	26.3%
Both increased confidence about equally	50.8%	44.0%
CFF increased confidence more than RF	31.2%	29.7%

Note. RF means Record Fire.

Soldiers rated their overall level of marksmanship at three time points: the start of training, at the end of BRM when they qualified, and at the end of ARM after they fired CFF. Ratings were on a ten-point scale from "low or minimal level of skill, need much more practice" (rating of 1) to "high level of skill, can't get much better" (rating of 10). The scale was used in the CFF research (Dyer, et al., 2010). As expected, skill ratings increased over time. The means of the company ratings are shown in Table 16. Also, as shown in Appendix C (Figures C-1 and C-2), the distributions of ratings were skewed, particularly the initial and final ratings.

Table 16
Soldier Self-Ratings of Skill During Marksmanship Training

	OSUT	BCT
	Mean of the Company Ratings	Mean of the Company Ratings
Start of Training	3.8	3.3
End of BRM	6.6	6.5
End of ARM	7.9	7.5

Note. Ten point rating scale from 1 to 10.

The self-ratings were correlated with three blocks of measures; rounds to group and to zero, Practice Record Fire and Record Fire scores, and CFF scores. For both OSUT and BCT, the same patterns were shown (see Tables G-8 and G-9). First, the correlations among the self-ratings became more consistent with time. The correlations between the initial and end ratings were lowest, being .36 and .23 for OSUT and BCT respectively; the correlations between the middle and end ratings were highest, being .72 and .61 respectively. Thus Soldiers' perceptions of their skill became more consistent with training. Second, self-ratings correlated highest with the marksmanship scenario that corresponded with the self-rating period. Specifically, for both groups of Soldiers, the highest correlation with ratings at the end of BRM was the Record Fire score (.33 and .43 for OSUT and BCT respectively). Similarly, the highest correlation with ratings at the end of ARM was the CFF score (.28 and .33 for OSUT and BCT).

The last question was a free-response item asking whether there was a point in time when Soldiers perceived a substantial change in their shooting ability. When tallied by whether a Soldier indicated a point in BRM or ARM, more OSUT Soldiers commented on ARM, whereas more BCT Soldiers commented on BRM (see Table 17, also see Appendix C). For BCT Soldiers, Practice Record and Record Fire had substantial impact. For OSUT Soldiers, comments were distributed across ARM periods (e.g., CFF, moving targets, barriers, and other ARM training). About 18% of all Soldiers indicated they could not identify a specific event or time when they perceived a substantial change in their shooting ability.

Table 17
Distribution of Soldier Comments on BRM and ARM

Strategy	% Comments on BRM	% Comments on ARM
OSUT	27%	35%
BCT	46%	20%

Note. 66% of all Soldiers responded to this question; 50% in OSUT; 84% in BCT.

Examples of comments on BRM are:

- *I feel like the pressure of qualification helped to increase my ability.*
- *My biggest increase was during qualifying when I got used to firing with my equipment.*
- *End of BRM – calmed down and did a good job.*
- *I went from shooting 20 out of 40 on pract qual to shooting 37 out of 40 on qual day.*
- *When I qualified.*
- *When I found a good cheek to stock weld, my accuracy increased.*
- *Discovering that I could hit a 300m target with iron sights was a huge step in moving forward.*
- *Firing on pop-up targets for the first few times was very helpful and really advanced my skills.*
- *When I found out that the reason I was hitting a very few targets because of my trigger squeeze, ever since then I noticed a big increase in my BRM skills.*

Examples of comments on ARM are:

- *When finishing the CFF training I did better than I thought and felt confident.*
- *CFF gave me lots of confidence because I did good and proper on malfunctions.*
- *Prior service – been in combat but never been through a course (ref CFF) like this. I think that my ability have improved more.*
- *The rapid aim fire because it gave me confidence in moving with the weapon.*
- *I felt I did better and increased in my shooting when we got to moving targets, it gave a lot of confidence.*
- *After completing CFF. It helped with transition between movements and changing sight picture between positions.*
- *At CFF I felt that I shot much better, acquired targets faster and had definitely improved since qualification.*
- *Yes, when during BRM record fire, but CFF just verified.*
- *When we started ARM, we learned different positions that we will likely use.*

Discussion

Implications of the Strategies

Training effectiveness.

The two strategies were very similar in the BRM phase of training. The major difference was that OSUT Soldiers wore combat gear starting in BRM7 and they used the CCO as their primary sight. Results on Record Fire, which was viewed as the primary criterion measure for the BRM strategy, showed that OSUT Soldiers scored significantly higher, but the mean difference was only 1.5 points on average, indicating no substantial differences in the two strategies.

For ARM, the two strategies were quite different. The OSUT strategy was primarily designed to train skills required by CFF (as well as reflexive fire skills and moving target engagement). Given the greater number of rounds for OSUT ARM, individual Soldiers had more opportunities than BCT Soldiers to practice a selected set of skills within basically the same period of time. The OSUT strategy also gradually increased the complexity of skills trained, yet did not focus on training the target CFF scenario per se. This is consistent with Schneider's (1984) conclusions that practicing only the target task does not necessarily optimize results and can often frustrate the learner. In contrast, the BCT ARM strategy involved limited training on and resources for a variety of skills, and did not parallel the OSUT strategy regarding training CFF skills. The culminating event in ARM was CFF, with OSUT Soldiers substantially outperforming BCT Soldiers. In addition, OSUT Soldiers increased their scores on the second iteration of CFF, indicating that they benefited from additional practice. OSUT Soldier perceptions also supported the value of ARM training. Thus the OSUT strategy clearly was more successful in training CFF-related as well as other advanced marksmanship skills.

The BCT ARM strategy was not focused, allocating limited training time for a variety of skills rather than incorporating a strategy which progressively trained advanced skills. Such an approach does not lead to expertise in these areas. An alternative approach would be to decide which advanced skills are most important for the BCT Soldier population (e.g., night fire, advanced optics, CFF skills) and develop a specific strategy to enable Soldiers to become proficient with those skills.

Marksmanship is a high performance skill, and extensive practice is needed to achieve a high level of proficiency. One cannot expect IET graduates to be as skilled as the expert marksmen in the US Army Marksmanship Unit or Soldiers with sniper training who achieve high levels of proficiency through extended practice. In discussing fallacies in training high performance skills, Schneider (1984) cited the importance of practicing consistent components of the task, so actions become automatic. At a minimum, the "fundamentals of marksmanship" (steady position, aiming (sight picture and sight alignment), breath control, and trigger squeeze, FM 3-22.9 [DA, 2011]) would be components of target engagement, and they are practiced throughout the marksmanship program. But other skill components essential to high performance are introduced later, with fewer opportunities for practice. In judging the overall

effectiveness of a marksmanship strategy, such factors should be considered in specifying the skill levels that can be achieved in 16 to 17 days of training. When there is little time or resources for practice on additional marksmanship skills, one would not expect the performance outcome to be high.

Ammunition and time resources.

One problem with the BRM strategy for both BCT and OSUT units was that the rounds to group, zero, and confirm zero to the standard specified in the POI were substantially underestimated, requiring 1.7 to 2 times more rounds. There had been no prior work with five-round shot groups to determine whether the round allocation was adequate or whether the accuracy and precision standards were similar in difficulty to the prior standards associated with three-round shot groups for grouping and zeroing. In addition, we found that the rounds required to enable at least 85% to 90% of the Soldiers to qualify on record fire exceeded the 40 rounds per Soldier in the POI. For the assessment, companies were allowed to have additional rounds so we could estimate the requirement. However, given the increased cost of ammunition, the total number of rounds is fixed for the new strategies.

To work within a fixed round allocation, we learned that training companies are often forced to shift rounds from ARM to BRM. We did find anecdotal evidence in the assessment data that when a trainer stressed dry-fire training (e.g., checking CCO boresight, practice with the target box) prior to live-fire grouping and zeroing, fewer rounds were required. So modified training approaches might also be effective in the early periods of BRM. At the Record Fire stage, decisions on the number of additional attempts should also consider the ammunition cost of recycling Soldiers. The data showed that the greatest increase in the percentage of Soldiers who qualified occurred when one additional attempt was allowed.

Although Soldiers must meet the grouping, zeroing, and Record Fire standards to progress in the marksmanship program, the other periods of instruction (e.g., Field Fire, barrier shoots) also had standards for a "Go." However, the POI did not allow for additional rounds or time for all Soldiers to meet these standards. Perhaps performance could have been increased if the POI did provide the necessary resources to enable more Soldiers to successfully complete these exercises.

The time required to complete some periods of instruction was underestimated. Specifically, these were grouping, zeroing, and some OSUT night fire exercises. In part, these shortages occurred because of changes in the POI (e.g., five-round shot groups, revised LOMAH program for confirmation of zero, new scenarios for night fire) which were systematically implemented for the first time in the assessment. Thus the actual time requirements were not known prior to the assessment period. The assessment results imply that initial assumptions regarding the times were flawed in some way.

Equipment resources.

Equipment shortages occurred in ARM. Both OSUT and BCT units did not have adequate numbers of night equipment to execute the training efficiently and effectively. BCT

units also had limited numbers of the day optic, the CCO. The result was that every Soldier was not trained on the same skills, so what was learned varied from Soldier to Soldier. For example, not every BCT Soldier zeroed the CCO. Because of limited CCO quantities and limited training time, Soldiers in the first firing order zeroed the CCO and then engaged targets. However, Soldiers in the next firing orders simply fired the first Soldier's weapon. In such situations, the weapon was not the Soldier's personal weapon and the Soldier did not learn how to zero the CCO. A similar situation occurred with night fire using night vision goggles and aiming lights, and trainers implemented what they called hot gun/hot helmet procedures. Although Soldiers observed other Soldiers zero sights or boresight aiming lights, hands-on training is necessary to acquire skill and to understand the facets of these tasks. Soldiers recognized the variations in training that resulted from lack of equipment and indicated they needed more practice on these skills in the questionnaires.

CFF standard.

The CFF cutpoints for hits established in the original CFF research (Dyer, 2010) were validated. When the same analytic methodology was applied to the OSUT sample, the cutpoints identified for marksman categories (Expert, Sharpshooter, Marksman, Unqualified), TPU, and Go/NoGo were replicated. This Go / NoGo cutpoint for hits (16 hits) was used in the assessment, although the marksmanship FM (DA, 2011) specifies a TPU standard, where "U" corresponds to the NoGo cutpoint.

The POI used 7 kills for the Go/ NoGo cutpoint. The assessment results showed that this cutpoint was an easier standard than the 16 hits specified in the FM. A minimum of 8 kills corresponded more closely to the 16-hits standard. It is noted that hits and kills are not linearly related and therefore a one-to-one correspondence does not exist. Also, hits is a more precise measure of skill than kills, as hits can range from 0 to 26, while kills only range from 0 to 15.

At the end of the assessment, the decision was to continue with the 16-hit standard for Go/NoGo in the OSUT companies, consistent with the FM. It was not known whether the standard for BCT would remain the same (i.e., 7 kills).

Combat equipment/gear.

The assessment data could not directly address the impact of wearing combat gear on marksmanship performance. A controlled experiment is needed --- comparing both BCT and OSUT Soldiers who wear combat gear with those who do not wear gear in the same marksmanship periods.

The trend in the assessment, based on Field Fire and Record Fire scores, showed that combat gear did not have a negative impact on OSUT Soldier performance in BRM. However, BCT Soldiers seemed to be negatively impacted based on ARM1 scores, even though they started to wear combat gear later in training than OSUT Soldiers.

Five-Round versus Three-Round Shot Groups

Because ammunition usage was a critical issue in this research and is currently an issue for the Army as a whole, the debate between three- vs. five-round shot groups may continue. Appendix E presents the frequency distributions we had for grouping and zeroing in this effort as well as additional historical ARI data on three-round shot groups from 1999 through 2009 (Dyer, 1999; Dyer et al., 2000, 2004, 2010; Hagman, 2004; Cobb et al., 2009) and on five-round shot groups (Cobb et al, 2009, 2010). Most of the research was with initial entry training Soldiers as was the case with the current research, although the Dyer 1999 and 2000 reports were with Forces Command (FORSCOM) Soldiers. The frequency distributions were not published in the original reports, but were generated from the master data files retained from each research effort.

Archival data cannot address all aspects of this issue. For example, the comparisons between three-round and five-round shot groups is complicated by the fact that different Soldier populations were involved at different time periods, covering a period of 10 years. Despite these differences, there were substantial consistencies in the data in terms of number of shot groups required to group and zero regardless of shot group size. Yet well-designed experiments that compare the impact of three- and five-round shot groups on multiple populations of Soldiers, using the sighting systems common to the training base and the active Army are needed.

The standards for three-rounds and five-rounds are repeated here. For three-rounds, the grouping standard was to obtain five of six rounds from two consecutive shot groups in a 4cm circle at 25m within 27 rounds or less. The zeroing standard was the same, except the 4cm circle was marked on the 25m target and the standard was within 18 rounds or less. Thus for grouping, 9 shot groups were allowed; for zeroing, 6 shot groups were allowed. For five-rounds in the strategies assessed in the current research, the grouping and zeroing standards were to obtain 8 of 10 rounds from two consecutive shot groups in a 4cm circle at 25m within 15 rounds or less. However, in earlier research with five-round shot groups, no total round allocation was specified.

Despite the difficulties comparing results of different shot group sizes, there were some interesting parallels and implications for future consideration. One parallel was that the data in the current research showed that it took more rounds to zero than to group with five-round shot groups regardless of sight and Soldier population (see Tables E-1 through E-3). This was also found in prior research with five rounds (see Tables E-5 and E-6). The same was the case with three-round shot groups (see Tables E-8 and E-9, and footnotes to Tables E-12 and E-13). The number of zero rounds was 1.3 to 1.9 times more than rounds to group for the five-round shot group. For three-round shot groups, zeroing required from 1.5 to 1.8 times more rounds than grouping. In contrast, the round allocations for three- and five-round shot groups in the IET marksmanship strategy and the marksmanship FM are inconsistent with these results. With the five-round strategy, the total round specification was the same for grouping and zeroing. With three-rounds, more rounds were allocated for grouping than zeroing, just the opposite of what Soldiers actually required.

In addition, Tables E-12 and E-13 show that more Soldiers grouped (90%) with the 3-round allocation of 27 rounds than zeroed (50%) with the allocation of 18 rounds. For five-round shot groups, again more Soldiers grouped (~ 45%) than zeroed (~ 20%) with the 15

round allocation. These results are simply another way of illustrating the number of rounds required to meet grouping and zeroing standards. Another factor that could influence the rounds required is the accuracy requirement (i.e., 5 of 6 rounds in the shot group, 8 of 10 rounds in the shot group).

A major question regarding three- vs. five-round shot groups is whether a five-round shot group is more efficient than a three-round shot group. In other words, do five rounds allow the trainer to better judge where the Soldier is firing and therefore require fewer shot groups and less ammunition on the average? Others argue that when a Soldier is learning to group and zero, the number of shot groups fired is the more important variable, regardless of the number of rounds per shot group.

We compared the number of shot groups required to group/zero 25%, 50% and 75% of the Soldiers who used either three- or five-rounds shot groups (see Appendix E). Of interest is that the number of shot groups for iron sight/BUIS grouping, iron sight/BUIS zeroing, and CCO zeroing were very similar regardless of the shot group size. These results are summarized in Table 18. They reinforce the proposition that it is the number of attempts to group or zero that counts, and that an increase in the number of rounds in the shot group does not necessarily lead to greater efficiency.

Table 18
Summary of Number of Shot Groups Required to Group and Zero With Three-and Five-Round Shot Groups

% Soldiers Grouped or Zeroed	Number of Shot Groups					
	Group – Iron/BUIS		Zero –Iron/BUIS		Zero- CCO	
	3 rounds	5 rounds	3 rounds	5 rounds [a]	3 round	5 rounds
25%	2-3	2-3	3-4	3-5	3	2-3
50%	4	3-5	5-7	5-8	4	4
75%	5-6	6-8	10-11	9-11	5	6

Note. Number of shot groups based on Appendix E. Lowest to highest number of groups shown in each cell except for Zero-BUIS with 5 rounds. No comparison data for CCO grouping.
[a] The numbers in the Zero-BUIS 5 round cells do *not* include the company the highest average number of round to zero and appeared to be an outlier (see Table E-13).

The similarity in the number of shot groups required to group or zero means that the 5 to 3 ratio in the number of rounds applies generally to the total number of rounds required, that is 1.67 times more rounds are needed with 5-round than with 3-round shot groups. For example, assuming 6 shot groups are required to zero the BUIS with both shot group sizes, for a 200 person company it would require 6000 rounds to zero half the company with five-round shot groups versus 3600 rounds to zero half the company with three-round shot groups.

The frequency distributions in Appendix E also clearly show how total round consumption for a unit is affected by poor shooters with some individuals shooting over 80 rounds to group and/or zero. All distributions were positively skewed regardless of shot group

size. Improvements to training that reduce the number of shooters who have difficulty grouping and zeroing could greatly impact ammunition requirements.

The limited data on FORSCOM Soldiers did not enable us to reach firm conclusions regarding differences between FORSCOM and IET Soldiers, and how such differences might impact the standards in marksmanship FMs. Additional data are needed to verify what the round allocations for grouping and zeroing should be for experienced Soldiers.

In summary, well-designed, controlled experiments that compare the impact of three- and five-round shot groups within multiple populations of Soldiers, using the sighting systems common to the training base and the active Army are needed. Nevertheless, the data available to us indicated that:

- More rounds are needed to zero than to group regardless of shot group size. These results are inconsistent with round allocations in marksmanship POIs.
- The round allocations for Soldiers to group and zero did not match "reality" which can impact ammunition planning and allocation during training. The only allocation which enabled most Soldiers to meet the standard was the 27 rounds to group with three-round shot groups. All other round allocations were insufficient.
- Total number of rounds to group or zero is strongly influenced by poor shooters who often require substantially more rounds than the typical Soldier.
- The number of shot groups required to group or to zero did not vary with shot group size. This finding reinforces the proposition that it is the number of attempts to group or zero that counts, and that an increase in the number of rounds in the shot group does not necessarily lead to greater efficiency with IET populations.

Relationship Among Marksmanship Performance Measures

The current effort provided the singular opportunity to examine the relationships among marksmanship skills among Soldiers over the BRM-ARM training period. Are the Soldiers who score high in one period the same as those who score high in another period? Are the Soldiers who score low in one period the same as those who score low in another period? However, multiple measures of marksmanship performance are typically not obtained in training research efforts since the focus of the research is often limited to a few primary measures (e.g., Record Fire).

Clearly, stable traits are not being assessed throughout marksmanship training. During this training, Soldiers learn new skills from one period to the next (e.g., hitting single stationary targets then hitting multiple targets and timed targets; progressing to firing in combat gear, firing from barricades, engaging targets at night). Throughout, they are also becoming more proficient on marksmanship fundamentals (e.g., sight picture, steady position). We used the correlation results to see if we could identify a point at which Soldiers became more consistent in their performance.

Consistent with the literature on skill development (Proctor & Dutta, 1995; Regian & Schneider, 1990; Schneider, 1985), the data showed that early measures of proficiency did not correlate with later measures, even measures obtained in the next firing period (see Appendix G).

Specifically rounds to group and zero did not correlate with each other nor with later measures of target hits. The later live-fire BRM periods (field fire and beyond) tended to have moderate relationships with other live-fire periods, with the highest relationships between Practice Record Fire and Record Fire (perhaps in part because they use the same course-of-fire). Record fire correlations with CFF were slightly lower than the correlations between Practice Record and Record Fire, indicative of the additional skills required to perform on the CFF course-of-fire. The one exception to the pattern just described was that performance measures on the marksmanship simulator (EST 2000) intercorrelated highly with the two tables fired on the simulator, but not with live-fire periods.

The relationships found in the current research were supported by prior marksmanship research (Dyer, et al., 2004; 2010). Specifically the relationships between Record Fire and CFF (Dyer, et al., 2010), and the live-fire BRM correlations and the EST2000 BRM correlations (Dyer, et al., 2004) showed the same patterns. This consistency with the EST results existed despite some differences in the Field Fire and Record Fire scenarios that were part of BRM training in 2003 and 2004 (see Tables G-**3** and G-4).

Thus, consistent with literature on skill development, live-fire marksmanship performance became more consistent with more training; Soldier performance became more predictable. However, it is acknowledged that the size of the correlations do not enable errorless prediction of "good" and "poor" shooters.

Performance on the marksmanship simulator did not conform to this trend. EST 2000 measures did not correlate with later live-fire measures, but only correlated with the EST measures. The reasons for this are not known. But the Dyer et al. (2004) data may provide some insights into this difference. In that research, scores on the EST 2000 were consistently significantly higher than live-fire scores for the same target engagement scenarios (Tables G-5 and G-6). In the EST 2000 simulator environment (an air-conditioned room), Soldiers use a replicated rifle (not their own rifle), a laser (not an actual round), and the simulator "zeros" the rifle (not the Soldier). Thus, Soldier performance in the simulator is not impacted by factors typical of live-fire, (e.g., variations in the quality of the live rounds, worn rifle barrels, and a zero that may not be precise as well as a small arms range where weather and lighting conditions cannot be controlled). These factors impact Soldiers differently, introducing variability and unpredictability in live-fire performance. Yet, the simulator controls for (or "filters" out) these factors, which may explain the higher scores in the simulator. Additionally, these differences could have led to the low correlations between the two sets of measures.

It is important to note that the low correlations between the EST and live-fire found in this research do not mean that the EST 2000 does not provide training value on selected skills. The results do mean however that EST 2000 performance should not be used as an indicator of how a Soldier will do in live fire even if the live-fire scenario is identical to the EST scenario. It may be beneficial to examine which skills the EST can best train, and then examine variations to the training exercises that will enhance these skills. For example, the EST could incorporate adaptive training, for example, the shot group accuracy criterion could gradually become more rigorous as Soldiers become better at grouping with the size of the shot group being even smaller than the 4cm equivalent required in live-fire. EST scenarios could be compressed in time (per

Schneider, 1984), thereby increasing the number of "trials" a Soldier performs. Soldiers may be less motivated in the EST than in live-fire, therefore some means of making the simulator training extrinsically rewarding could be considered.

Summary

The assessment showed the importance of conducting research on new and revised training programs in order to identify unexpected resource issues and to determine whether the training objectives are met. Because multiple changes were made to the marksmanship strategies, each marksmanship period in each company was observed in order to document the impact of these changes. Additionally, data were collected on multiple measures of performance.

At the heart of the research were questions about Soldier performance, ammunition allocation, and training time. The core findings were:

- Infantry OSUT Soldiers scored significantly higher on the first attempt at Record Fire and on Combat Field Fire (the culminating exercise in ARM) than BCT Soldiers. However, the difference was much greater with Combat Field Fire than Record Fire.
- Regarding ammunition allocation in the strategies, there were three major findings. First, based on the Combat Field Fire results, we concluded that the additional rounds in the ARM strategy for OSUT Soldiers were warranted. Second, ammunition allocations were inadequate in other marksmanship periods, primarily grouping and zeroing. The analyses showed that these shortages resulted primarily from a change from 3-round shot groups to 5-round shot groups. Also more rounds were required in grouping than zeroing, inconsistent with the strategy which specified the same round allocations in each period. Third, although the strategy allocated only 40 rounds per Soldier for Record Fire, for research purposes the Soldiers in the companies were allowed to refire if they did not qualify on the first attempt. Results showed that the greatest increment in the percentage of Soldiers who qualified came on the second attempt. Determining the most cost- and training-effective policy regarding refires was beyond the scope of the research. But the data we obtained provide a basis for making such comparisons.
- Lastly, in general, the times allocated for each period were adequate for conducting the specific exercises and firing tables.

The research enabled us to examine some other marksmanship questions which have not typically been examined in prior research. We found that the Combat Field Fire standards were replicated with the OSUT Soldiers. The results also showed that Soldiers, in general, benefited from two repetitions of Practice Record Fire. We conducted additional analyses which incorporated archival data and compared the number of shot groups required to group and zero using three-round vs. five-round shot groups. Furthermore we examined the relationship between major performance measures in BRM and ARM to determine the degree to which Soldier performance is consistent over time and at what point it starts to stabilize.

In the assessment, the OSUT ARM strategy, which involved increased rounds and training scenarios stressing more combat-like skills, was supported. The OSUT ARM strategy focused on Soldiers acquiring specific advanced marksmanship skills and was designed to enable

Soldiers to have repeated practice on these skills. OSUT Soldiers performed significantly better than BCT Soldiers on the culminating event in ARM --Combat Field Fire. This difference was substantial, with about twice as many OSUT than BCT Soldiers meeting the minimum requirement. Of interest is that OSUT Soldiers were likely to cite a period in ARM that substantially improved their shooting ability, whereas that was not the case for BCT Soldiers. The BCT ARM strategy was not as focused, allocating limited training time to a variety of skills rather than incorporating a strategy which progressively trained advanced skills. This probably contributed to lower performance on the culminating event in ARM. An alternative BCT ARM approach would be to decide which advanced skills are most important for the BCT Soldier population (e.g., night fire, advanced optics, CFF skills) and develop a specific strategy to enable Soldiers to become proficient with those skills.

The results also supported having OSUT Soldiers wear combat gear in BRM, although a formal experiment on the impact of combat gear could not be conducted. Problems in executing new scenarios primarily in ARM and software changes in LOMAH were identified. Equipment shortages also hindered effective and efficient training, specifically CCOs for BCT units and night equipment for both BCT and OSUT although night equipment quantities were more limited in BCT. Soldiers also indicated that they needed more practice in the periods of instruction where equipment was limited.

There were some unexpected benefits from the assessment, both practical and conceptual. The CFF hit standards which had been established the year prior were validated. We found that, in general, Soldiers did better on Record Fire than on Practice Record Fire in terms of their marksmanship category. Very few did more poorly on Record Fire than Practice Record Fire. Consequently, using Practice Record Fire scores as “Record Fire” scores for the final Record Fire marksmanship categories would penalize more Soldiers than benefit Soldiers, and the policy of using the Record Fire period for qualification should continue.

The data base allowed a comparison of five- and three-round shot groups with archival data bases dating back to 1999. Overall, the number of shot groups required to group and zero was the same regardless of whether three-round or five-round shot groups were used. Each research effort consistently showed that more shot groups were required to zero than to group. Both findings have implications for round allocations in future marksmanship strategies, and warrant controlled experimentation to better address these issues.

The ability to record Soldier performance from multiple marksmanship periods provided a picture of skill development over time. The results reinforced the general finding that performance in early stages of learning is rather elastic and variable. Even near the end of ARM, Soldiers are still in the process of acquiring new marksmanship skills. Consequently the marksmanship performance for many Soldiers has not stabilized. Predictions of who will perform well or poorly cannot be made with any degree of certainty by a trainer. The Army’s best shooters achieve high levels of skill through extensive practice. An IET marksmanship program cannot provide the same amount of practice. Thus it is important to identify which marksmanship skills should be stressed in the strategy and provide adequate practice for those skills.

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APPENDIX A

FIRING TABLES

BRM Firing Tables: OSUT and BCT

Table A-1
BRM 6 Field Fire 1 – Live Fire (40 rounds) – OSUT and BCT [revised firing tables]

TABLE ONE				TABLE TWO			
RND	RNG	TIME	POSITION	RND	RNG	TIME	POSITION
1-5	75	na	Kneeling	1-5	75	na	Prone Supported
6-10	175	na	Kneeling	6-10	175	na	Prone Supported
11-15	175	na	Prone Supported	11-15	175	na	Prone Unsupported
16-20	300	na	Prone Supported	16-20	300	na	Prone Unsupported

Note. 10 rounds kneeling, 20 rounds prone sandbag supported, 10 rounds prone unsupported.

Note. It appears that the revised tables in the POI strategy were based on the downrange feedback tables in the 2008 Marksmanship FM 3-22.9. All target presentations were untimed, similar to what was specified in the downrange feedback firing tables in the FM (at 100, 200, and 300 meters). Forty rounds were fired, and three target distances were used with half the targets at the intermediate distance. However, in downrange feedback there was is no kneeling position. The specifications for downrange feedback are presented below for comparison purposes.

Downrange Feedback Firing Tables From the Marksmanship FM (2008)			
Supported Firing Position		Prone Firing Position	
Rounds	Range (m)	Rounds	Range (m)
5	100	5	100
10	200	10	200
5	300	5	300

Table A-2

BRM 7 and 8 Field Fire 2- Single Targets [revised firing tables]
BRM 7 conducted in the EST (simulated); BRM 8 conducted with live fire.
OSUT Soldiers in combat gear in BRM 7 and 8. BCT Soldiers – no gear.

PRONE SUPPORTED TABLE ONE			PRONE UNSUPPORTED TABLE TWO			KNEELING FIRING TABLE THREE		
RND	RNG	TIME	RND	RNG	TIME	RND	RNG	TIME
1	75	6	1	75	6	1	75	6
2	175	8	2	175	8	2	175	8
3	75	6	3	75	6	3	75	6
4	300	10	4	300	10	4	175	8
5	75	6	5	75	6	5	75	6
6	175	8	6	175	8	6	175	8
7	75	6	7	75	6	7	75	6
8	175	8	8	175	8	8	175	8
9	300	10	9	300	10	9	75	6
10	75	6	10	75	6	10	75	6
11	300	10						
12	75	6						
13	175	8						
14	300	10						
15	75	6						
16	175	8						
17	75	6						
18	175	8						
19	300	10						
20	75	6						

Table A-3
BRM 7 and 8 Field Fire 2- Multiple Targets [revised firing tables]
BRM 7 conducted in the EST (simulated); BRM 8 conducted with live fire.
OSUT Soldiers in combat gear in BRM 7 and 8. BCT Soldiers – no gear.

PRONE SUPPORTED FIRING			PRONE UNSUPPORTED FIRING			KNEELING FIRING		
TABLE ONE			TABLE TWO			TABLE THREE		
RND	RNG	TIME	RND	RNG	TIME	RND	RNG	TIME
1	75	5	1	75	6	1	175	8
2	175	7	2	175	8	2	75	6
3/4	75/300	11	3/4	75/300	13	3/4	75/175	11
5/6	75/175	9	5/6	75/175	11	5/6	75-175	11
7/8	75/300	10	7/8	75/300	12	7/8	75-175	11
9/10	175/300	11	9/10	175/300	13	9/10	75/175	11
11	75	6						
12	175	8						
13/14	75-300	13						
15/16	75-175	11						
17/18	75-300	12						
19/20	175-300	13						

The single target firing table (A-2) was fired first. The multiple target firing table (A-3) was fired second. For each table the round allocation was: 20 rounds prone sandbag supported, 10 rounds prone unsupported, and 10 rounds kneeling.

Note. The firing tables for BRM 7 and 8 were revisions to what was designated as Field Fire I and II in the 2008 Marksmanship FM. In the FM, there were 36 target exposures for Field Fire I and 44 target exposures for Field Fire II, for a total of 80 rounds. The revised tables also had a total of 80 rounds, but these rounds were evenly distributed between the single and multiple target tables. These tables are presented below.

Field Fire I from Marksmanship FM (2008) – FM 3-22.9
Single Target Tables

PRONE SUPPORTED FIRING			PRONE UNSUPPORTED FIRING			KNEELING FIRING		
TABLE ONE			TABLE TWO			TABLE THREE		
RND	RNG	TIME	RND	RNG	TIME	RND	RNG	TIME
1	75	6	1	75	6	1	75	6
2	175	8	2	175	8	2	175	8
3	300	10	3	300	10	3	75	6
4	175	8	4	175	8	4	175	8
5	75	6	5	75	6	5	75	6
6	300	10	6	300	10	6	175	8
7	300	10	7	300	10	7	75	6
8	75	6	8	75	6	8	75	6
9	175	8	9	175	8	9	175	8
10	175	8						
11	300	10						
12	175	8						
13	75	6						
14	300	10						
15	175	8						
16	75	6						
17	300	10						
18	75	6						

Field Fire II from Marksmanship FM (2008), FM3-22.9
Multiple Target Tables

PRONE SUPPORTED FIRING POSITION			PRONE UNSUPPORTED FIRING POSITION		
TABLE ONE			TABLE TWO		
RND	RNG	TIME	RND	RNG	TIME
1	175	7	1	75	6
2/3	75/300	10	2	175	8
4/5	75/175	9	3 /4	75/300	13
6	300	9	5/6	75/175	11
7/8	75/175	9	7/8	75/300	12
9/10	175/300	11	9/10	175/300	13
11/12	75/175	9	11/12	75/175	11
13/14	175/300	11	13	175	8
15	75	5	14	75	6
16/17	175/300	11	15/16	75/175	11
18/19	75/175	9	17/18	75/300	12
20/21	75/300	10	19/20	75/175	11
22	175	7	21/22	175/300	13

Table A-4
Comparison of Target Distances in the New Strategy with Revised Tables and FM 3-22.9

	New Strategy- Revised Tables		FM 3-22.9	
Target Distance	Single Target Tables	Multiple Target Tables	FFI: Single Target Tables	FFII: Multiple Target Tables
	# (%) targets	# (%) targets	# (%) targets	#(%) targets
75m	20 (50%)	17 (43%)	14 (39%)	16 (36%)
175m	13 (33%)	14 (35%)	13 (36%)	17 (39%)
300m	7 (18%)	9 (23%)	9 (25%)	11 (25%)
Total # Targets	40	40	36	44
Standard	Hit 22 of 40	Hits 24 of 40	Hit 22 of 36	Hit 27 of 44

The revised strategy changed the distribution of targets across the three distances. For each table there were more 75m targets and fewer 175m and 300m targets. Comparing the total number of hits required across both tables, the revised strategy specified fewer hits (46 versus 49).

Table A-5
Record Fire Table in FM 3-22.9 Rifle Marksmanship M16-/M4- Series Weapons (2008) Used for Practice Record Fire (BRM 9) and Record Fire (BRM 10) in OSUT and BCT

Table 1 Prone Supported or Foxhole Supported				Table 2 Prone Unsupported		Table 3 Kneeling	
Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)
50	3	100		200	6	150	8
200	6	200	8	250	8	50	4
100	4	150	10	150	6	100	5
150	5	300		300		150	6
300	8	100	9	200	10	100	5
250	7	250		150		50	4
50	3	200	6	200	12	100	5
200	6	150	5	250		150	6
150	5	50	6	150	9	50	4
250	7	100		150	6	100	5

Note. Based on DA Form 3595-R, September, 2008. Practice Record was fired twice, Record Fire was fired once. Round allocation was: 20 rounds prone sandbag supported, 10 rounds prone unsupported, and 10 rounds kneeling.

Table A-6
Infantry OSUT, ARM 1 Rapid Aim Fire Tables – executed in the EST

Stationary Fire Standards					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Straight Ahead	4	25	Single Shot	None	3 of 4
Straight Ahead	4	25	Controlled pair	None	3 of 4
Straight Ahead	2 Magazine	10	Single Shot	None	1 of 2
Straight Ahead	4	10	Controlled Pair	None	3 of 4

Moving Fire Standards					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Facing left, turning right	4	25	Controlled Pair	None	3 of 4
Facing right, turning left	4	25	Controlled Pair	None	3 of 4
Straight ahead walking	4	10, start at 15	Controlled Pair	None	3 of 4
Straight Ahead	4	10	Controlled Pair	None	3 of 4

Walk and Shoot Standards					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Start 25m, Fire Straight	2	25m	Controlled Pair	None	1 of 2
Walk Straight, Fire Straight	4	Start 25m Fire at 20m	Controlled Pair	None	1 of 2
Walk to Right, Fire to Left	4 Magazine	20m	Controlled Pair	None	1 of 2
Walk Straight, Fire Straight	4	Start 20m Fire 15m	Controlled Pair	None	3 of 4
Walk to Left, Fire to Right	4	15m	Controlled Pair	None	3 of 4
Walk Straight Fire Straight	2 Magazine 2	Start 15m Fire 10m	Controlled Pair	None	3 of 4
Walk to Right, Fire to Left	4	10m	Controlled Pair	None	3 of 4
Walk Straight Fire Straight	2	Start 10m Fire 5m	Controlled Pair	None	3 of 4
Walk to Left, Fire to Right	2	5m	Controlled Pair	None	3 of 4

Table A-7
Infantry OSUT ARM 2 – Live Fire Reflexive Fire Tables

Stationary Fire Standards (Table 1)					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Straight Ahead	4	25	Single Shot	None	3 of 4
Straight Ahead	4	25	Controlled pair	None	3 of 4
Straight Ahead	2 Magazine	10	Single Shot	None	1 of 2
Straight Ahead	4	10	Controlled Pair	None	3 of 4

Note. 14 rounds from standing unsupported position

Moving Fire Standards (Table 2)					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Facing left, turning right	4	25	Controlled Pair	None	3 of 4
Facing right, turning left	4	25	Controlled Pair	None	3 of 4
Straight ahead walking	4	10, start at 15	Controlled Pair	None	3 of 4
Straight Ahead	4	10	Controlled Pair	None	3 of 4

Note. 16 rounds from the standing unsupported position

Walk and Shoot Standards (Table 3)					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Start 25m Fire Straight	2	25m	Controlled Pair	None	1 of 2
Walk Straight Fire Straight	4	Start 25m Fire at 20m	Controlled Pair	None	1 of 2
Walk to Right Fire to Left	4 Magazine	20m	Controlled Pair	None	1 of 2
Walk Straight Fire Straight	4	Start 20m Fire 15m	Controlled Pair	None	3 of 4
Walk to Left Fire to Right	4	15m	Controlled Pair	None	3 of 4
Walk Straight Fire Straight	2 Magazine 2	Start 15m Fire 10m	Controlled Pair	None	3 of 4
Walk to Right Fire to Left	4	10m	Controlled Pair	None	3 of 4
Walk Straight Fire Straight	2	Start 10m Fire 5m	Controlled Pair	None	3 of 4
Walk to Left Fire to Right	2	5m	Controlled Pair	None	3 of 4

Note. 30 rounds from the standing unsupported position.

Table A-8
Infantry OSUT ARM 2N – Introduction to Night Fire - Live Fire Tables

Night Moving Standards (Table 1)					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Straight Ahead	4	(Start 25m) 2 x 25m	Controlled Pair	None	2 of 4
Straight ahead walking	4	(Begin at 25m) 2 x 20m	Controlled Pair	None	2 of 4
Straight ahead walking	4	(Begin at 20m) 2 x 15m	Controlled Pair	None	2 of 4
Straight ahead walking	4	(Begin at 15m) 2 x 10m	Controlled Pair	None	2 of 4
Straight ahead walking	4	(Begin at 10m) 2 x 5m	Controlled Pair	None	2 of 4

Note. 20 rounds from the standing supported position.

Night Moving Standards (Table 2)					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Start 25m Fire Straight	2	25m	Controlled Pair	None	1 of 2
Walk Straight Fire Straight	4	Start 25m Fire 15m	Controlled Pair	None	1 of 2
Walk to Right Fire to Left	4	15m	Controlled Pair	None	1 of 2
Walk Straight Fire Straight	4	Start 15m Fire 10m	Controlled Pair	None	3 of 4
Walk to Left Fire to Right	4	10m	Controlled Pair	None	3 of 4
Walk Straight Fire Straight	2	Start 10m Fire 5m	Controlled Pair	None	3 of 4

Note. 20 rounds from the standing supported position

Table A-9
Infantry OSUT ARM 3 Barrier Shoot

Single Barricade Table:

POSITION	ROUNDS FIRED	TARGET DISTANCE (meters)	ACTION AFTER FIRING
START (0M) Standing Position	5	100M	Walk Straight Ahead
Barricade (10M) Supported Position	5 Change Magazine	100 to 200M	Change Firing Position Only
Barricade (10M) Kneeling Supported Position	5	100 to 200M	Change Firing Position Only
Barricade (10M) Prone Unsupported Position	5 Change Magazine	100 to 200M	Walk Straight Ahead
Walking Straight Ahead	5	75M	Assume Kneeling Unsupported Position
Kneeling Unsupported Position	5	75 to 150M	Clear the weapon

Note. Each magazine included 1 dummy round loaded randomly for an induced malfunction. 30 rounds per Soldier. 3 magazines of 11 rounds (10 live rounds and 1 dummy round loaded randomly) per Soldier

Multiple Barricade Table:

POSITION	ROUNDS FIRED	TARGET DISTANCE (meters)	ACTION AFTER FIRING
START 0M leftside Standing Position	5	100M	Walk Straight Ahead toward left barricade
Left Barricade (10M) Barricade Supported Firing Position	5 Change Magazine	75 to 150M	Change Barricade Firing Position Only
Left Barricade (10M) Barricade Supported Firing Position	5	100 to 200M	Move laterally towards the right barricade
Right Barricade (10M) Barricade Supported Firing Position	5 Change Magazine	75 to 150M	Change Firing Position Only
Right Barricade (10M) Barricade Supported Firing Position	5	100 to 200M	Walk Straight Ahead
Kneeling Unsupported Position	5	75 to 150M	Clear the weapon

*Note***.** Each magazine included 1 dummy round loaded randomly for an induced malfunction. 30 rounds per Soldier. 3 magazines of 11 rounds (10 live rounds and 1 dummy round loaded randomly) per Soldier

Table A-10
Infantry OSUT ARM 3N Night Fire Barrier Shoot

Single Barricade Table:

POSITION	ROUNDS FIRED	TARGET DISTANCE (meters)	ACTION AFTER FIRING
START (0M) Standing Position	5	100M	Walk Straight Ahead
Barricade (10M) Supported Position	5 Change Magazine	100 to 200M	Change Firing Position Only
Barricade (10M) Kneeling Supported Position	5	100 to 200M	Change Firing Position Only
Barricade (10M) Prone Unsupported Position	5 Change Magazine	100 to 200M	Clear the weapon

Note. Each magazine included 1 dummy round loaded randomly for an induced malfunction. 20 rounds per Soldier. 2 magazines of 11 rounds (10 live rounds and 1 dummy round loaded randomly) per Soldier.

Multiple Barricade Table:

POSITION	ROUNDS FIRED	TARGET DISTANCE (meters)	ACTION AFTER FIRING
START 0M leftside Standing Position	5	100M	Walk Straight Ahead toward left barricade
Left Barricade (10M) Barricade Supported Firing Position	5 Change Magazine	75 to 150M	Change Barricade Firing Position Only
Left Barricade (10M) Barricade Supported Firing Position	5	100 to 200M	Move laterally towards the right barricade
Right Barricade (10M) Barricade Supported Firing Position	5 Change Magazine	75 to 150M	Clear the weapon

Note. Each magazine included 1 dummy round loaded randomly for an induced malfunction. 20 rounds per Soldier. 2 magazines of 11 rounds (10 live rounds and 1 dummy round loaded randomly) per Soldier

Table A-11
Infantry OSUT ARM 4 Moving Target Firing Table

A			B			C			D		
Task	**Dist**	**Time***	**Task**	**Dist**	**Time**	**Task**	**Dist**	**Time**	**Task**	**Dist**	**Time**
1	75	0:05	1	300	0:05	1	175	0:05	1	75	0:04
2	125	0:05	2	35	0:05	2	125	0:04	2	35	0:04
3	35	0:05	3	175	0:08	3	75	0:04	3	300	0:08
4	75	0:04	4	125	0:04	4	125	0:04	4	125	0:04
5	175	0:05	5	75	0:04	5	35	0:03	5	175	0:05
6	125	0:05	6	35	0:03	6	75	0:04	6	75	0:04
7	300	0:08	7	125	0:04	7	125	0:04	7	35	0:03
8	125	0:05	8	75	0:04	8	175	0:08	8	125	0:04
9	35	0:03	9	175	0:05	9	35	0:03	9	75	0:04
10	75	0:04	10	125	0:04	10	300	0:05	10	125	0:04

For Infantry OSUT, ARM 4 involved moving targets: 40 single, double, or triple stationary or moving target exposures. Exposure times in the table are in seconds.

Table A-12
Infantry OSUT ARM 5 Barrier Shoot #2

Multiple Barricade (Lateral Movement only) Table 1:

POSITION	ROUNDS FIRED	TARGET DISTANCE (m)	ACTION AFTER FIRING
START 0M leftside Standing Position	5	25M Paper	Walk Straight Ahead toward left barricade
Left Barricade (10M) Barricade Supported Firing Position	5 Change Magazine	100 to 200M Steel	Change Barricade Firing Position Only
Left Barricade (10M) Barricade Supported Firing Position	5	75 to 100M Steel	Move laterally towards the right barricade
Right Barricade (10M) Barricade Supported Firing Position	5 Change Magazine	50 to 100M Paper	Change Firing Position Only
Right Barricade (10M) Barricade Supported Firing Position	5	100 to 200M Steel	Walk Straight Ahead
Kneeling Unsupported Position	5	75 to 150M Steel	Clear the weapon

Note. 30 rounds per Soldier. 3 magazines of 11 rounds (10 live rounds and 1 dummy round loaded randomly) per Soldier.

Multiple Barricade (Lateral and Forward Movement) Table 2:

POSITION	ROUNDS FIRED	TARGET DISTANCE (m)	ACTION AFTER FIRING
START 0M leftside Standing Position	5	100M steel	Walk Straight Ahead between the two 10M barricades
Left or Right Barricade (10M) Barricade Supported Firing Position	5 Change Magazine	75 to 150M Paper	Change Barricade Firing Position Only
Left or Right Barricade (10M) Barricade Supported Firing Position	5	100 to 200M steel	Move laterally towards the opposite (right or left) barricade
Right or Left Barricade (10M) Barricade Supported Firing Position	5 Change Magazine	75 to 150M paper	Walk Forward to the next barricade row (25M)
Center Barricade (20M) Barricade Supported Firing Position	5	100 to 200M steel	Change Firing Position Only
Kneeling Barricade Supported Position	5	75 to 150M paper	Clear the weapon

Note. 30 rounds per Soldier. 3 magazines of 11 rounds (10 live rounds and 1 dummy round loaded randomly) per Soldier.

Table A-13
Infantry OSUT ARM6 CFF (fired twice)
BCT ARM 7 CFF (fired once)

Table A-13 shows five arrays of targets, there were no single target exposures. Each iteration had 3 magazines of 11 rounds (10 live rounds and 1 dummy round loaded randomly) per Soldier. Soldiers changed magazines at own discretion. For Infantry OSUT, CFF was fired twice (60 live rounds per firer/30 live rounds per each iteration). BCT only fired CFF once (30 live rounds per Soldier).

Kneeling Unsupported (4-target array)		
RANGE (METERS)	**HITS TO KILL**	**EXPOSURE TIME (SECONDS)**
50 (Left)	2	31
50 (Right)	2	31
100	1	45
150	2	60

Barricade Supported Set 1 (2 target array)		
RANGE (METERS)	**HITS TO KILL**	**EXPOSURE TIME (SECONDS)**
50 (Left or Right)	3	26
100	2	40
Barricade Supported Set 2 (3 target array)		
RANGE (METERS)	**HITS TO KILL**	**EXPOSURE TIME (SECONDS)**
100	1	19
150	2	21
200	1	40

Prone Unsupported Set 1 (3 target array)		
RANGE (METERS)	**HITS TO KILL**	**EXPOSURE TIME (SECONDS)**
100	2	23
200	2	36
250	1	50
Prone Unsupported Set 2 (3 target array)		
RANGE (METERS)	**HITS TO KILL**	**EXPOSURE TIME (SECONDS)**
150	2	21
250	2	37
300	1	50

BCT ARM TABLES

For ARM1, see Tables A-2 and A-3.

Table A-14
BCT ARM 4 and 4N (CCO used during the day; Night vision device/goggles and AN/PAQ-4 aiming light used at night)

DAY FIRING					
PRONE SUPPORTED			PRONE UNSUPPORTED		
TABLE ONE			TABLE TWO		
RND	RNG	TIME	RND	RNG	TIME
1	50	3	1	200	6
2/3	100/200	8	2/3	300/200	10
4	200	6	4	250	8
5/6	150/300	10	5/6	150/200	12
7	200	6	7	150	6
8/9	100/250	9	8/9	250/150	9
10	150	5	10	150	6

Note. 10 rounds from prone sandbag supported position. 10 rounds from prone unsupported position.

NIGHT FIRING					
PRONE SUPPORTED			PRONE UNSUPPORTED		
TABLE ONE			TABLE TWO		
RND	RNG	TIME	RND	RNG	TIME
1	50	3	1	100	5
2	200	6	2/3	50/200	12
¾	50/150	8	4/5	100/150	12
5	150	5	6	200	8
6	250	7	7	150	6
7	100	6	8/9	50/150	12
8/9	50/250	9	10	100	8
10	200	6			

Note. 10 rounds from prone sandbag supported position. 10 rounds from prone unsupported position.

Table A-15
BCT: ARM 5 and 5N Reflexive Fire

Day Stationary Fire Standards (Table 1)					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Straight Ahead	4	25	Single Shot	None	3 of 4
Straight Ahead	4	25	Controlled pair	None	3 of 4
Straight Ahead	2	10	Single Shot	None	1 of 2
Straight Ahead	4	10	Controlled Pair	None	3 of 4

Note. 14 rounds from the standing unsupported position.

Day Moving Fire Standards (Table 2)					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Facing left, turning right	4	25	Controlled Pair	None	3 of 4
Facing right, turning left	4	25	Controlled Pair	None	3 of 4
Straight ahead walking	4	10, start at 15	Controlled Pair	None	3 of 4
Straight Ahead	4	10	Controlled Pair	None	3 of 4

Note. 16 rounds from the standing unsupported position.

Night Stationary and Moving Standards (Table 3)					
Position	**Rounds Fired**	**Distance**	**Method**	**Time**	**Lethal Zone Standard**
Straight Ahead	4	(Start 25m) 2 x 25m	Controlled Pair	None	2 of 4
Straight ahead walking	4	(Begin at 25m) 2 x 20m	Controlled Pair	None	2 of 4
Straight ahead walking	4	(Begin at 20m) 2 x 15m	Controlled Pair	None	2 of 4
Straight ahead walking	4	(Begin at 15m) 2 x 10m	Controlled Pair	None	2 of 4
Straight ahead walking	4	(Begin at 10m) 2 x 5m	Controlled Pair	None	2 of 4

Note. 20 rounds from the standing unsupported position.

Table A-16
BCT ARM6 – Barrier shoot

Position	**Rounds Fired**	**Target Distance (Meters)**	**Action After Firing**
START (0m) Standing Position	5	100M	Walk straight ahead
Barricade (10M) Supported Position	5 Change Magazine	100 to 200M	Change Firing Position Only
Barricade (10M) Kneeling Supported Position	5	100 to 200M	Change Firing Position Only
Barricade (10M) Prone Unsupported Position	5 Change Magazine	100 to 200M	Walk Straight Ahead
Walk Straight Ahead	5	75M	Assume Kneeling Unsupported Position
Kneeling Unsupported Position	5	75 to 150M	Clear the Weapon

Note. 30 Rounds per Soldier. 3 magazines of 11 rounds (10 live rounds and 1 dummy round loaded randomly) per Soldier.

BCT ARM 7 was CFF; See Table A-13.

LOMAH: BRM 8 Field Fire II Solution: Companies at Ft. Benning

Tables A-17 and A-18 document the temporary changes made to the LOMAH software at Ft. Benning to make it as consistent as possible with the revised Field Fire II (BRM8) scenarios in the new strategy. For both the single and multiple tables, the only deviation was with the prone unsupported position, as the existing LOMAH software could be adapted to correspond to the new strategy for the prone unsupported and kneeling positions.

For **Single Targets**, each Soldier fired three tables:

Table 1: Prone Supported Firing Position – 18 rounds – only deviation from the new strategy.
Table 2: Prone Unsupported Firing Position – 10 rounds
Table 3: Kneeling Firing Position – 10 rounds

Table A-17
Field Fire II Prone Supported Position Only – Single Targets (New strategy compared to LOMAH solution)

New Strategy				**LOMAH Temporary Solution**			Comments
PRONE SUPPORTED 20-round mag				PRONE SUPPORTED 18-round mag			
TABLE ONE				TABLE ONE			
RND	RNG	TIME		RND	RNG	TIME	
1	75	6		1	75	6	
2	175	8		2	175	8	
3	75	6		3	75	6	
4	300	10		4	300	10	
5	75	6		5	75	6	
6	175	8		6	175	8	
7	75	6		7	300	10	Deviation (vs.75)
8	175	8		8	175	8	
9	300	10		9	300	10	
10	75	6		10	75	6	
11	300	10		11	300	10	
12	*75	6		12	75	6	
13	175	8		13	175	8	
14	300	10		14	300	10	
15	75	6		15	175	8	Deviation (vs.75)
16	175	8		16	175	8	
17	75	6		17	300	10	Deviation (vs.75)
18	175	8		18	175	8	
19	300	10					
20	75	6					

Notes.

1. Three deviations in target distance because of the constraints on # of targets by distance; no deviation in exposure times.

2. Soldiers had an 18-round magazine, no more than 18 single target exposures were possible with LOMAH software*
3. Procedures for running the LOMAH range had to be modified (e.g., when to cease fire), but are not presented here.

For **Multiple Targets**, each Soldier fired three tables:
Table 1: Prone Supported Firing Position – 20 rounds – only deviation from new strategy
Table 2: Prone Unsupported Firing Position – 10 rounds
Table 3: Kneeling Firing Position – 10 rounds

Table A-18
Field Fire II Prone Supported Only – Multiple Targets (New strategy compared to LOMAH solution)

New Strategy				**LOMAH Temporary Solution**			Comments
PRONE SUPPORTED 20 round mag				PRONE SUPPORTED 20 round mag			
TABLE ONE				TABLE ONE			
RND	RNG	TIME		RND	RNG	TIME	
1	75	5		1	75	5	
2	175	7		2	175	7	
3/4	75/300	11		3/4	75/300	11	
5/6	75/175	9		5/6	75/175	9	
7/8	75/300	10		7/8	75/300	10	
9/10	175/300	11		9/10	175/300	11	
11	75	6		11	175	6	Only deviation
12	175	8		12	175	8	
13/14	75/300	13		13/14	75/300	13	
15/16	75/175	11		15/16	75/175	11	
17/18	75/300	12		17/18	75/300	12	
19/20	175/300	13		19/20	175/300	13	

Notes.
1. Only one deviation from prone unsupported table in new strategy.
2. Soldier issued a 20-round magazine.
3. All target distances were the same except for one – see round 11 – 175 vs. 75m.
4. Exposure times are same for the respective target distances.
5. Procedures for running the LOMAH range had to be modified (e.g., when to cease fire), but are not presented here.

APPENDIX B

BASIC RIFLE MARKSMANSHIP QUESTIONNAIRE AND RESULTS

This questionnaire focuses on the basic rifle marksmanship training you have received – from the start of marksmanship training through record fire which you just completed.

Sample Size

OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
185	193	209	175	191	133

Question 1 through 4 are on whether you feel that you needed more practice on basic marksmanship skills. The next two questions on the training you received in the Engagement Skills Trainer. Last are questions on wearing combat equipment during marksmanship training.

Firing Positions

1. On which positions do you feel that you need ***more practice*** to establish and maintain a stable firing position? (Circle "Y" or "N" for each position)

Y N a. Prone Supported
Y N b. Prone Unsupported
Y N c. Kneeling

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	8.1	17.2	16.9	13.7	20.9	26.3
B	16.2	29.0	40.9	26.9	55.5	55.6
C	79.5	65.3	72.5	69.1	48.7	45.9

Weapon Handling

2. For which of the following weapon handling procedures do you feel you need ***more practice*****?** (Circle "Y" or "N" for each procedure)

Y N a. Weapon maintenance procedures
Y N b. Performing a function check
Y N c. Preventing an accidental discharge from my weapon
Y N d. Proper weapon clearing procedures

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	23.2	19.7	12.5	26.3	18.3	27.8
B	10.3	10.9	8.7	9.7	13.6	16.5
C	9.2	5.2	7.7	4.0	17.8	17.3
D	4.	8.3	9.6	5.1	5.2	1.5

Basic Skills

3. For which of the following basic skills do you feel you need ***more practice*****?**
(Circle "Y" or "N" for each skill)

Y N a. Consistently getting tight shot groups
Y N b. Controlling my breathing so my weapon does not move when I fire
Y N c. Squeezing the trigger so my weapon does not move when I fire
Y N d. Controlling or avoiding flinching in anticipation of the round going off
Y N e. Maintaining the same sight picture each time I fire
Y N f. Adjusting my back up iron sights to zero my weapon with no assistance
Y N g. Adjusting the M68 (CCO) to zero my weapon with no assistance

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	30.3	26.9	32.1	25.7	43.5	31.6
B	20.5	30.6	28.0	18.3	28.3	30.1
C	25.4	22.8	27.5	21.1	28.3	27.1
D	23.8	21.9	26.3	27.4	23.6	25.6
E	34.6	35.2	34.0	25.7	34.0	46.6
F	48.6	30.2	37.0	57.7	42.9	59.4
G	28.6	40.4	38.9			

Note. Question 3g was not asked of BCT Soldiers as they did not use the CCO in BRM.

Target Engagement

4. For which of the following skills do you feel you need ***more practice*****?**
(Circle "Y" or "N" for each skill.)

Y N a. Hitting targets at 250 and 300 meters
Y N b. Hitting multiple targets exposed simultaneously
Y N c. Acquiring (seeing) targets as they are exposed

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	43.8	55.4	68.4	69.1	72.3	80.5
B	31.9	31.1	34.4	25.1	25.7	27.1
C	29.7	27.5	20.9	30.3	20.4	17.3

EST Training

5. In what ways did your training in the Engagement Skills Trainer (EST) prepare you for ***grouping*** on the live-fire range?

Y N a. helped to make me aware of what would happen during grouping on the live fire range
Y N b. helped me to understand range safety procedures that would be followed on the live-fire range
Y N c. helped me to improve fundamental shooting skills such as trigger pull, sight picture, sight alignment, and breath control.
Y N d. improved my performance in grouping on the live fire range.

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	89.7	85.4	78.6	72.4	83.2	74.4
B	82.2	84.9	73.9	72.4	80.6	76.7
C	90.3	84.9	70.5	81.0	85.3	72.9
D	78.9	74.3	56.3	61.5	72.8	61.7

6. In what ways did your training in the EST prepare you for the ***field fire exercise*** (shooting at timed, single and multiple targets at various distances) on the live-fire range?

Y N a. helped to make me aware of what would happen during field fire on the live-fire range
Y N b. helped to improve my ability to detect targets exposed for a short time
Y N c. helped to improve my ability to hit targets exposed for a short time
Y N d. improved my performance in field fire on the live-fire range.

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	90.3	82.8	72.8	78.2	90.6	82.7
B	82.2	83.9	67.6	78.7	84.3	74.4
C	77.8	76.6	59.4	66.7	77.5	68.4
D	75.7	75.0	58.0	68.4	75.4	69.9

Combat Equipment

The next set of questions pertain to the effect of wearing combat equipment (e.g., body armor, helmet, and load bearing equipment) on three marksmanship skills from three firing positions.

Please mark "Yes" or "No" in each of the cells. (Note. BCT Soldiers did not have these questions as they did not put on combat gear until ARM.)

When you used your combat equipment for **the first time in the EST**, did it **interfere** with:			
Position	a. Obtaining a stable firing position?	b. Seeing targets?	c. Hitting targets?
7. prone supported	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
8. prone unsupported	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
9. kneeling	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
7a	36.9	44.3	32.9			
7b	22.4	28.1	23.8			
7c	24.0	32.2	31.9			
8a	34.2	47.4	36.7			
8b	19.7	25.0	20.3			
8c	26.2	29.7	34.0			
9a	53.8	53.9	56.3			
9b	16.9	18.8	20.3			
9c	40.9	42.4	45.6			

When you used your combat equipment **during record fire today**, did it **interfere** with:			
Position	a. Obtaining a stable firing position?	b. Seeing targets?	c. Hitting targets?
10. prone supported	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
11. prone unsupported	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
12. kneeling	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
10a	21.2	23.6	17.3			
10b	14.7	17.7	15.9			
10c	14.8	18.2	18.8			
11a	22.8	27.2	24.0			
11b	15.2	15.6	14.0			
11c	16.4	20.8	22.3			
12a	43.5	32.2	42.3			
12b	12.5	14.6	14.4			
12c	32.2	30.2	35.3			

APPENDIX C

ADVANCED RIFLE MARKSMANSHIP QUESTIONNAIRE AND RESULTS

In ARM, you fired at night with aiming lights, executed reflexive fire techniques, fired a barrier shoot scenario, and in the last period you fired a Combat Field Fire scenario. The next questions pertain to these advanced marksmanship skills.

Sample Size

OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
171	180	195	164	180	125

Procedures

1. Do you feel you needed **more practice** on the following?
   (Circle "Y" or "N" or "did not perform")

Y N Did not perform a. Boresighting/zeroing an aiming light (PAQ/ PEQ)
Y N Did not perform b. Boresighting/zeroing a CCO

% Soldiers responding to each option

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
a.Y	23.4	30.0	35.2	23.3	46.9	52.5
a. N	69.0	66.7	59.6	28.8	39.5	30.3
a. Not Perf	7.6	3.3	5.2	48.1	13.6	17.2
b Y				28.4	39.2	56.0
b N				40.7	56.3	40.8
B Not Perf				30.9	4.5	3.2

Note. OSUT Soldiers did not boresight/zero the CCO in ARM; they did this in BRM.

Advanced Firing Positions

2. Do you feel you need **more practice** on any of the firing positions listed below?
   (Circle "Y" or "N" for each)

Y N. a. Standing Unsupported Firing Position
Y N b. Standing Supported Position around/over Obstacles (e.g., barricade)
Y N c. Kneeling Supported Position

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	26.9	38.3	39.4	33.1	31.8	52.8
B	8.2	15.0	26.0	23.3	14.4	41.6
C	18.1	24.4	28.0	23.8	12.3	28.0

Advanced Firing Techniques

3. Do you feel you need **more practice** on any of the advanced firing techniques listed below? (Circle "Y" or "N" for each)

Y N a. Reflexive fire techniques (ready position to target engagement)
Y N b. Rapid fire (controlled pairs)
Y N c. Ability to move and fire from different positions
Y N d. Rapidly transitioning from one position to another
Y N e. Quickly correcting a malfunction while engaging targets
Y N f. Quickly changing magazines while engaging targets
Y N g. Engaging targets at night with an aiming light (PAQ/PEQ) and night vision goggles/device
Y N h. Engaging moving targets (OSUT)
Y N h2. Engaging targets with a CCO (BCT)

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	19.3	21.1	28.2	18.3	16.1	39.0
B	32.2	24.4	41.5	25.2	22.8	46.8
C	19.9	30.0	38.5	28.2	36.9	44.8
D	24.0	32.2	33.3	37.2	29.4	40.0
E	19.9	25.1	28.7	34.1	35.2	21.0
F	27.5	23.3	28.0	30.2	23.5	23.4
G	42.1	43.3	50.0	76.8	78.7	72.0
H	32.7	30.0	51.8			
H2				26.8	30.7	40.8

Note. Blank cells indicate that specific items were not included in the OSUT or BCT questionnaire.

4. Did the second day of barrier training improve any of the following skills? (Circle "Y" or "N" for each)

Y N a. improved my proficiency in changing magazines
Y N b. improved my skill in reacting to an induced malfunction
Y N c. improved my ability to move and fire from different positions
Y N d. improved my ability to use the barricade for stability

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	73.1	82.8	77.8			
B	83.0	85.6	82.5			
C	89.5	82.2	83.0			
D	85.4	91.1	86.7			

Note. BCT units did not have a second day of barrier shooting in ARM.

Combat Field Fire (CFF)

Note. The nomenclature preceding the items indicates the question number in the respective BCT and OSUT surveys. Blank cells indicate that a unit did not have that question.

4 BCT / 5 OSUT. Today, you fired CFF twice. Did you run out of ammunition before you could engage all targets? (Circle "Y" or "N" for each).

Y N a. Ran out of ammunition the first time.
Y N b. Ran out of ammunition the second time

% Soldiers answering "Yes"

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
A	46.2	46.1	39.3	28.7	37.2	44.0
B	56.7	49.7	38.1			

5 BCT / 6 OSUT. How would you describe the pace of the CFF scenario the first and second time you fired? Pace refers to whether you had time to detect and engage all the targets and also change magazines and react to malfunctions. (choose one)

a. The **first** time you fired CFF:

___ Too slow for me ___ The right pace for me ___ Too fast for me

b. The **second** time you fired CFF:

___ Too slow for me ___ The right pace for me ___ Too fast for me

% Soldiers selecting each option

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
a. slow	9.4	12.8	15.5	12.2	6.7	20.2
a. right	82.5	77.8	80.9	77.4	82.2	74.2
a. fast	8.2	9.4	3.6	10.4	11.1	5.6
b slow	12.3	17.2	23.6			
b right	84.2	77.8	74.5			
B fast	3.5	5.0	1.9			

Firing with Combat Equipment.

This section focuses on your reactions to the combat equipment that you were issued during marksmanship training: your helmet, body armor, and load bearing equipment (LBE).

6 BCT / 7 OSUT. Listed below are the marksmanship periods in which you wore combat equipment. <u>They are listed in the order in which you performed them.</u>

Mark the ONE point in training where you feel you had adapted/adjusted to your combat equipment.

[We're referring to the point where you "did not have to think" about your combat equipment either before or during shooting.]

7. (OSUT companies only)

Select <u>one</u> training period (the first period you felt you had adapted to your combat equipment for shooting)

BRM	____ a. Simulated field fire in the EST - the <u>first time</u> you wore this equipment in a firing exercise. ____ b. Field Fire (single and multiple targets) ____ c. Practice record fire ____ d. Record fire (qualification)
ARM	____ e. Rapid aim fire – EST exercise ____ f. Rapid aim fire and night fire with aiming lights on a 25m range ____ g. First barrier shoot – day and night ____ h. Engaging moving targets ____ i. The second barrier shoot ____ j. Combat Field Fire – the training you just completed.
	____ k. Never adapted/adjusted ____ l. Don't recall when I adjusted to my equipment

% Soldiers checking option

		OSUT 1	OSUT 2	OSUT 3
BRM	____ a.	5.3	6.7	3.9
	____ b.	18.1	15.1	23.6
	____ c.	12.9	10.1	14.2
	____ d.	14.0	17.9	15.7
ARM	____ e.	4.7	4.5	7.1
	____ f.	7.0	6.1	3.2
	____ g.	4.1	6.7	6.3
	____ h.	9.9	5.6	7.1
	____ i.	1.8	3.4	3.9
	____ j. .	16.4	16.2	6.3
	____ k.	0.0	1.7	1.6
	____ l.	5.8	6.1	7.1

6. (**BCT companies only)**

Select <u>one</u> ARM training period (the first period you felt you had adapted to your combat equipment for shooting)

ARM	_____	a.	First ARM period –simulated field fire in the EST – the <u>first time</u> you wore this equipment during marksmanship training
	_____	b.	Introduction to the CCO and aiming lights; quick fire
	_____	c.	Zero the CCO and aiming light
	_____	d.	Engage targets with CCO and aiming light
	_____	e.	Reflexive fire (25m range)
	_____	f.	Barrier shoot
	_____	g.	Combat Field Fire – the training you just completed
	_____	h.	Never adapted/adjusted
	_____	i.	Don't recall when I adjusted to my equipment

% Soldiers checking option

			BCT 1	BCT 2	BCT 3
ARM	_____	a.	6.2	9.8	14.4
	_____	b.	9.3	11.5	13.6
	_____	c.	6.8	13.2	16.8
	_____	d.	15.5	9.8	12.8
	_____	e.	27.3	17.2	20.0
	_____	f.	8.1	13.2	3.2
	_____	g.	9.4	19.0	8.0
	_____	h.	9.9	1.2	5.6
	_____	i.	7.5	5.2	5.6

BCT continued

Indicate whether wearing combat equipment interfered with these marksmanship skills from these firing positions. Please mark "Yes" or "No" in each of the cells.

When you used your combat equipment for **the first time in the EST**, did it **interfere** with:			
Position	a. Obtaining a stable firing position?	b. Seeing targets?	c. Hitting targets?
7. prone supported	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
8. prone unsupported	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
9. kneeling	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___

% Soldiers answering "Yes" (BCT Question #s)

	BCT 1	**BCT 2**	**BCT 3**
7a	54.0	59.2	39.2
7b	44.0	50.3	31.2
7c	45.9	53.6	36.8
8a	50.3	50.3	40.3
8b	37.1	41.0	32.5
8c	44.6	47.8	36.6
9a	39.9	36.9	36.3
9b	27.7	26.3	20.2
9c	37.1	33.1	34.7

BCT and OSUT

Indicate whether wearing combat equipment interfered with these marksmanship skills from these firing positions. Please mark "Yes" or "No" in each of the cells.

When you used your combat equipment **during CFF today**, did it interfere with:			
Position	a. Obtaining a stable firing position?	b. Seeing targets?	c. Hitting targets?
10 / 8. kneeling	Yes____ No ___	Yes ___ No ___	Yes ___ No ___
11/ 9. barricade	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___
12/10. prone unsupported	Yes ___ No ___	Yes ___ No ___	Yes ___ No ___

BCT/OSUT item #s: % Soldiers answering "Yes"

	OSUT 1	**OSUT 2**	**OSUT 3**	**BCT 1**	**BCT 2**	**BCT 3**
10/8a	28.1	35.0	19.0	26.8	14.5	18.4
10/8b	11.1	15.6	9.7	16.5	8.4	6.4
10/8c	21.6	26.8	17.5	25.2	16.3	16.1
11/9a	14.6	16.1	12.3	16.0	12.3	11.2
11/9b	10.5	15.1	9.7	12.2	6.7	8.0
11/9c	10.5	14.0	15.0	17.2	14.5	14.6
12/10a	15.2	18.9	17.4	38.9	23.9	20.2
12/10b	11.7	21.2	12.9	29.4	17.9	17.6
12/10c	11.1	16.8	16.0	36.8	25.1	20.8

Confidence and Skill

13 BCT/ 11 OSUT. Which course of fire did you find more difficult? (check one)

____ Record Fire more difficult
____ Both were about equally difficult
____ CFF was more difficult

14 BCT / 12 OSUT. Which course of fire did you find increased your confidence more? (check one)

____ Record fire increased my confidence more than CFF
____ Both increased my confidence about equally
____ CFF increased my confidence more than record fire

% Soldier selecting each option

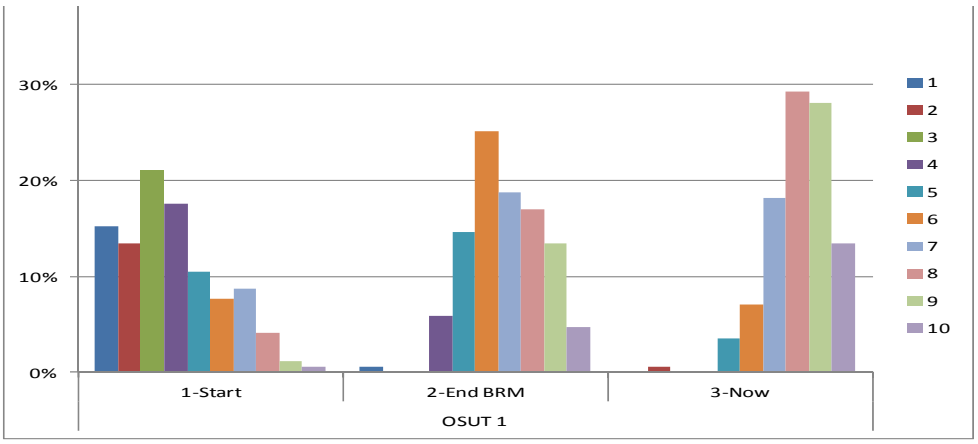
	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
Difficulty						
13/11. RF diff	32.4	35.2	39.7	24.4	39.4	21.6
13/11. equal	46.5	41.9	44.2	40.9	37.8	40.0
13/11. CFF diff	21.1	22.9	19.1	34.8	22.8	38.4
Confidence						
14/ 12 RF incr	20.5	21.3	11.9	30.7	21.1	27.2
14/12 equal	52.6	46.1	53.9	39.9	41.7	50.4
14/12 CFF incr	26.9	32.6	34.2	29.4	37.2	22.4

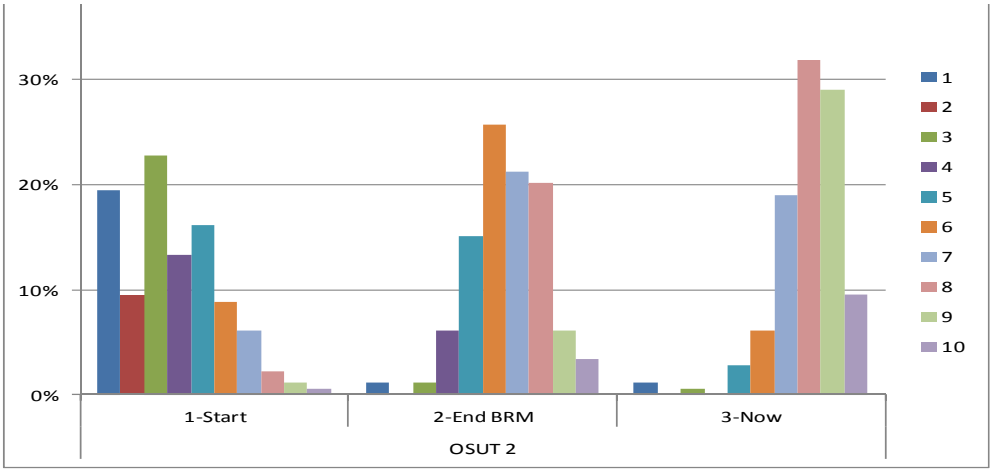
Indicate your **overall level of marksmanship skill** at three time points: the beginning of your training, the end of BRM (when you qualified), and now (i.e., end of ARM).

	Level of Skill (check one box for each question)									
	Low or minimal level of skill, need much more practice									High level of skill, can't get much better
	1	2	3	4	5	6	7	8	9	10
15 BCT/13 OSUT. Start of training	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
16 BCT/ 14 OSUT. End of BRM – when you qualified	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
17 BCT /15 OSUT. Now.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Mean rating

	OSUT 1	**OSUT 2**	**OSUT 3**	**BCT 1**	**BCT 2**	**BCT 3**
Start	3.8	3.7	3.8	3.3	3.3	3.3
End of BRM	6.8	6.6	6.5	6.5	6.5	6.7
Now end of ARM	8.1	8.0	7.7	7.3	7.7	7.6





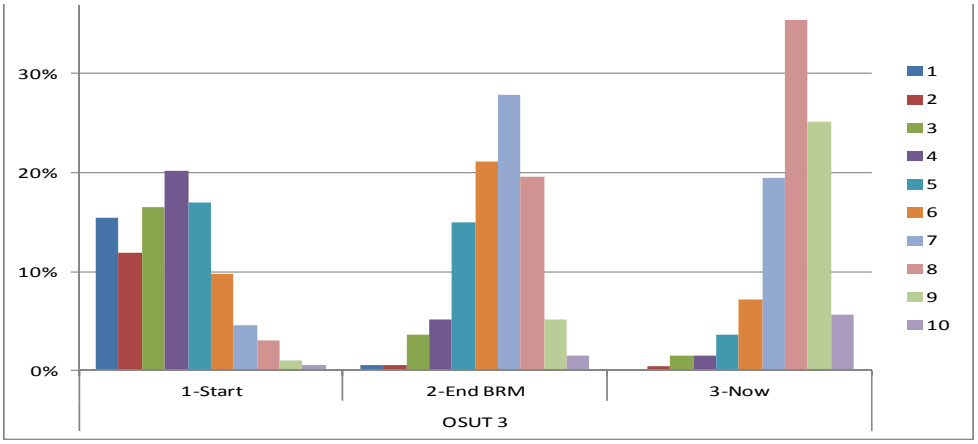
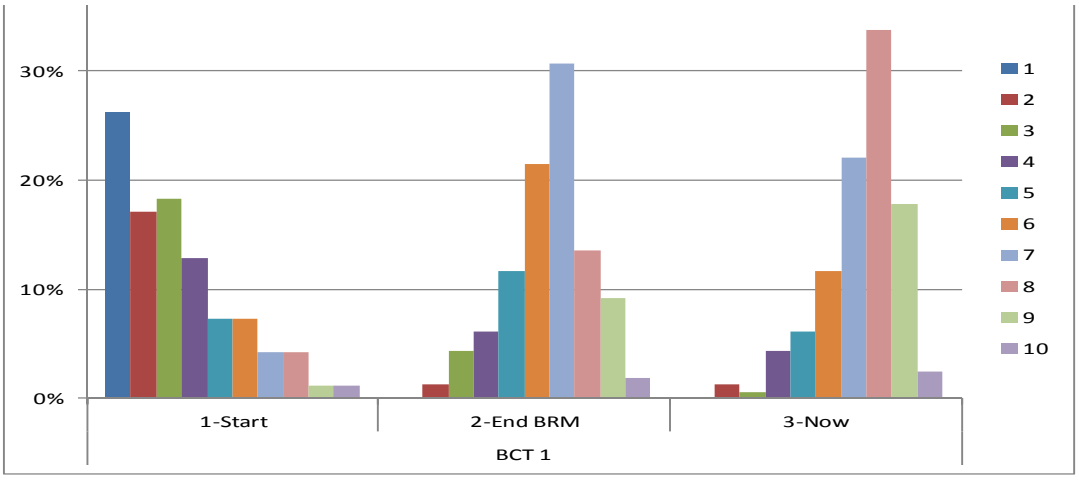
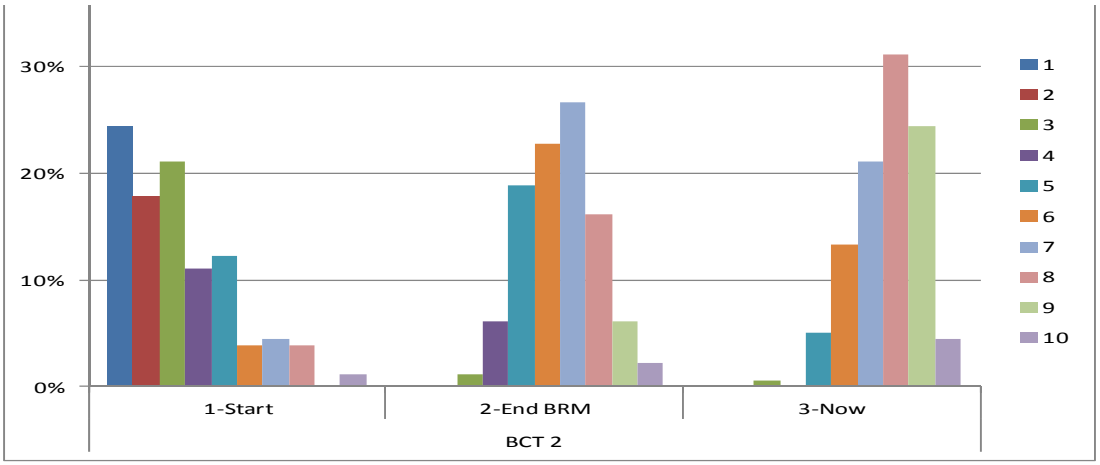


Figure C-1. Distribution of answers to questions 13-15 for each OSUT company. Responses shown by % Soldiers responding to each rating.





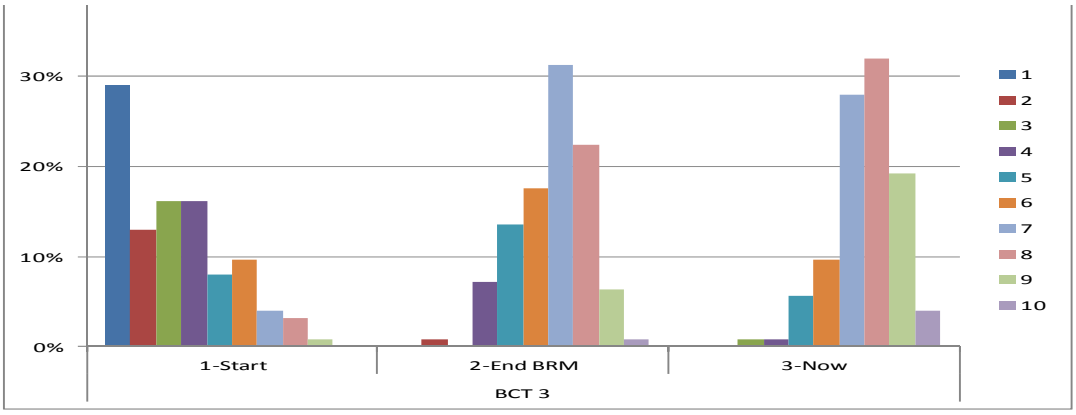


Figure C-2. Distribution of responses to Questions 15-17 for each BCT company. Responses shown by % Soldiers responding to each question.

Percentage Soldiers Responding to Each Level of Skill

Skill Level	1	2	3	4	5	6	7	8	9	10
OSUT 1										
1-Start	15.2%	13.5%	21.1%	17.5%	10.5%	7.6%	8.8%	4.1%	1.2%	0.6%
2-End BRM	0.6%			5.9%	14.6%	25.2%	18.7%	17.0%	13.6%	4.7%
3-Now		0.6%			3.5%	7.0%	18.1%	29.2%	28.1%	13.5%
OSUT 2										
1-Start	19.4%	9.4%	22.8%	13.3%	16.1%	8.9%	6.1%	2.2%	1.1%	0.6%
2-End BRM	1.1%		1.1%	6.2%	15.1%	25.7%	21.2%	20.1%	6.2%	3.4%
3-Now	1.1%		0.6%		2.8%	6.2%	19.0%	31.8%	29.1%	9.5%
OSUT 3										
1-Start	15.5%	11.9%	16.5%	20.1%	17.0%	9.8%	4.6%	3.1%	1.0%	0.5%
2-End BRM	0.5%	0.5%	3.6%	5.2%	15.0%	21.1%	27.8%	19.6%	5.2%	1.6%
3-Now		0.5%	1.5%	1.5%	3.6%	7.2%	19.5%	35.4%	25.1%	5.6%
BCT 1										
1-Start	26.2%	17.1%	18.3%	12.8%	7.3%	7.3%	4.3%	4.3%	1.2%	1.2%
2-End BRM		1.2%	4.3%	6.1%	11.7%	21.5%	30.7%	13.5%	9.2%	1.8%
3-Now		1.2%	0.6%	4.3%	6.1%	11.7%	22.1%	33.7%	17.8%	2.5%
BCT 2										
1-Start	24.4%	17.8%	21.1%	11.1%	12.2%	3.9%	4.4%	3.9%		1.1%
2-End BRM			1.1%	6.1%	18.9%	22.8%	26.7%	16.1%	6.1%	2.2%
3-Now			0.6%		5.0%	13.3%	21.1%	31.1%	24.4%	4.4%
BCT 3										
1-Start	29.0%	12.9%	16.1%	16.1%	8.1%	9.7%	4.0%	3.2%	0.8%	
2-End BRM		0.8%		7.2%	13.6%	17.6%	31.2%	22.4%	6.4%	0.8%
3-Now			0.8%	0.8%	5.6%	9.6%	28.0%	32.0%	19.2%	4.0%

18 BCT/ 16 OSUT. Was there an experience or point in time when you felt there was a big increase in your shooting ability? If so, describe it below.

Response Category	% Responses					
	OSUT 1	**OSUT 2**	**OSUT 3**	**BCT 1**	**BCT 2**	**BCT 3**
No Change	15.8	17.0	23.5	13.5	18.9	21.8
Gradual Increase	---	9.5	5.9	6.0	5.9	5.9
BRM	28.4	30.2	22.1	43.6	40.8	51.5
PRF & RF	(17.9)	(16.0)	(16.2)	(23.3)	(31.9)	(27.7)
Other BRM	(10.5)	(14.1)	(5.9)	(20.3)	(8.8)	(23.7)
ARM	41.0	33.0	32.3	22.6	26.6	10.9
CFF	(15.8)	(6.6)	(10.3)	(3.0)	(10.6)	(3.9)
Moving Tgts	(6.3)	(6.6)	(5.9)	NA	NA	NA
Reflexive Fire	(6.3)	---	---	---	---	---
Barriers	(3.1)	---	(5.9)	---	(1.8)	---
CCO	NA	NA	NA	(8.3)	(2.3)	(3.0)
Other	(9.5)	(19.8)	(10.3)	(11.3)	(15.0)	(3.9)
Specific Events	14.7	11.3	16.2	14.3	7.7	10.9
Total # Responses	95	106	68	133	169	101

Note. The percentages for each company are based on the number of responses for that company.

APPENDIX D

DATA OBSERVATION FORMS (EXAMPLE: BCT ARM6)

Company_____ Observer Name_____ Date_____
ARM 6 (BCT) Post: Ft. Benning ☐ Ft. Jackson ☐ Ft. Leon.Wd ☐

TITLE
BARRIER SHOOT

INSTRUCTIONS

For each ELO, describe the methods of instruction used, e.g., company classroom with slides, platoon instruction, individual Soldier hands-on practice, instructor demonstration, Soldiers complete action with other Soldiers watching etc.

Be sure to also cite the specific training aids used.
Check the box to indicate if the ELO was covered.
Collect the tower data printouts and also complete the CFF data collection sheet

GENERAL SESSION DATA

Number of Soldiers: _____

DSs _____

Range name_____
Range type _____

Weather:
_____

WB Temp: _____N/A _____Morning _____ Midday _____Afternoon
Heat cat: _____N/A _____Morning _____ Midday _____Afternoon

☐ **ELO A. Identify the Procedures for the ARM Barrier Shoot Range**
Start: _____Stop: _____
Training group size: _____

☐ Demonstration- Blank fire
☐ Understand the concept of Barrier Firing / Course of Fire
☐ Review advanced firing positions
☐ Review quick fire technique
☐ Review Immediate Actions
Describe how the training was conducted

_____

_____

Other comments: _____

_____

☐ **ELO B. Conduct ARM Barrier Shoot - Blank Fire**
Start: _____Stop: _____
Number of lanes used: _____ of _____

☐ Blank fire engage targets
Describe how the training was conducted:

_____
_____

Other comments: _____

_____

☐ **ELO C. Review the Procedures for the ARM Barrier Shoot Range**
Start: _____Stop: _____
Training group size: _____

☐ Live fire demonstration
☐ Review the concept of Barrier Fire / Course of Fire

Describe how the training was conducted:_____

_____

_____

Other comments:
_____

_____

☐ **ELO D. Conduct ARM Barrier Shoot - Live Fire**
Start: _____Stop: _____
Number of lanes used: _____ of _____

Was the dummy round loaded randomly according to the specified randomization procedures?
☐ Yes
☐ No

Was the following firing table (as specified in the POI) executed on the range?
☐ Yes
☐ No

POSITION	ROUNDS FIRED	TARGET DISTANCE (meters)	ACTION AFTER FIRING
Start (0M) Standing Position	5	100M	Walk Straight Ahead
Barricade (10M) Supported Position	5 Change Magazine	100-200M	Change Firing Position Only
Barricade (10M) Kneeling Supported Position	5	100-200M	Change Firing Position Only
Barricade (10M) Prone Unsupported Position	5 Change Magazine	100-200M	Walk Straight Ahead
Walking Straight Ahead	5	75M	Assume Kneeling Unsupported Position
Kneeling Unsupported Position	5	75-150M	Clear the Weapon

Describe how the training was conducted:_____

_____

_____

Other comments: _____

_____

Ammunition Received_____

Ammunition Returned_____

APPENDIX E

ROUNDS TO GROUP AND ZERO WITH FIVE- AND THREE-ROUND SHOT GROUPS

This Appendix compiles data on three- and five-round shot groups from ARI marksmanship research conducted since 1999 through 2010. The detailed shot group data come from six different reports, and have not been published previously.

The entire frequency distributions for the number of rounds used for grouping and zeroing are shown. The distributions were generated from the master data files retained from each research effort. The sighting system / optic used is cited as well --- iron sight/back-up iron sight (BUIS) and close combat optic (CCO). All grouping and zeroing data were based on 25-meter target results. The marksmanship data came primarily from initial entry training Soldier populations, with limited data from Forces Command (FORSCOM) Infantry platoons.

The last three tables in the Appendix compare results for three- and five-round shot groups for grouping, where possible, and zeroing. The direct basis for comparison is the number of shot groups required to group or zero 25%, 50% and 75% of the Soldiers.

RESULTS FROM CURRENT RESEARCH: FIVE-ROUND SHOT GROUPS

Table E-1
*Infantry OSUT CCO Rounds to Group and Zero: Five-Round Shot Groups (*Numbers include only those who grouped and zeroed)

	GROUP			ZERO		
Rounds	*N*	Percent	Cumulative Percent	*N*	Percent	Cumulative Percent
5	5	0.9	0.9	---	---	---
10	190	32.4	33.3	66	11.1	11.1
15	185	31.5	64.8	140	23.5	34.6
20	65	11.1	75.9	126	21.1	55.7
25	35	6.0	81.9	89	14.9	70.6
30	24	4.1	86.0	41	6.9	77.5
35	21	3.6	89.6	42	7.0	84.6
40	16	2.7	92.3	21	3.5	88.1
45	7	1.2	93.5	22	3.7	91.8
50	3	0.5	94.0	16	2.7	94.5
55	9	1.5	95.5	10	1.7	96.2
60	13	2.2	97.7	9	1.5	97.7
65	3	0.5	98.2	4	.7	98.4
70	3	0.5	98.7	2	.3	98.7
75	3	0.5	99.2	2	.3	99.0
80	1	0.2	99.4	2	.3	99.3
85	1	0.2	99.6	1	.2	99.5
90	1	0.2	99.8	---		
95	---			2	.3	99.8
100	---			2	.3	100.1*
110	2	0.3	100.1*	---		
DESCRIPTIVE STATISTICS						
N	587			597		
Mean	20.13			25.31		
Median	15.00			20.00		
Mode	10			14		
SD	14.92			14.59		
N not group/zero	20			12		

*Rounding error.

Table E-2
Infantry OSUT BUIS Rounds to Group and Zero: Five-Round Shot Groups

	GROUP			ZERO		
Rounds	*N*	Percent	Cumulative Percent	*N*	Percent	Cumulative Percent
5	1	1.1	1.1	1	1.6	1.6
10	5	5.3	6.4	2	3.2	4.8
15	45	47.9	54.3	7	11.1	15.9
20	4	4.3	58.6	10	15.9	31.8
25	8	8.5	67.1	6	9.5	41.3
30	10	10.6	77.7	15	23.8	65.1
35	10	10.6	88.3	2	3.2	68.3
40	9	9.6	97.9	1	1.6	69.9
45	1	1.1	99.0	3	4.8	74.7
50	1	1.1	100.1*	5	7.9	82.6
55	---			3	4.8	87.4
60	---			1	1.6	89.0
65	---			2	3.2	92.2
70	---			2	3.2	95.4
125	---			1	1.6	98.6
130	---			1	1.6	100.2*
DESCRIPTIVE STATISTICS						
N	94			63		
Mean	22.50			35.87		
Median	15.00			30		
Mode	15			30		
SD	10.28			23.85		

*Rounding error.

Note. Only a sample of OSUT Soldiers fired the BUIS. A sample of Soldiers from 2 companies grouped with the BUIS. Zeroing was limited to the sample of Soldiers from one of these two companies.

Table E-3
BCT Iron Sight/BUIS Rounds to Group and Zero: Five-Round Shot Groups

	GROUP			ZERO		
Rounds	*N*	Percent	Cumulative Percent	*N*	Percent	Cumulative Percent
5	10	1.9	1.9	1	0.2	0.2
10	88	16.4	18.3	46	10.2	10.4
15	145	27.1	45.4	67	14.9	25.0
20	28	5.2	50.6	39	8.6	33.6
25	66	12.3	62.9	56	12.4	46.3
30	67	12.5	75.4	45	10.0	56.3
35	11	2.1	77.5	16	3.5	59.8
40	24	4.5	82.0	26	5.8	65.6
45	25	4.7	86.7	26	5.8	71.4
50	10	1.9	88.6	22	4.9	76.3
55	11	2.1	90.7	17	3.8	80.1
60	14	2.6	93.3	12	2.7	82.8
65	8	1.5	94.8	8	1.8	84.6
70	3	0.6	95.4	13	2.9	87.5
75	4	0.7	96.1	14	3.1	90.6
80	6	1.1	97.2	4	0.9	91.5
85	7	1.3	98.5	5	1.1	92.6
90	1	0.2	98.7	11	2.4	95.0
95	2	0.4	99.1	6	1.3	96.3
100	1	0.2	99.3	2	0.4	96.7
105	3	0.6	99.9	2	0.4	97.1
110	1	0.2	100.1	4	0.9	98.0
115	---			4	0.9	98.9
120	1	0.2	100.3*	1	0.2	99.1
125	---			1	0.2	99.3
130	---			1	0.2	99.5
135	---			2	0.4	99.9*
DESCRIPTIVE STATISTICS						
N	536			451		
Mean	27.55			38.28		
Median	20.00			30		
Mode	15			15		
SD	20.00			26.73		
N not group/zero	20			85		

*Rounding error.

RESULTS FROM PRIOR RESEARCH: FIVE-ROUND SHOT GROUPS

This section of the Appendix presents historical data from prior ARI marksmanship research that used five-round shot groups. The data came from two different research efforts conducted during the time when training companies were "trying out" five-round shot groups. In both efforts the original data bases were available, which made it possible to present the entire frequency distributions for grouping and zeroing.

The research reports are:

Cobb, M. G., James, D. R., Graves, T. R., & Wampler, R. L. (2009). *Warrior task skills retention assessment* (ARI Study Report 2009-03). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A516 970)

Research was executed in 2007.

Cobb, M. G., Graves, T. R., James, D. R., Dlubac, M. D., & Wampler, R. L. (2010) *Applying Combat Application Course techniques to rifle marksmanship in Basic Combat Training (BCT): Acquisition and retention of skills* (ARI Research Report 1920). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A516 970)

The frequency distribution in Table E-4 is based on a secondary analysis of data from the following:

Cobb, M. G., James, D. R., Graves, T. R., & Wampler, R. L. (2009). *Warrior task skills retention assessment* (ARI Study Report 2009-03). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A516 970)

The standard for grouping and zeroing: 8 of 10 rounds from two consecutive shot groups in 4 cm circle. No grouping data were available.

Table E-4
Infantry OSUT BUIS Rounds to Zero: Five-Round Shot Groups

	ZERO			ZERO CONTINUED			
Rounds	*N*	Percent	Cumulative Percent	Rounds	*N*	Percent	Cumulative Percent
10	4	4.2	4.2	70	1	1.0	88.5
15	12	12.5	16.7	75	1	1.0	89.6
20	15	15.6	32.3	80	3	3.1	92.7
25	12	12.5	44.8	85	1	1.0	93.8
30	17	17.7	62.5	88	1	1.0	94.8
35	4	4.2	66.7	90	2	2.1	96.9
40	4	4.2	70.8	95	--	--	--
45	2	2.1	72.9	100	--	--	--
50	5	5.2	78.1	110	1	1.0	97.9
55	4	4.2	82.3	115	--	--	--
60	5	5.2	87.5	120	1	1.0	99.0
65	--	---	--	127	1	1.0	100.0
DESCRIPTIVE STATISTICS							
N	96						
Mean	37.30						
Median	30.00						
Mode	30						
SD	25.03						

The frequency distributions in Table E-5 and E-6 came from a secondary analysis of the data from the following:

Cobb, M. G., Graves, T. R., James, D. R., Dlubac, M. D., & Wampler, R. L. (2010) *Applying Combat Application Course techniques to rifle marksmanship in Basic Combat Training (BCT): Acquisition and retention of skills* (ARI Research Report 1920).). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A516 970)

For Company A (Table E-5), the standard for grouping and zeroing was 8 of 10 rounds from two consecutive shot groups in 4 cm circle. For Company B (Table E-6) the standard for grouping and zeroing differed, being 7 rounds from two consecutive shot groups in 4 cm circle. Some variations occurred with individual drill sergeants (5 to 8 rounds). Companies were mixed gender.

Table E-5
BCT (non-Infantry) Iron Sight BUIS Rounds to Group and Zero (Company A): Five-Round Shot Groups

	GROUP			ZERO		
Rounds	*N*	Percent	Cumulative Percent	*N*	Percent	Cumulative Percent
10	27	14.1	14.1	---		
15	40	20.8	34.9	5	3.8	3.8
20	37	19.3	54.2	5	3.8	7.6
25	11	5.7	59.9	12	9.1	16.7
30	10	5.2	65.1	14	10.6	27.3
35	14	7.3	72.4	3	2.3	29.5
40	14	7.3	79.7	11	8.3	37.9
45	5	2.6	82.3	13	9.8	47.7
50	13	6.8	89.1	6	4.5	52.3
55	5	2.6	91.7	11	8.3	60.6
60	9	4.7	96.7	11	8.3	68.9
65	---	---	---	6	4.5	73.5
70	---	---	---	3	2.3	75.8
75	1	0.5	96.9	1	0.8	76.5
80	1	0.5	97.4	2	1.5	78.0
85	---	---	---	1	0.8	78.8
90	1	0.5	97.9	10	7.6	86.4
95	1	0.5	98.4	3	2.3	88.6
100	---	---	---	1	0.8	89.4
105	3	1.6	100.0	---		
110				4	3.0	92.4
115				1	0.8	93.2

	GROUP			ZERO		
Rounds	*N*	Percent	Cumulative Percent	*N*	Percent	Cumulative Percent
120				4	3.0	96.2
125				1	0.8	97.0
130				--		
135				1	0.8	97.7
140				---		
145				1	0.8	98.5

160				1	0.8	99.2

180				1	0.8	100.0
DESCRIPTIVE STATISTICS						
N	192			132		
Mean	29.06			57.39		
Median	20.00			50.00		
Mode	15			30		
SD	19.43			32.68		
N not group/zero	14			2		

Table E-6

BCT (non-Infantry) Iron Sight/BUIS Rounds to Group and Zero (Company B): Five-Round Shot Groups

	GROUP			ZERO		
Rounds	*N*	Percent	Cumulative Percent	*N*	Percent	Cumulative Percent
5	1	0.5	0.5	---	---	---
10	42	22.7	23.2	4	2.4	2.4
15	34	18.4	41.6	11	6.7	9.1
20	20	10.8	52.4	14	8.5	17.6
25	9	4.9	57.3	9	5.5	23.0
30	17	9.1	66.5	27	16.4	39.4
35	10	5.4	71.9	14	8.5	47.9
40	13	7.0	78.9	15	9.1	57.0
45	3	1.6	80.5	11	6.7	63.6
50	3	1.6	82.2	13	7.9	71.5
55	3	1.6	83.8	8	4.8	76.4
60	5	2.7	86.5	9	5.5	81.8
65	1	0.5	87.0	5	3.0	84.8
70	3	1.6	88.6	2	1.2	86.1
75	4	2.2	90.8	5	3.0	89.1
80	2	1.1	91.9	6	3.6	92.7
85	---	---	---	5	3.0	95.8
90	2	1.1	93.0	1	0.6	96.4
95	---	---	---	---	---	---
100	2	1.1	94.1	---	---	---
105	1	0.5	94.6	2	1.2	97.6
110	3	1.6	96.2	---	---	---
115	---	---	---	2	1.2	98.8
120	2	1.1	97.3	1	0.6	99.4
125	1	0.5	97.8	---	---	---
130	3	1.6	99.5	---	---	---
---	---	---	---	---	---	---
160	---	---	---	1	0.6	100.0
170	1	0.5	100.0	---	---	---
DESCRIPTIVE STATISTICS						
N	185			165		
Mean	33.30			44.17		
Median	20.00			40.00		
Mode	10			30		
SD	30.46			24.57		
N not group/zero	10			5		

RESULTS FROM PRIOR RESEARCH: THREE-ROUND SHOT GROUPS

This section of the Appendix presents historical data from prior ARI research that involve rifle marksmanship which was executed in accordance with the three-round shot group designated in the Marksmanship FMs (23-9 and 3-22.9) published from 1989 through 2008. The data came from five research efforts. In three efforts the original data bases were available, which made it possible to present the entire frequency distributions for grouping and zeroing. Limited data were available from the Hagman (2004) report (all male) and are summarized in Tables E-12 and E-13. The research reports, cited by date of publication are:

Dyer, J. L. (1999, November). *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)

Dyer, J. L., Fober, G. W., Wampler, R., Blankenbeckler, N., Dlubac, M., & Centric, J. (2000, December). *Observations and assessments of Land Warrior Training* (Report to TRADOC Systems Manager- Soldier). Ft. Benning, GA: Infantry Forces Research Unit, U.S. Army Research Institute.

Dyer, J. L., Pleban, R. J., Vaughan, A., Salvetti, J., & Clark, T. (2004). *Using the Engagement Skills Trainer 2000 in basic rifle marksmanship: Initial investigation* (Final Report to G3, U. S. Army Infantry School). Ft. Benning, GA: Infantry Forces Research Unit, U.S. Army Research Institute for the Behavioral and Social Sciences.

Hagman, J. D. (2004). *Basic rifle marksmanship training with the Laser Marksmanship Training System* (ARI Research Report 1761). Alexandria, VA: US Army Research Institute for the Behavioral and Social Sciences. DTIC No. AD A380 109

Cobb, M. G., James, D. R., Graves, T. R., & Wampler, R. L. (2009). *Warrior task skills retention assessment* (ARI Study Report 2009-03). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A516 970)

In the marksmanship FMs, the rounds and standards for grouping and zeroing with three-round shot groups were as follows:

> Grouping: Five of six rounds in two consecutive shot groups within a 4-centimeter circle at 25 meters using 27 or fewer rounds to group
>
> Zeroing: Five of six rounds in two consecutive shot groups within the designated 4-centimeter circle on the 25 meter zero target using 18 rounds or fewer to zero.

The frequency distribution in Table E-7 was derived from a secondary analysis of data from:

Cobb, M. G., James, D. R., Graves, T. R., & Wampler, R. L. (2009). *Warrior task skills retention assessment* (ARI Study Report 2009-03). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A516 970)

The standard for zeroing was 5 of 6 rounds from two consecutive shot groups in 4cm circle. No grouping data were available. Not all rounds are multiples of 3. Round counts were based on counting holes in targets, not by multiplying number of shot groups by 3. Since some shots missed the target, some large holes in targets could have been more shots than counted, and some Soldiers shot rounds at the wrong targets, there are cases where the number of rounds is not an exact multiple of 3. Companies were mixed gender.

Table E-7
BCT (Non Infantry) Iron Sight Rounds to Zero: Three-Round Shot Groups

	ZERO			ZERO CONTINUED			
Rounds	*N*	Percent	Cumulative Percent	Rounds	N	Percent	Cumulative Percent
3	2	0.4	0.4	38	1	0.2	87.1
5	3	0.5	0.9	39	6	1.1	88.2
6	37	6.2	7.1	40	5	0.9	89.1
7	2	0.4	7.5	41	2	0.4	89.5
8	2	0.4	7.8	42	3	0.5	90.0
9	57	10.4	18.2	43	1	0.2	90.2
10	2	0.4	18.5	44	1	0.2	90.4
12	65	11.8	30.4	45	16	2.9	93.3
13	1	0.2	30.5	46	1	0.2	93.5
15	70	12.7	43.3	47	2	0.4	93.8
16	2	0.4	43.6	48	5	0.9	94.7
18	63	11.5	55.1	49	1	0.2	94.9
19	1	0.2	55.3	51	2	0.4	95.3
20	2	0.4	55.6	52	1	0.2	95.5
21	32	5.8	61.5	54	3	0.5	96.0
22	1	0.2	61.6	55	1	0.2	96.2
23	4	0.7	62.4	56	3	0.5	96.7
24	31	5.6	68.0	58	2	0.4	97.1
25	3	0.4	68.4	60	3	0.5	97.6
26	2	0.2	68.5	63	3	0.5	98.2
27	24	4.4	72.9	66	1	0.2	98.4
29	1	0.2	73.1	67	1	0.2	98.5
30	31	5.6	78.7	72	2	0.4	98.9
32	1	0.2	78.9	75	2	0.4	99.3
33	19	3.5	82.4	76	1	0.2	99.5
34	2	0.4	82.7	78	1	0.2	99.6
35	2	0.4	83.1	79	1	0.2	99.8

36	21	3.8	86.9	100	1	0.2	100.0

DESCRIPTIVE STATISTICS	
N	550
Mean	22.40
Median	18.00
Mode	15
SD	14.47

The frequency distributions in Table E-8 and E-9 were derived from secondary analysis of data from the following:

Dyer, J. L., Pleban, R. J., Vaughan, A., Salvetti, J., & Clark, T. (2004). *Using the Engagement Skills Trainer 2000 in basic rifle marksmanship: Initial investigation* (Final Report to G3, U. S. Army Infantry School). Ft. Benning, GA: Infantry Forces Research Unit, U.S. Army Research Institute for the Behavioral and Social Sciences.

The tables are based on two different initial entry training (IET) companies that participated in the research. All Soldiers were male.

Table E-8
OSUT Iron Sight Rounds to Group and Zero (Company C): Three-Round Shot Groups

	GROUP			ZERO		
Rounds	*N*	%	Cumulative %	*N*	%	Cumulative %
6	31	16.1	16.1	3	1.5	1.5
9	43	22.3	38.3	15	7.7	9.3
12	39	20.2	58.5	27	13.9	23.2
15	30	15.5	74.1	29	14.9	38.1
18	11	5.7	79.8	24	12.4	50.5
21	5	2.6	82.4	12	6.2	56.7
24	10	5.2	87.6	9	4.6	61.3
27	6	3.1	90.7	11	5.7	67.0
30	7	3.6	94.3	15	7.7	74.7
33	4	2.1	96.4	11	5.7	80.4
36	2	1.0	97.4	3	1.5	82.0
39	2	1.0	98.4	3	1.5	83.5
42	1	0.5	99.0	6	3.1	86.6
45	---			9	4.6	91.2
48	1	0.5	99.5	3	1.5	92.8
51	---			2	1.0	93.8
54	---			---		
57	---			2	1.0	94.8
60	---			3	1.5	96.4
63	1	0.5	100.0	---		
66	---			---		
69	---			4	2.1	98.5
72	---			1	0.5	99.0
…	…			…		
99	---			1	0.5	99.5
…	…			…		
126	---			1	0.5	100.0
DESCRIPTIVE STATISTICS						
N	193			194		

Mean	14.72	25.34
Median	12.0	18.0
Mode	9	15
SD	8.95	16.95

Table E-9
BCT Iron Sight Rounds to Group and Zero (Company D): Three-Round Shot Groups

	GROUP			ZERO		
Rounds	*N*	Percent	Cumulative Percent	*N*	Percent	Cumulative Percent
6	47	22.1	22.1	17	8.1	8.1
9	43	20.2	42.3	18	8.6	16.7
12	37	17.4	59.6	20	9.6	26.3
15	22	10.3	70.0	24	11.5	37.8
18	14	6.6	76.5	20	9.6	47.4
21	13	6.1	82.6	15	7.2	54.5
24	10	4.7	87.3	4	1.9	56.5
27	5	2.3	89.7	18	8.6	65.1
30	5	2.3	92.0	9	4.3	69.4
33	3	1.4	93.4	11	5.3	74.6
36	3	1.4	94.8	6	2.9	77.5
39	4	1.9	96.7	3	1.4	78.9
42	2	0.9	97.7	2	1.0	79.9
45	2	0.9	98.6	11	5.3	85.2
48	2	0.9	99.5	2	1.0	86.1
51	---			6	2.9	89.0
54	---			2	1.0	90.0
57	---			2	1.0	90.9
60	---			3	1.4	92.3
63	---			---		
66	---			4	1.9	94.3
69	1	0.5	100.0	1	0.5	94.7
72				4	1.9	96.7
75				1	0.5	97.1
78				---		
81				1	0.5	97.6
84				1	0.5	98.1
87				1	0.5	98.6
…				…		
102				1	0.5	99.0
…				…		
111				1	0.5	99.5
114				1	0.5	100.0
DESCRIPTIVE STATISTICS						

N	213	209
Mean	15.01	27.49
Median	12.00	21.00
Mode	6	15
SD	10.19	20.57

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The frequency distributions in Table E-10 are from Infantry Soldiers in Forces Command (FORSCOM). The CCO zero data are from three platoons; the iron sight zero data from one of the three platoons. The data were collected at two time points per the references below.

Dyer, J. L. (1999, November). *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)

Dyer, J. L., Fober, G. W., Wampler, R., Blankenbeckler, N., Dlubac, M., & Centric, J. (2000, December). *Observations and assessments of Land Warrior Training*. Ft. Benning, GA: Infantry Forces Research Unit, U.S. Army Research Institute.

Table E-10
FORSCOM Infantry Platoons Rounds to Zero with CCO and Iron Sights: Three-Round Shot Groups

	CCO			IRON SIGHTS		
Rounds	*N*	Percent	Cumulative Percent	*N*	Percent	Cumulative Percent
6	9	12.2	12.2	3	9.7	9.7
9	9	12.2	24.3	4	12.9	22.6
12	25	33.8	58.1	5	16.3	38.7
15	13	17.6	75.7	2	6.4	45.2
18	4	5.4	81.1	4	12.9	58.1
21	5	6.8	87.8	1	3.2	61.3
24	5	6.8	94.6	--	---	
27	1	1.3	95.9	1	3.2	64.5
30	1	1.3	97.3	3	9.7	74.2
33	---	---	---	2	6.4	80.6
36	---	---	---	1	3.2	83.9
39	1	1.3	98.6	2	6.4	90.3
42	1	1.3	100.0	---		
45				1	3.2	93.5
---				---		
54				1	3.2	96.8
---				---		
69				1	3.2	100.0
DESCRIPTIVE STATISTICS						
N	74			31		
Mean	14.41			22.65		
Median	12.0			18		
Mode	12			12		
SD	7.02			15.37		

COMPARISON OF THREE-ROUND AND FIVE-ROUND SHOT GROUP RESULTS

Tables E-11 through E-13 compare the rounds and shot groups fired with 3 and 5 rounds. The only common metric is number of shot groups which were required for 25%, 50% and 75% of the Soldiers to meet the grouping or zeroing standard (see last three rows in each table). The three tables, in turn, document CCO zeroing, iron sight/BUIS grouping and iron sight/BUIS zeroing.

The sub-header rows in Tables 11through 13 cite three (3) items of information:

- the source table number in this Appendix for the summary data,
- the Soldier population (OSUT – which refers only to Infantry OSUT; BCT, and/or FORSCOM), and
- the year the reference report was published.

Data based on the research cited in this report are labeled "current." All other data sources are ARI "archives" from which the frequency distributions were generated.

Table E-11
Comparison of CCO Three- vs.Five-Round Shot Groups During Zeroing

3 ROUNDS		5 ROUNDS	
Results Summary	E-10 FORSCOM 1999, 2000	Results Summary	E-1 OSUT Current
# Soldiers	74	# of Soldiers	597
Mean Rounds / Soldier	14.4	Mean rounds / Soldier	25.31
% Soldiers meeting standard of 18 rds	81%	% Soldiers meeting standard of 15 rds	35%
# rounds to zero 25% of Soldiers	9	# Rounds to Zero 25% of Soldiers	10-15
# rounds to zero 50% of Soldiers	12	# rounds to zero 50% of Soldiers	20
# rounds to zero 75% of Soldiers	15	# rounds to zero 75% of Soldiers	30
# shot groups to zero 25% of Soldiers	3	# shot groups to zero 25% of Soldiers	2-3
# shot groups to zero 50% of Soldiers	4	# shot groups to zero 50% of Soldiers	4
# shot groups to zero 75% of Soldiers	5	# shot groups to zero 75% of Soldiers	6

Note. All Soldiers, FORSCOM and OSUT, were Infantry.

Table E- 12

Comparison of Iron Sight/BUIS Three- vs. Five-Round Shot Groups During Grouping

3 ROUNDS			5 ROUNDS				
Results Summary	E-8 OSUT 2004	E-9 BCT 2004	Results Summary	E-3 BCT Current	E-2 OSUT Current	E-5 BCT 2010	E-6 BCT 2010
# Soldiers	193	213	# Soldiers	536	94	192	185
Mean Rounds / Soldier	14.72	15.01	Mean rounds / Soldier	27.55	22.50	29.06	33.30
% Soldiers meeting standard of 27 rounds	91%	90%	% Soldiers meeting standard of 15 rds	45%	54%	(35%)[a]	(42%)[a]
# rounds to group 25% of Soldiers	6-9	6	# Rounds to group 25% of Soldiers	10-15	10-15	10-15	10
# rounds to group 50% of Soldiers	12	12	# rounds to group 50% of Soldiers	20	15	20	20
# rounds to group 75% of Soldiers	15	18	# rounds to group 75% of Soldiers	30	30	35-40	35-40
# shot groups to group 25% of Soldiers	2-3	2	# shot groups to group 25% of Soldiers	2-3	2-3	2-3	2
# shot groups to group 50% of Soldiers	4	4	# shot groups to group 50% of Soldiers	5	3	4	4
# shot groups to group 75% of Soldiers	5	6	# shot groups to group 75% of Soldiers	6	6	7-8	7-8

Note. Hagman (2004): Data two companies- 3 round shot groups: Means 16.35 (n = 202) and 13.52 (n =184) with 87% and 92% Soldiers meeting the standard of 27 rounds for grouping.

[a] The percentages in parentheses represent the percent of Soldiers who would have grouped in 15 rounds or less. However, at the time the research was conducted, the criterion did not specify the total number of rounds.

Table E- 13

Comparison of Iron Sight/BUIS Three- vs. Five-Round Shot Groups During Zeroing

3 ROUNDS					5 ROUNDS					
Results Summary	E-8 OSUT 2004	E-9 BCT 2004	E-7 BCT 2009	E-10 FORSCOM 1999,2000	Results Summary	E-3 BCT Current	E-2 OSUT Current	E-4 OSUT 2009	E-5 BCT 2010	E-6 BCT 2010
# Soldiers	194	209	550	31	# Soldiers	451	63	96	132	165
Mean Rounds / Soldier	25.34	27.49	22.44	22.65	Mean rounds / Soldier	38.28	35.87	37.30	57.39	44.17
% Soldiers meeting standard of 18 rds	51%	47%	55%	52%	% Soldiers meeting standard of 15 rds	25%	16%	(17%)[a]	(4%)[a]	(9%)[a]
# rounds to zero 25% of Soldiers	12	12	12	9	# Rounds to Zero 25% of Soldiers	15	15-20	15-20	30	25
# rounds to zero 50% of Soldiers	18	21	18	15-18	# rounds to zero 50% of Soldiers	30	25-30	25-30	50	35-40
# rounds to zero 75% of Soldiers	30	33	30	30	# rounds to zero 75% of Soldiers	50	45	45-50	70	55
# shot groups to zero 25% of Soldiers	4	4	4	3	# shot groups to zero 25% of Soldiers	3	3-4	3-4	6	5
# shot groups to zero 50% of Soldiers	6	7	6	5-6	# shot groups to zero 50% of Soldiers	6	5-6	5-6	10	7-8
# shot groups to zero 75% of Soldiers	10	11	10	10	# shot groups to zero 75% of Soldiers	10	9	9-10	14	11

Note. Hagman (2004). Data on two companies – 3 round shot groups: Means were 25.55 (n = 202) and 20.97 (n =184) with 49% and 55% Soldiers meeting the standard of 18 rounds.

[a] The percentages in parentheses represent the percent of Soldiers who would have grouped in 15 rounds or less. However, at the time the research was conducted, the criterion did not specify the total number of rounds.

APPENDIX F

FIELD FIRE II RESULTS (EST AND LIVE-FIRE)

Appendix F presents detailed data on the Field Fire results for both OSUT and BCT. The results are shown by company given the differences in Field Fire scenarios in the POIs as executed. It was not possible for every installation to update the Field Fire EST scenarios and/or the live-fire scenarios before the research started. In most cases these differences were slight and statistical adjustments were made in order to make the results "equivalent." The overall results are summarized in the body of this report.

Several criteria are presented in the tables. The mean score (# targets hit) can only be used as a basis of comparison when companies fired the same scenario. The percentage of Soldiers who received a "Go" was based on the standard for the specific firing tables that were used. The "Go" percentages can be compared across companies, if you assume the differences in the scenarios are not great and the cutpoints for a "Go" represent similar levels of difficulty. The percentage of hits (from the total number of possible hits) is also comparable from company to company, if you assume the differences in the scenarios are not great.

OSUT. For the OSUT companies, the EST scenarios for BRM7 were modified in accordance with the revised scenario as documented in Tables A-2 and A-3 in Appendix A. Each OSUT company fired the same scenario in BRM7. The OSUT companies fired BRM8 on a LOMAH (location of miss and hit) range. It was not possible to change the software prior to start of the research to exactly match the revised scenario. The only modifications necessary were to the prone supported position. But the modifications very closely approximated the specified scenario (see Tables A-17 and A-18). Thus performance comparisons between Period 7 (EST) and Period 8 (live fire) were possible for these companies. Each OSUT company fired the same scenario in BRM8. Results are in Table F-1 below.

The overall results were very similar for BRM7 and BRM8. Obviously, it is not possible to determine the extent to which using the EST BRM7 as the first introduction to combat gear helped performance on the live-fire BRM8 that followed.

Table F-1
EST Field Fire II and Live-Fire Field Fire II Results for Infantry OSUT Companies

	Field Fire – EST BRM7		Field Fire – Live Fire BRM8	
	Single Targets (Go = 22 hits of 40 targets)	Multiple Targets (Go = 24 hits of 40 targets)	Single Targets (Go = 20 hits of 38 targets)	Multiple Targets (Go = 24 hits of 40 targets)
Company 1				
Mean (SD)	28.26 (6.15)	29.58 (5.41)	27.91 (5.06)	26.89 (6.51)
% Go	85.0%	85.0%	87.4%	77.5%
% hit	70.6%	73.9%	73.4%	67.2%
# Soldiers	173	171	143 [a]	178
Company 2				
Mean (SD)	28.89 (5.85)	27.49 (6.96)	24.26 (7.18)	24.93 (6.91)
% Go	80.0%	75.5%	80.1%	66.2%
% hits	72.3%	68.7%	63.8%	62.3%
# Soldiers	184	184	186	192
Company 3				
Mean (SD)	30.19 (5.95)	29.93 (6.30)	27.79 (5.65)	28.70 (5.07)
% Go	93.5%	83.7%	93.0%	89.1%
% hits	75.5%	74.8%	73.1%	71.7%
# Soldiers	214	214	207	214
Company average - % Soldiers GO across tables	83.8%		82.2%	

[a] Smaller number of Soldiers because data were missing from one firing order

BCT. The data on the Field Fire periods were not complete for all the BCT companies. No live fire data for BRM8 were available for one company. In addition, Company 2 did not have the updated EST field fire tables. Results for the EST periods, BRM7 and ARM1 as well as BRM8 (live-fire) are in Table F-2. For each company, the difference between the two EST periods was that BRM7 was fired without combat gear, while ARM1 was fired with gear, making within company comparisons possible. For BRM8, one company fired the same scenario as did the OSUT companies (minor modifications from the new scenario); the other company fired the new scenario.

For two companies (#1 and 2) the trend was for scores to decrease as a function of combat gear, while for the third company (#3), the scores tended to increase. In general, BRM7 and BRM8 scores were lower for the BCT companies compared to the OSUT companies, even though the OSUT companies wore combat gear in BRM7 and BRM8 and the BCT companies did not.

Table F-2

EST Field Fire II, Live-fire Field Fire II, and ARM1 (Field Fire II) Results for BCT Companies

	Field Fire –EST BRM7 (no gear)		Field Fire – Live Fire (BRM8)		Field Fire - EST ARM1 (gear)	
Companies 1 and 2	Single Targets (Go = 22 hits of 40 targets)	Multiple Targets (Go = 24 hits of 40 targets)	Single Targets (Go = 20 hits of 38 targets – (mod Scenario)	Multiple Targets (Go = 24 of 40 targets)	Single Targets (Go = 22 hits of 40 targets)	Multiple Targets (Go = 24 hits of 40 targets)
Company 1						
Mean (SD) % Go % hits # Soldiers	28.51 (6.39) 85.8% 71.3% 176	28.09 (7.65) 75.7% 70.2% 177	23.41 (6.52) 75.7% 61.6% 181	26.55 (5.81) 77.9% 66.4% 181	24.58 (6.32) 80.2% 61.5% 101	22.86 (7.78) 50.0% 57.2% 102
Company 3						
Mean (SD) % Go % hits # Soldiers	22.20 (9.70) 57.5% 55.5% 153	22.82 (8.90) 57.8% 57.0% 116	No data available	No data available	25.60 (7.78) 70.1% 64.0% 147	26.10 (7.19) 64.4% 65.2% 146
Company 2	Old EST Scenario		New Scenario		Old EST Scenario	
	Single Targets (Go = 22 hits of 36 targets)	Multiple Targets (Go = 27 hits of 44 targets)	Single Targets (Go = 22 of 40 targets)	Multiple Targets (Go = 24 of 40 targets)	Single Targets (Go = 22 hits of 36 targets)	Multiple Targets (Go = 27 hits of 44 targets)
Mean (SD) % Go % hits # Soldiers	24.97 (6.93) 71.1% 69.4% 194	31.40 (8.21) 85.6% 71.4% 194	23.49 (7.03) 66.7% 58.7% 203	22.65 (6.46) 51.0% 56.6% 202	21.23 (7.27) 51.1% 58.9*% 90	26.63 (7.69) 64.8% 60.5% 90
Company averages - % Soldiers GO across tables	72.2%		67.8%		63.5%	

Note on sample sizes. Number of Soldiers for Company 1 in ARM1 was reduced because of short training day, and not all Soldiers could fire. For Company 2, only 2 platoons fired ARM1.

APPENDIX G

CORRELATION TABLES

This Appendix presents the correlations among the marksmanship performance measures for OSUT and BCT. Correlations are presented at the company level. The measures are presented in order of the marksmanship POI.

Missing data or data not collected are indicated by "na." In all tables, significant correlations at $p < .0\text{-}5$ are in bold. Negative correlations are underlined. CFF kills were excluded from the tables as the correlation with CFF hits was very high ($r = .91$ to $.97$). Kills, therefore, did not provide any information beyond that shown with the CFF hits measure.

A cautionary note is included regarding the correlations with the second attempt at Record Fire. For all companies, the number of Soldiers who conducted this second attempt at RECORD FIRE was limited to only those who did not qualify the first time,. The difference in the size and nature of the sample influenced these correlations. Clearly, the second attempt at Record Fire does not reflect what would happen if all Soldiers fired another iteration of Record Fire, as was done with Practice Record Fire for OSUT and BCT and with CFF for OSUT.

Also presented are correlations among marksmanship scores from previous marksmanship research conducted in 2003:

Dyer, J. L. & Pleban, R. J. (2004). *Using the Engagement Skills Trainer 2000 in Basic Rifle Marksmanship: Initial Investigation: Summary Report for the G3, U.S Army Infantry School. Ft. Benning GA: Army Research Institute, Infantry Forces Research Unit*

Dyer, J. L, Pleban, R. J., Vaughan, A., Salvetti, J., & Clark, T. (2004). *Using the Engagement Skills Trainer 2000 in Basic Rifle Marksmanship: Initial Investigation: Final Report for the G3, U.S Army Infantry School*. Ft. Benning GA: Army Research Institute, Infantry Forces Research Unit

These results were included to examine consistency in correlations over time. Although the marksmanship strategy differed somewhat, some measures were the same.

Table G-1

Correlations Among Marksmanship Measures for Each OSUT Company in the Current Research

	Gp	**Zero CCO**			**BRM 7 EST FF**		**BRM 8 FF**		**Practice RF**		**RF**	**RF**	**CFF**	
	25m	25m	100m	200m	S Tgt	M Tgt	S Tgt	M Tgt	#1	#2	Qual	2d att	#1	#2
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	**.18**	**.19**	.07	.05	.10	**.21**	.11	**.26**	na	**.24**	.23	**.21**	**.17**
		.08	.06	.01	.06	.07	na	na	.08	.14	.11	.13	.07	.05
		.07	.08	.02	.11	**.21**	**.27**	**.19**	**.25**	**.26**	**.17**	.04	.12	.11
2		1	**.24**	.08	**.18**	**.16**	**.18**	**.18**	.08	na	.17	.10	.04	.08
			.08	.01	.02	.08	na	na	.01	.10	.03	.09	.04	.07
			.01	.04	.06	.10	.06	**.16**	**.29**	**.16**	**.22**	.24	.10	.14
3				.13	.11	**.17**	.14	.15	**.22**	.na	.09	.11	.08	.06
			1	**.25**	.10	.02	na	Na	.14	.05	.06	.02	.01	.01
				.10	.12	**.21**	**.19**	**.20**	.09	.12	.12	**.43**	.09	.01
4					.06	**.19**	.09	.03	.01	na	.08	.11	.03	.11
				1	.13	.09	Na	na	.14	.05	.04	.26	**.19**	.10
					.09	.01	.03	.05	.08	.04	.01	.12	.04	.01
5						**.67**	**.24**	**.20**	.07	na	.11	.13	**.17**	.13
					1	**.71**	na	na	.11	.02	.09	.02	.10	.05
						.65	**.23**	**.17**	**.21**	**.17**	.12	.04	**.22**	**.19**
6							**.23**	.15	.15	na	**.20**	.06	.15	.11
						1	na	na	.00	.04	.11	.11	.09	.04
							.28	**.18**	**.28**	**.24**	**.15**	.07	.13	.11
7								**.34**	**.40**	.22	**.25**	.29	**.29**	**.24**
							1	na	na	na	na	na	na	na
								.52	**.46**	**.42**	**.39**	**.33**	**.24**	**.18**
8									**.28**	.07	**.26**	.22	**.32**	**.21**
								1	na	na	na	na	na	na
									.43	**.50**	**.41**	**.31**	**.26**	**.15**
9										na	**.45**	.11	**.31**	**.29**
									1	**.46**	**.39**	.32	**.27**	**.24**
										.65	**.41**	**.38**	**.25**	**.17**

	Gp	Zero CCO			BRM 7 EST FF		BRM 8 FF		Practice RF		RF	RF	CFF	
	25m	25m	100m	200m	S Tgt	M Tgt	S Tgt	M Tgt	#1	#2	Qual	2d att	#1	#2
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
10										1	na **.36** **.36**	na **.48** **.31**	na **.31** **.23**	na **.27** .10
11											1	.12 **.43** **.48**	**.25** **.31** **.34**	**.20** **.27** **.18**
12												1	.06 .27 .11	.17 .33 .01
13													1	**.50** **.49** **.61**

Notes. OSUT company sizes ranged from 189 to 215 in BRM and from 167 to 197 in ARM. Major blocks of instruction are distinguished by bolded lines.

Measure by number.

1. Group with CCO at 25m (# rounds), BRM4
2. Zero with CCO at 25m (# rounds), BRM4
3. Confirm zero at 100m (# rounds), BRM5
4. Confirm zero at 200m (# rounds), BRM5
5. Field Fire w EST, Single Target Tables, BRM7
6. Field Fire w EST, Multiple Target Tables, BRM7
7. Field Fire Live, Single Target Tables, BRM8
8. Field Fire Live, Multiple Target Tables, BRM8
9. Practice Record Fire, 1st iteration, BRM9
10. Practice Record Fire, 2nd iteration, BRM9
11. Record Fire, qualification, BRM10
12. Record fire, 2nd attempt at Qualification, BRM10
13. CFF, 1st iteration, ARM6
14. CFF, 2nd iteration, ARM6

Table G-2

Correlations Among Marksmanship Measures for Each BCT Company in the Current Research

	Gp	Zero BUIS		BRM 7 EST		Practice RF		RF	RF	ARM1 FF EST		CFF
	25m	25m	175m	S Tgt	M Tgt	#1	#2	Qual	2nd att	S Tgt	M Tgt	
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	.12 .08 **.31**	.10 na **.36**	.00 .03 .11	.04 .09 .04	.10 **.33** **,26**	.00 **.32** **.33**	.05 **.34** **.20**	.12 **.39** .14	.06 .00 **.16**	.07 .01 **.17**	.14 **.27** .15
2		1	.08 na **.17**	.14 .10 .04	.04 .00 .01	.05 .01 **.34**	**.15** .05 **.29**	.11 .09 **.29**	.19 .06 .20	.08 .00 **.18**	.11 .00 **.17**	.08 .00 **.31**
3			1	.09 na .06	.04 na .03	**.21** na **.16**	**.17** na **.28**	**.26** .na **.14**	.31 na .02	.18 na **.20**	.13 na .09	.01 na **.40**
4				1	**.69** **.65** **.83**	**.21** **.20** **.19**	**.28** **.19** **.17**	**.20** **.21** **.**05	.10 .25 .14	.18 **.23** .06	.18 **.23** .04	.03 **.21** .08
5					1	**.18** **.27** **.26**	**.23** **.27** .13	.11 **.17** .08	.23 .21 .02	.05 **.24** .13	.08 .17 .06	.04 **.24** .08
6						1	**.46** **.68** **.66**	**.44** **.62** **.46**	**.59** **.52** .16	.18 .08 .16	**.23** .00 .16	**.27** **.38** **.36**
6							1	**.43** **.67** **.57**	**.44** **.50** .06	.17 .05 .12	**.22** .02 .07	**.17** **.48** **.33**
8								1	.16 **.45** .03	.01 .03 .09	.06 .01 .01	**.18** **.36** **.24**
9									1	.25 .17 .08	.44 .16 .08	.01 .10 .28

	Gp	Zero BUIS		BRM 7 EST		Practice RF		RF	RF	ARM1 FF EST		CFF
	25m	25m	175m	S Tgt	M Tgt	#1	#2	Qual	2nd att	S Tgt	M Tgt	
	1	2	3	4	5	6	7	8	9	10	11	12
10										1	**.81** **.80** **.81**	06 **.21** .12
11												05 .09 .04

Notes. BCT company sizes ranged from 159 to 182 in BRM and from 125 to 187 in ARM. Major blocks of instruction are distinguished by bolded lines.

Measure by number.

1. Group with BUIS at 25m (# rounds), BRM4
2. Zero with BUIS at 25m (# rounds), BRM4
3. Confirm zero at 175m (# rounds), BRM5
4. EST single targets, BRM7
5. EST multiple targets, BRM7
6. Practice Record Fire, 1st iteration, BRM9
7. Practice Record Fire, 2nd iteration, BRM9
8. Record Fire, qualification, BRM10
9. Record fire, 2nd attempt at Qualification, BRM10
10. EST Single Targets (in gear) ARM1
11. EST Multiple Targets (in gear), ARM1
12. CFF, only iteration, ARM7

Correlations Among Marksmanship Measures: Archival Data

In this research, Soldiers used the EST 2000 to conduct BRM exercises prior to live-fire execution of the same exercises. This was done for grouping, zeroing, Field Fire I and II, and practice record fire. Periods of instruction are presented in order with the marksmanship program in effect at the time the research was conducted.

Measures by number in Table G-3

1. EST rounds to group, 3 round shot groups, BRM3
2. EST rounds to zero, 3 round shot groups, BRM 3
3. Live rounds to group, 3 round shot groups, BRM4
4. Live rounds to zero, 3 round shot groups, BRM5
5. Live Known Distance firing, total score for 75m, 175m, and 300m targets, BRM6
6. EST Field Fire I, single targets (maximum score of 36), BRM7
7. EST Field Fire II, multiple targets (maximum score of 44), BRM 8
8. Live Field Fire I, BRM9
9. Live Field Fire II, BRM10
10. EST Practice Record Fire (40 rounds from prone supported (20) and prone unsupported (20), BRM11
11. Live Practice Record Fire 1st iteration, BRM 12
12. Live Practice Record Fire 2nd iteration, BRM 12
13. Live Record Fire, qualification, BRM13
14. Live Record Fire, 2nd attempt, BRM13

The Field Fire scenarios differed somewhat from the current research. Complete descriptions of these differences are in Appendix A on Firing Tables. The Record Fire scenario also differed in that only two positions were used. The change to three positions (kneeling was added) was made to the rifle marksmanship FM published in 2006.

Two companies participated, each with about 200 Soldiers.

Table G-3

Correlations Among Marksmanship Measures in Prior Research (Archival data – 2004)

	EST		**Live**		**Live**	**EST**		**Live**		**EST**	**Live**			
	Gp	Zero	Gp	Zero	KD total	FFI	FFII	FFI	FFII	PRF	PRF1	PRF2	**RF-Q**	RF2
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	.08 **.33**	**.18** **.**09	**.19** .12	.08 **.28**	.09 .13	.09 .09	.14 **.24**	.10 .11	.08 **.21**	.09 **.25**	.13 **.23**	**.19** **.16**	.14 .14
2		1	.10 .10	**.28** **.15**	.04 .12	.13 **.20**	.14 **.16**	**.23** **.28**	.13 .08	.14 **.17**	**.20** **.21**	.08 **.23**	.13 **.17**	.06 .08
3			1	**.29** .02	.13 .10	**.17** .08	**.17** .02	.08 .05	**.18** .12	.06 .05	**.17** .09	.02 .06	**.19** .08	.06 .14
4				1	.15 .15	**.26** .04	**.34** .06	**.30** .08	**.30** .07	.06 .06	**.39** .14	.11 .06	**.29** .00	.16 .11
5					1	.15 **.18**	,21 **.21**	.17 **.36**	.19 **.22**	.02 .03	**.27** **.41**	.11 **.21**	**.21** **.17**	**.36** .15
6						1	**.52** **.55**	**.45** .13	**.21** .04	.10 **.21**	.13 **.16**	.01 .13	**.31** **.15**	.05 .00
7							1	**.49** .11	.15 .04	.05 **.20**	**.21** **.22**	.11 .13	**.26** **.15**	.18 .08
8								1	**.34** **.22**	.00 **.33**	.17 **.28**	.18 **.20**	**.43** **.24**	.01 .17
9									1	.13 .12	**.34** **.24**	**.26** **.20**	**.20** .12	.20 .08
10										1	.12 **.15**	.07 .13	**.23** **.**11	.10 .11
11											1	**.38** **.54**	**.41** **.28**	**.29** **.21**
12												1	**.32** **.26**	**.56** .14
13													1	**.45** .18

Table G-4
Correlations Among Subsets of Performance Measures in Prior Research (Archival Data, 2004)

	EST Grp/Zero	Live Grp/Zero	KD	EST FF	Live FF	EST PRF	Live PRF & RF
EST Grp/Zero	.21 .08 to .33	.15 .09 to .28	-.18 -.28 to -.08	-.13 -.20 to -.09	-.16 -.28 to -.08	-.15 -.21 to -.08	-.11 -.25 to .23
Live Grp/Zero		.16 .02 to .29	-.13 -.15 to -.10	-.14 -.34 to .02	-.15 -.30 to -.05	-.06 -.06 to -.05	-.09 -.39 to .17
KD				.19 .15 to .21	.23 .17 to .36	.00 -.02 to .03	.12 -.21 to .41
EST FF				.54 .52 to .55	.20 .04 to .49	.14 .05 to .21	.16 .01 to .31
Live FF					.28 .22 to .34	.14 .00 to .33	.24 .12 to .43
EST PRF							.13 .07 to .23
Live PRF & RF							.37 .28 to .54

Notes. First entry in each cell is mean of the company correlations (See Table G-3). The second row in each cell presents the lowest and highest individual company correlations. There is no entry for the diagonal entries for KD and EST PRF as only one measure existed (correlation is 1).

In addition to the correlations, the archival data and the design of the research allowed a comparison between levels of performance on live-fire and the comparable scenario conducted in the EST 2000. Each EST and live-fire comparison presented next is based on those Soldiers who had both scores for the comparison that was made (e.g., only those who had both an EST score and a comparable live-fire score). Consequently, the sample size varies with the specific comparison. The means are shown in Table G-5 with the EST mean first followed by the live-fire mean for each comparison made. For each performance measure, the means in Table G-5 are based on Soldiers who had both EST and live-fire data on that measure. The statistical test results which compared these means are in Table G-6. Table G-7 presents the results on the entire sample for each company.

Table G-5

EST 2000 and Live Fire Comparisons by Comparable BRM Periods (Archival data)

	Company 1: Mean (SD), n	Company 2: Mean (SD). n
EST rounds to group	15.81 (13.07) 199	19.10 (21.81), 191
Live rounds to group	15.04 (9.66), 199	14.80 (8.96), 191
EST rounds to zero	17.64 (7.65), 197	40.80 (29.64), 190
Live rounds to zero	27.18 (20.67), 197	25.17 (17.03), 190
EST Field Fire I (Single Targets)	28.03 (5.53), 76	27.22 (5.93), 188
Live Field Fire II (Single Targets)	15.78 (6.03), 76	17.13 (5.80), 188
EST Field Fire II (Multiple Targets)	34.35 (7.20), 132	35.11 (6.52), 161
Live Field Fire II (Multiple Targets)	22.44 (7.49, 132	22.88 (7.56), 161
EST Practice Record Fire w Live Practice Record I	24.39 (8.35) , 176	27.07 (7.25), 189
Live Practice Record I	16.63 (5.67), 176	22.08 (5.87), 189
EST Practice Record fire w Live Practice Record II	24.11 (8.46), 120	27.01 (7.20) , 181
Live Practice Record II	17.26 (5.50), 120	20.53 (5.76), 181
EST Practice Record fire w Record Fire- Qualification	24.10 (8.26), 192	27.09 (7.24), 190
Live Record Fire (Qualification - 1st attempt)	22.46 (6.22), 192	22.43 (5.84), 190

Note . Live fire data highlighted in gray.

The results in Table G-6 show that, with the exception of grouping, the live-fire scenarios proved more difficult for the Soldiers than the same scenario conducted in the EST 2000.

Table G-6
Dependent Sample T-Test Results Comparing EST 2000 to Live Fire Results for Each Company (Archival data)

EST-Live Fire Comparison	Company 1	Company 2	Direction of Difference
Grouping (# rounds)	t = 0.74, df = 198, p = .462	t = 2.61. df = 190, p.= 010	Equivalent; live fewer rounds
Zeroing (# rounds)	t = -6.73, df = 196, p = .000	t = 6.76, df = 189, p. = .000	Live more rounds – both companies
Field Fire I	t = 17.60, df = 75, p =.000	t = 17.84, df = 187, p =.000	Live fewer hits – both companies
Field Fire II	t = 14.30, df = 131, p = .000	t = 15.83, df = 160, p = .000	Live fewer hits – both companies
EST PR w Live PR I	t = 10.81, df = 175, p = .000	t = 7.94, df = 188, p = .000	Live fewer hits – both companies
EST PR w PR II	t = 7.69, df = 119, p = .000	t = 10.13, df = 180, p = .000	Live fewer hits – both companies
EST PR w RF	t = 2.51, df = 191, p = .013	t = 7.32, df = 189, p = .000	Live fewer hits – both companies

Table G-7
Means for All Soldiers on EST 2000 and Live-Fire Periods (Archival data)

Variables	Company 1: Mean (SD), n	Company 2: Mean (SD), n
EST # rounds to group	15.74 (12.98), 203	19.08 (21.67), 194
EST # rounds to zero	17.57 (7.65), 207	42.03 (31.38), 197
Live # rounds to group	15.01 (10.19), 213	14.72 (8.95), 193
Live # Round to zero	27.49 (20.57), 209	25.34 (16.95), 194
EST FFI hits	27.76 (5.53), 156	27.30 (5.89), 196
EST FFII hits	34.63 (7.02), 145	34.89 (6.66), 196
Live FFI Hits	15.60 (5.82), 108	17.18 (5.86), 190
Live FFII hits	22.67 (7.35), 186	22.99 (7.58), 165
EST practice record fire hits	23.91 (8.36), 197	27.09 (7.24), 190
Live Practice record fire #1 hits	16.53 (5.69), 188	21.92 (6.01), 195
Live Practice record fire #2 hits	17.30 (5.47), 126	20.45 (5.78), 187
Live Record Fire –Qualification – hits	22.29 (6.31), 208	22.47 (5.92), 196

Current Research: Correlations Between Self-Ratings and Performance Measures

Table G-8

Correlations Between Self-Ratings (10-point scale) and Performance Measures for OSUT Soldiers: Current Research

	Self-Rating		
	Start	End of BRM	End of ARM
Start Rating	…	.54	.36
End of BRM Rating		…	.72
# Rounds to Group (CCO)	-.10	-.11	-.08
# Rounds to Zero (CCO)	-.12	-.07	-.05
Practice RF 1st Iteration	.20	.28	.20
Practice RF 2nd Iteration	.18	.15	.11
Record Fire 1st Iteration	.23	.33	.23
CFF 1st Iteration (hits)	.20	.14	.27
CFF 2nd Iteration (hits)	.17	.12	.28

Note. Ns ranged from 512 to 545. Correlations > +/- .08 were significant.

Table G-9

Correlations Between Self-Ratings (10-point scale) and Performance Measures for BCT Soldiers: Current Research

	Self-Rating		
	Start	End of BRM	End of ARM
Start Starting	…	.39	.23
End of BRM Rating		…	.61
# Rounds to Group (Iron sights)	-.19	-.20	-.10
# Rounds to Zero (Iron Sights)	-.08	-.04	-.05
Practice RF 1st Iteration	.21	.28	.22
Practice RF 2nd Iteration	.25	.28	.23
Record Fire 1st Iteration	.23	.43	.28
CFF 1st Iteration (hits)	.21	.12	.33

Note. Ns ranged from 416 to 469. Correlations > +/- .08 were significant.

APPENDIX H

COMPANY RESULTS ON RECORD FIRE AND CFF

Table H-1
Descriptive Statistics on Practice Record Fire and Record Fire by Company

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
Practice Record Fire 1						
N	194	190	216	181	201	160
Mean	25.31	22.32	25.87	21.33	23.70	21.68
SD	6.51	7.20	6.55	6.18	6.89	6.38
Min/Max	4/37	1/38	4/38	1/33	3/37	5/35
Expert	2.1%	1.1%	4.2%	0.1%	2.5%	0.0%
Sharpshooter	25.8%	16.3%	24.1%	7.7%	16.4%	11.9%
Marksman	41.2%	35.8%	44.9%	39.2%	38.8%	39.4%
Unqualified	30.9%	46.8%	26.8%	53.1%	42.2%	53.7%
Practice Record Fire 2						
N		193	215	182	201	154
Mean		24.04	26.19	21.93	24.34	21.60
SD		6.96	6.35	6.60	7.17	6.30
Min/Max		4/36	2/39	2/36	0/38	6/34
Expert		3.1%	3.7%	0.1%	3.5%	0.0%
Sharpshooter		20.2%	29.3%	11.5%	20.4%	11.0%
Marksman		38.3%	40.5%	39.0%	37.8%	35.7%
Unqualified		38.3%	26.5%	48.9%	37.8%	53.3%
Record Fire						
N	189	194	215	182	207	159
Mean	28.77	27.34	27.27	27.10	25.58	25.96
SD	5.76	6.20	5.63	5.76	6.68	6.09
Min/Max	6/40	3/39	9/37	11/39	5/39	8/37
Expert	11.1%	5.7%	3.7%	6.6%	4.8%	4.4%
Sharpshooter	39.7%	33.5%	35.3%	29.7%	23.7%	24.5%
Marksman	33.9%	40.7%	40.9%	43.4%	44.0%	45.3%
Unqualified	15.4%	20.1%	20.1%	20.3%	27.5%	25.8%

Notes. No Practice Record Fire 2 for OSUT 1 because of insufficient ammunition. BCT1 and BCT3 both showed a substantial improvement on Record Fire because Record Fire was executed on a different range than Practice Record Fire. With BCT1, the Practice Record Fire range was rolling and known as the most difficult Record Fire range on the installation; the Record Fire range was flat. With BCT3, Soldiers had difficulty engaging the distant targets during Practice Record Fire because there was a bank of dark trees at the end of the range. With the Record Fire range, there was an open field with light-colored stubble making it easy for Soldiers to detect targets.

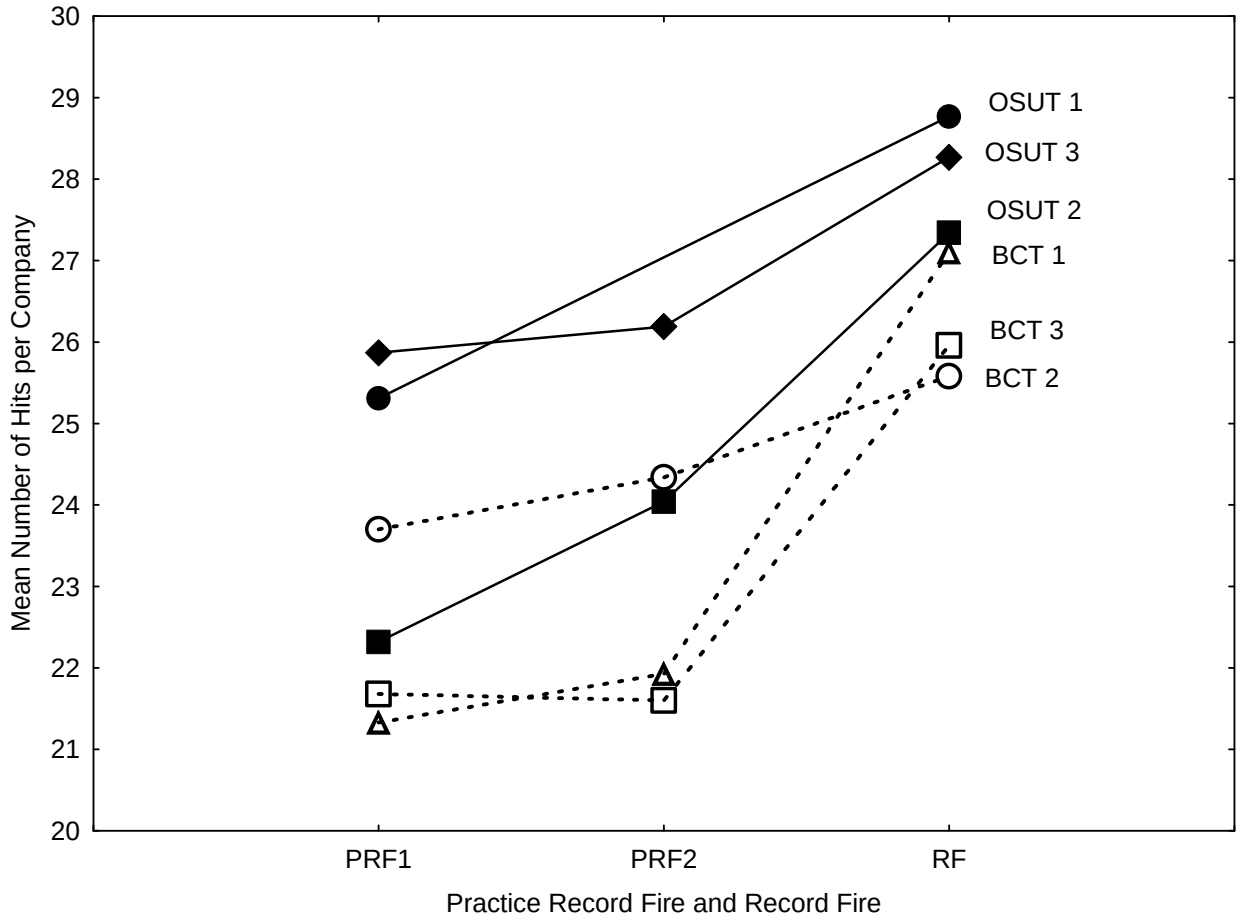

Figure H-1. Practice Record Fire and Record Fire mean scores for each company.

Table H-2
Descriptive Statistics on Combat Field Fire by Company

	OSUT 1	OSUT 2	OSUT 3	BCT 1	BCT 2	BCT 3
CFF Iteration 1						
N	167	180	197	160	187	80
Hits: Mean	16.75	17.47	18.55	11.12	14.82	10.86
Hits: SD	4.05	4.12	3.79	5.54	4.99	5.33
Hits: Min/Max	4/26	3/25	9/26	0/24	0/26	1/21
Kills: Mean	8.43	9.04	9.56	4.91	7.35	5.55
Kills: SD	2.66	2.72	2.51	3.13	3.03	3.07
Kills: Min/Max	1/15	0/14	3/15	0/13	0/15	0/12
CFF Iteration 2						
N	171	179	184			
Hits: Mean	18.71	18.68	19.15			
Hits: SD	3.80	3.71	3.48			
Hits: Min/Max	6/26	2/26	7/26			
Kills: Mean	9.74	9.74	9.92			
Kills: SD	2.52	2.47	2.33			
Kills: Min/Max	2/15	0/15	3/15			

Note. The sample size for BCT3 was reduced because of malfunctions with the range targets and the automated scoring was in error for about half the company.

APPENDIX I

ACRONYMS

ARM	Advanced rifle marksmanship
BCT	Basic combat training
BRM	Basic rifle marksmanship
BUIS	Back-up iron sight
CCO	Close combat optic (M68)
CFF	Combat field fire
DCG-IMT	Deputy Commanding General for Initial Military Training
ELO	Enabling learning objective
EST	Engagement skills trainer
IET	Initial entry training
FF	Field fire
FORSCOM	Forces Command
FM	Field manual
LOMAH	Location of misses and hits
NVGs	Night vision goggles
OSUT	One station unit training
POI	Program of instruction
RF	Record fire
TPU	Trained, needs practice, untrained