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Human Factors Evaluation of the High Mobility Artillery Rocket System (HIMARS) in the Combined HIMARS-Guided Multiple Launch Rocket System (GMLRS) Initial Operational Test

by Charles L. Hernandez

ARL-TR-4112 **May 2007**

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14. ABSTRACT

The primary purpose of this effort by the U.S. Army Research Laboratory (ARL) was to collect data that could be used to assess human factors issues related to mission performance, training, and safety. Using questionnaires specifically designed for this initial operational test (IOT), Soldier participant comments, we recorded impressions and recommendations for improving the HIMARS launcher and its associated support vehicles. Four multi-faceted questionnaires were developed to support the applicable measures of performance listed in the HIMARS test and evaluation master plan. The questionnaires were administered to military occupational specialties 13M (MLRS Crewman), 27M (MLRS Repairman), 13P (Fire Direction Specialist), and 63 series (Vehicle Maintenance) personnel. Selected leaders (i.e., support platoon leader and fire direction officer) were also given the opportunity to answer any of the questionnaires they felt qualified to answer, based on their having received HIMARS IOT training or having been closely involved in multiple aspects of the tactical IOT events or both. Results from this evaluation were used by the U.S. Army Test and Evaluation Command (for the HIMARS system evaluation report) and ARL (for the human factors evaluation) in support of the Milestone C decision for full-rate production that occurred in June 2005.

15. SUBJECT TERMS
GMLRS; HFE; HIMARS; IOT

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Contents

List of Figures

List of Tables

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1. Introduction

1.1 Background

The High Mobility Artillery Rocket System (HIMARS) initial operational test (IOT) was conducted at Fort Sill, Oklahoma, and White Sands Missile Range (WSMR), New Mexico, from 20 September to 12 November 2004. Soldier training was conducted from 6 July to 27 August 2004. The pilot test was conducted from 30 August to 10 September 2004. The IOT ground phase (at Fort Sill) was conducted from 20 September to 1 October 2004 and included two 96-hour live fire field training exercises. During these exercises, 120 live fire missions were executed; 719 reduced range practice rockets and 223 dry fire missions were fired (simulating the firing of the full range of multiple launch rocket system (MLRS) family of munitions [MFOM]). The IOT flight phase (at WSMR) was conducted from 11 October to 12 November 2004 and the following munitions were fired: (1) Four guided MLRS (GMLRS) rocket pods (24 rockets), (2) one Army Tactical Missile System, (3) two M26 rocket pods (12 rockets), and (4) one M26A2 rocket pod (six rockets).[1] The IOT was a comprehensive test of the HIMARS launcher and its resupply vehicles and trailers (RSV/T), to provide data and analyses of the operational effectiveness, suitability and survivability of HIMARS Block I. The U.S. Army Research Laboratory (ARL) supported the test effort with a manpower and personnel integration (MANPRINT)-related human factors evaluation (HFE).

1.2 Purpose

The primary purpose of this ARL effort was to collect data that could be used to assess human factors issues related to mission performance, training, and safety. The scope of this data collection effort was the recording of Soldier comments, impressions, and recommendations for improving the HIMARS launcher and its associated support vehicles, based upon their individual experiences in the IOT. These data were analyzed in an evaluation that provided human factors insights into the operational effectiveness and operational suitability of the HIMARS and its RSV/T.

2. Method

2.1 Requirements

ARL support for the HIMARS IOT was formalized immediately before the February 2004 Operational Test Working Group 3 met. The scope of the support desired was a MANPRINT assessment, but an HFE was actually conducted. This HFE support was further defined in a series of

[1] Final HIMARS-GMLRS IOT "Record Test" Daily Test Status report (DTSR), dated 16 November 2004.

meetings and video teleconferences chaired by the U.S. Army Test and Evaluation Command (ATEC) System Team for the HIMARS.

From January 2004 until approximately 60 days before the IOT, the HIMARS system underwent three project manager (PM)-sponsored developmental test events: the Logistics Demonstration, a Performance Qualification Test II, and an Extended System Integration Test (ESIT) III. A draft pattern of analysis (POA) was prepared for ESIT III and the IOT in order to frame MANPRINT issues against the critical operational issues (COI) and associated issues documented in Chapter 4 Operational Test and Evaluation Outline of the HIMARS Test and Evaluation Master Plan (*4*). A separate MANPRINT COI was not prescribed because all COIs were total system measures. As such, they inherently covered hardware, software, personnel, doctrine, organization and training implications and requirements. The application and integration of MANPRINT was therefore also implied, with a focus on "human factors" within the human-system interface and individual, crew and support personnel performance during the IOT. This HFE is more limited in scope than a full-scale MANPRINT assessment. Whereas the primary purpose of a MANPRINT assessment is to address unresolved critical MANPRINT issues in all seven MANPRINT domains, the HFE conducted in this IOT supported the ATEC evaluation of the system and highlighted the operational suitability of the Soldier-system interface in an operational setting. This HFE provides information to the test agency as to whether Soldiers could successfully operate the system being evaluated in accordance with required standards, after having been trained to meet those standards.

The primary HFE POA criterion was *the HIMARS system design must allow the crew to be able to perform all required tasks successfully*. The applicable measures of performance (MOPs) were

- Individual and crew capabilities to carry mission equipment for the performance of assigned duties and mission-critical tasks within the overall design of the HIMARS.
- Individual and crew capabilities to perform preventive maintenance checks and services (PMCS) on HIMARS.
- Individual and crew capabilities to perform assigned and mission-critical tasks safely.
- Individual and crew capabilities to perform driving, navigation, and fire control tasks within the overall design of the HIMARS cab.
- Individual and crew performance of reload operations.
- Operator and maintainer personnel use of integrated electronic technical manuals (IETMs).
- Operator and maintenance personnel use of on-board system diagnostics.
- Individual and crew workload stress and fatigue observed/recorded in the performance of operations and maintenance.
- An assessment by the crews as to their level of training.

Four multi-faceted questionnaires were the primary instruments used to gather Soldier data for the stated MOPs. The questionnaires were administered to military occupational specialties (MOS)

13M (MLRS Crewman), 27M (MLRS Repairman), 13P (Fire Direction Specialist), and 63 series (Vehicle Maintenance) personnel. In addition to these Soldiers, selected leaders (i.e., the support platoon leader and fire direction officer) were afforded the opportunity (recommended by the Fort Sill Fire Support Test Directorate [FSTD]) to answer any of the questionnaires that they felt qualified to answer, based on their having received HIMARS IOT training or having been closely involved in multiple aspects of the operations conducted during the test, or both.

2.2 General Procedures

All test personnel received formal training in their MOS-related tasks for the HIMARS and GMLRS rocket. Individual training progressed to collective training in accordance with the outline test plan (OTP) HIMARS initial operational test and evaluation (IOT&E), dated 30 August 2004, and the OTP, GMLRS IOT&E, dated 3 August 2004. On 7 September 2004, the U.S. Army Field Artillery School provided an operational test readiness statement for the combined HIMARS and GMLRS IOT&E. It documented that all test personnel could satisfactorily perform individual and collective tasks to meet the standard. No other formal training and evaluation were administered to the test personnel. In order to assess how well trained the test Soldiers were, the Soldier surveys contained training-related questions in which the respondents were asked to assess the level of training they felt they had achieved in the IOT.

A pilot test was conducted immediately after individual and collective training. The pilot test was followed by a week of maintenance training in preparation for the record test ground phase of the IOT, which was conducted from 20 to 30 September 2004. Data collection throughout the period from the pilot test through the completion of the record test ground phase was performed with manual and automated methods. Manual methods included test incident reports, the Soldiers' questionnaires, and data collection forms completed by data collectors who were part of the FSTD. Automated methods included AFATDS print-outs and instrumentation installed on the launchers and fire direction equipment (*3, paragraph 4.8.3.5*).

The Fort Sill Field Element of ARL's Human Research and Engineering Directorate (HRED) and the FSTD jointly developed the primary questionnaire instruments. These questionnaires were administered on 4 October 2004 at the culmination of the IOT ground phase. Although the 4 October 2004 survey session was the primary data collection event for Soldier feedback, two smaller survey sessions were administered at the request of FSTD. The first was on 13 October 2004 at the test-player unit in order to administer the MOS 13P survey to battalion fire direction center (FDC) personnel who were not present at the first session. The second was at the culmination of the IOT flight phase at WSMR. In this session, administered and controlled by the GMLRS Test Officer from FSTD, only those MOS 13M, 13P, and 27M Soldiers who deployed to WSMR for the IOT flight phase were again administered the same questionnaires. Respondents were asked to answer only those questions that were applicable. The answers obtained from the flight phase were combined with those from the ground phase but were not used to compare the Soldiers' experiences between the ground and flight phases.

2.3 Questionnaires

The four surveys already described, provided Soldiers the opportunity to address maintenance, training, and fire direction related topics and issues for the HIMARS, RSV/T, and GMLRS rocket.

2.3.1 MOS 13M Questionnaire

The MOS 13M Soldier Questionnaire consisted of four parts: (1) Part I: Individual and Crew Satisfaction, (2) Part II: Focused Feedback on HIMARS Launcher Operations, (3) Part III: Focused Feedback on HIMARS RSV/T Operations, (4) Part IV: Focused Feedback on GMLRS Operations. This survey was the most extensive of the four. It required all 13M Soldiers to initially rate their levels of satisfaction or dissatisfaction (using the Likert scale described in appendix A) with various characteristics and design features of both the HIMARS launcher and the RSV/T. A total of 31 questions was asked in Part I of the survey.

Since MOS 13M Soldiers were assigned duty positions as either HIMARS launcher crew members or RSV/T drivers (not intermixed), after completing Part I, they then completed either Part II (HIMARS Launcher Operations) or Part III (RSV/T Operations) in order to provide applicable focused feedback, based on their individual IOT experiences. Part II presented 18 HIMARS launcher-related questions affording player participants the opportunity to provide comments spanning launcher design, operations, safety, and training. Part III presented 11 RSV/T-related questions affording player participants the opportunity to provide comments spanning RSV/T design, operations, and safety.

Part IV of the MOS 13M survey specifically focused on training, the use of the launcher fire control system (LFCS) to process GMLRS missions and general handling of the GMLRS launch pod container (LPC). It was more applicable to the GMLRS portion of the combined IOT and is therefore not discussed in this report.[2] Regardless, all MOS 13M Soldier comments and responses are provided in appendix A, including Part IV for informational purposes. The applicable findings for only Parts I through III, based on an analysis of Soldier responses, are presented in section 4 of this report.

2.3.2 MOS 13P Questionnaire

The MOS 13P Soldier questionnaire presented seven questions in which fire direction Soldiers from platoon to battalion level could provide feedback and comments on processing fire missions for the XM30 GMLRS. As in Part IV of the 13M survey, this survey was more applicable to the GMLRS IOT and is therefore not discussed in this report.[3] Regardless, MOS 13P player comments and responses are provided in appendix B for informational purposes.

[2] See reference (*5*) for a complete discussion and analysis of Part IV of the MOS 13M Soldier survey.

[3] See reference (*5*) for a complete discussion and analysis of the MOS 13P Soldier survey.

2.3.3 MOS 27M Questionnaire

The MOS 27M Soldier questionnaire consisted of two parts. In Part I, MOS 27M Soldiers were presented with eight questions about maintaining and repairing the HIMARS launcher system. In Part II, MOS 27M Soldiers were presented with five questions about performing troubleshooting and maintenance-related tasks on the XM30 GMLRS rocket. For the purposes of this HIMARS IOT HFE report, Part II is not applicable and therefore is not discussed.[4] The MOS 27M Soldier questionnaire was administered at Fort Sill after the ground phase of the IOT culminated and again at WSMR after the IOT flight phase culminated. All Soldier comments and responses are presented in appendix C, including Part II responses for informational purposes. The resultant findings for Part I only, based on an analysis of Soldier responses, are presented in section 4 of this report.

2.3.4 MOS 63 Series Questionnaire

Finally, the MOS 63 series Soldier questionnaire consisted of two parts, each with eight vehicle maintenance-related questions similarly worded for the HIMARS launcher and the RSV/T. Soldier comments and responses are summarized in appendix D, with the resultant findings presented in section 4 of this report.

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3. Results

3.1 General

All the results discussed are based on a subjective analysis of the Soldiers' responses to the surveys they were administered. The purpose of this analysis was to glean human factors insights and issues into the operational effectiveness and suitability of the HIMARS and its resupply vehicle and trailer, as well as recommendations for improving both.

3.2 MOS 13 M Survey Results

3.2.1 Satisfaction/Dissatisfaction

The Soldier responses to Part I of the 13M questionnaire revealed that Soldiers were generally satisfied with the HIMARS launcher and RSV/T. The Soldiers answered each question using a Likert scale whereby a score of "1" meant the Soldier was extremely satisfied, a score of "2" meant the Soldier was satisfied, a score of "3" meant the Soldier was dissatisfied, and a score of "4" meant the Soldier was extremely dissatisfied. An additional scaled numeric of "5" could be selected if the Soldier had absolutely no opportunity to use or experience the HIMARS launcher or RSV/T design

[4] See reference (*5*) for a complete discussion and analysis of Part II of the MOS 27M Soldier survey.

or capability addressed in the question. The scaled numeric equated to an "N/A" (not applicable) response. As such, it carried no measurable weight in analyzing the levels of satisfaction or dissatisfaction experienced by the Soldiers. Based on the Soldier responses, the average satisfaction rating was 1.41 and the overall median score was 2.0.

Clear Soldier satisfaction (scores from 1.0 to 2.0) was recorded in 17 of the 31 questions asked. Soldiers were satisfied with the following individual system designs and capabilities:

- A door, window, or the Commander's hatch open is sufficient for ventilation when the chemical and air filtration unit (CAFU) is not operating (Question 1). Satisfaction rating: 82.4% (N=17; avg. score: 2.0)
- The cautions and warning labels throughout the vehicles are easy to locate and read (Question 4). Satisfaction rating: 96.5% (N=29; avg. score: 2.14)
- All lighted indicator displays are easy to read during daytime and nighttime (Question 5). Satisfaction rating: 85.7% (N=28; avg. score: 1.78)
- The cab adequately protects the crew from launch hazards, debris, tube covers, plume pressures, and from the flash of rocket and missile firings (Question 9). Satisfaction rating: 93.3% (N=15; avg. score: 1.60)
- When seated in the commander's seat with the seat belt on and with feet flat on the floor, the vehicle commander felt safe and secure from possible injury during vehicle movement (Question 13 [for the HIMARS vehicle commander only]). Satisfaction rating: 85.7% (N=7; avg. score: 1.71)
- The design of the commander's hatch lock (Question 14 [for the HIMARS vehicle commander only]). Satisfaction rating: 66.7%; (N=6; avg. score: 2.0)
- The boom control unit is easy to use (Question 16). Satisfaction rating: 93.8% (N=16; avg. score: 1.56)
- With the functionality of the LFCS used in the HIMARS launcher (Question 17). Satisfaction rating: 86.7% (N=15; avg. score: 1.87)
- The gunner's display unit (GDU) allows the gunner to accurately control the operation of the HIMARS fire control system (Question 18). (Satisfaction rating: 80%; N=15; avg. score: 1.67)
- There is adequate space to access the tactical processor unit (TPU) and mass storage unit (MSU) after the gunner's seat is folded forward (Question 19). Satisfaction rating: 100% (N=14; avg. score: 1.71)
- The maintenance support device-field ready (MSD-FR) is easy to use (Question 20). Satisfaction rating: 85% (N=20; avg. score: 1.95)

- The MSD-FR is easy to maintain (Question 21). Satisfaction rating: 100% (N=18; avg. score: 1.78)
- Whenever the MSD is powered up, the IETMs are easy to use (Question 23). Satisfaction rating: 94.7% (N=19; avg. score: 1.84)
- Anyone in the HIMARS crew can successfully remove and replace line-replaceable units (LRUs) (Question 24). Satisfaction rating: 100% (N=16; avg. score: 1.69)
- Anyone in the HIMARS crew can isolate to an LRU and perform PMCS using the IETM, built-in test self diagnosis, the MSD-FR, and common tools (Question 25). Satisfaction rating: 86.7% (N=15; avg. score: 1.87)
- The IETM tutorials are well organized and easy to understand (Question 26). Satisfaction rating: 73.7% (N= 19; avg. score: 1.32)
- The MLRS MFOM weapons simulator adequately helps train the HIMARS crew to perform essential tasks (Question 31). Satisfaction rating: 79.2% (N=24; avg. score: 2.0)

Some measure of Soldier dissatisfaction (scores from 2.1 to 2.9) was recorded in 13 of the 31 questions asked. Soldiers expressed some dissatisfaction with the following individual system designs and capabilities:

- There is sufficient room in the family of medium tactical vehicles (FMTV) crew cab for a three-man HIMARS crew to perform individual and crew tasks satisfactorily (Question 2). Dissatisfaction rating: 19% (N=21; avg. score: 2.14)
- The vehicle steps and hand-holds are adequately designed and positioned to make boarding and exiting the vehicle easy and safe (Question 3). Dissatisfaction rating: 55% (N=29; avg. score: 2.55)
- The accelerator and brake pedals can be accidentally engaged at the same time (Question 6). Dissatisfaction rating: 27.6% (N=29; avg. score: 2.10)
- The design and function of the cab doors and windows (Question 7). Dissatisfaction rating: 53.5% (N=28; avg. score: 2.64)
- Exhaust fumes from rocket and missile firings enter the cab and affect the crew in any way (Question 8). Dissatisfaction rating: 37.5% (N=16; avg. score: 2.25)
- The cab seats are not sturdy, did not function as they were designed to function (i.e., handles did not work, adjustments could not be made, etc.) and did not provide adequate comfort and support for all operations (Question 11). Dissatisfaction rating: 24.1% (N=29; avg. score: 2.10)
- With the seating area for the vehicle commander within the cab of the HIMARS vehicle (Question 12 [for the vehicle commander only]). Dissatisfaction rating: 42.8% (N=7; avg. score: 2.29)

- The IETMs are not easy to use (Question 22). Dissatisfaction rating: 21.0 (N=19; avg. score: 2.32)
- The materiel handling crane (MHC) on the M1084A1 resupply vehicle is easy to use (Question 27). Dissatisfaction rating: 25% (N=16; avg. score: 2.12)
- The remote control unit (RCU) always provided reliable, controlled operation of the MHC (Question 28). Dissatisfaction rating: 37.5 (N=16; avg. score: 2.38)
- By using the RCU, the operator could always prevent the MHC from being slewed at full speed to its final position (to prevent damaging the slewing system) (Question 29). Dissatisfaction rating: 26.7% (N=15; avg. score: 2.13)
- By using the RCU, one could always prevent the inner boom from lowering at full speed (to prevent uncontrolled movement by the boom) (Question 30). Dissatisfaction rating: 26.7% (N=15; avg. score: 2.20).

Clear Soldier dissatisfaction (scores from 3.0 to 4.0) was recorded in only 1 of the 31 questions asked (see table 1). Soldiers were dissatisfied with the design of the steering wheel in the HIMARS launcher vehicle (Question 10). Dissatisfaction rating: 42.9% (N=14; avg. score: 3.09)

Portraying Soldier satisfaction or dissatisfaction via summarized responses to random questions of system designs and capabilities does little to highlight the areas about the HIMARS and the RSV/T that the Soldiers were really satisfied or dissatisfied with. Without this clarity, the Part I responses remain disconnected from the focused feedback the Soldiers provided in other parts of the survey. As the survey instrument was designed, it was hoped that the Soldiers would use some of their answers in Part I to fuel meaningful feedback in the other sections of the survey. The desire to have this kind of linkage was explained to the Soldiers during the administrative portion of the 4 October 2004 survey session.

3.2.2 Cross Walk and Implications

Before leaving this discussion of Part 1 of the 13M survey, let us broadly categorize the satisfaction/dissatisfaction questions to see where common implications exist. For example, which questions have "training" implications? If Soldier dissatisfaction is registered for several questions with "training" implications, is there perhaps a "training issue" that the Soldiers will highlight in another part of the survey? For this review, the following arbitrary categories are used: (1) Cab Design and Functionality, (2) Individual and Crew Safety, (3) Reload System Functionality, (4) Training and Usability, (5) Fire Control System Design and Functionality, and (6) Capability to Perform Maintenance. Almost half of the questions cross walk to more than one category, as shown in table 1. The frequency with which each of the categories appears for each question was not purposefully designed into the questionnaire. As a result, there is a disparity between the numbers of questions that can be associated for each category. For example, a review of table 1 reveals that Cab Design and Functionality is addressed in the highest number of questions (11)

while the Fire Control System is addressed in only two questions. Of the others, Safety and Training implications are apparent in 10 questions, Maintenance in seven questions, and Reload System Functionality in six. In addition to this disparity, approximately half (15) of all the questions asked are also shared by two or more categories. What this inequality points to is the need to relate the indications of strong Soldier satisfaction and dissatisfaction with the Soldier commentaries in the focused feedback portions of the survey in order to ascertain merit and worthiness. Here again, however, caution is warranted since there may not be sufficient focused feedback commentaries to support the intensity of the satisfaction and dissatisfaction expressed in Part I of the survey and more importantly, to support a subjective assessment of the human factors issue at hand.

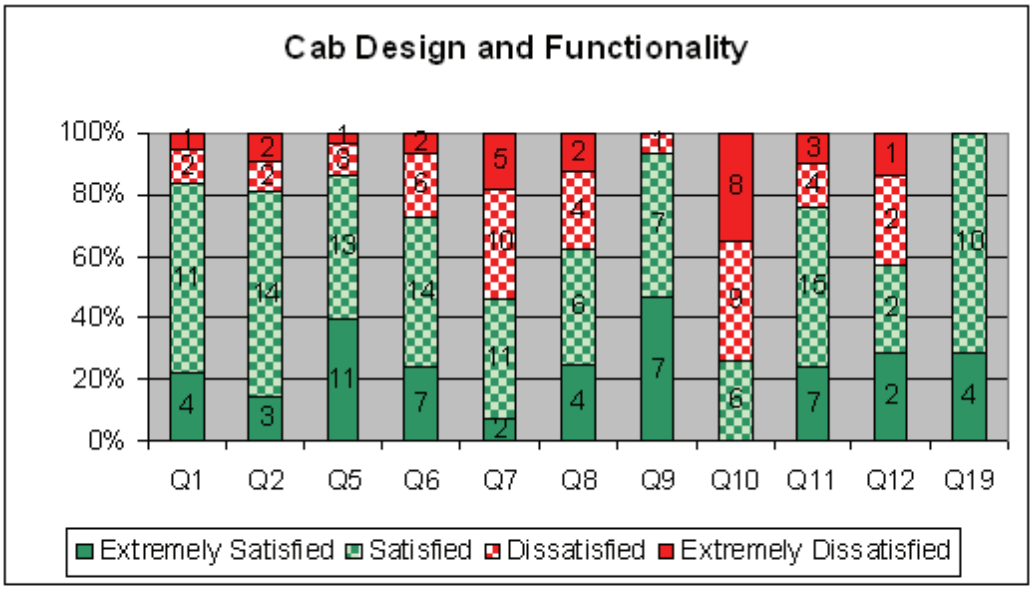
Table 1. Cross walk of satisfaction/dissatisfaction questions by category.

	Questions																													
Categories	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Cab	x	x			x	x	x	x	x	x	x	x							x												
Safety			x	x		x		x	x				x	x														x	x	x	
Reload															x	x											x	x	x	x	
Training					x										x	x				x		x	x	x	x		x				x
FCS																	x	x													
Maintenance																				x	x	x	x	x	x	x					

	Clear Satisfaction (17 of 31 questions with average scores from 1.0-2.0)
	Some Dissatisfaction (13 of 31 questions with average scores from 2.1-2.9)
	Clear Dissatisfaction (1 question with an average score greater than 3.0)

3.2.3 Cab Design and Functionality

The questions that are categorized and grouped under "Cab Design and Functionality" are shown in figure 1. The HIMARS launcher (consisting of an FCS, a carrier [automotive portion], and a launcher module) is mounted on a FMTV 6x6 all-wheel-drive 5-ton truck. The FMTV crew cab is modified so that a crew of three can employ the HIMARS to meet operational requirements. Crew cab modifications also provide for crew survivability and safety and protect the crew from toxic gases, tube cover impact, and launch area debris penetration during firing activities. A CAFU in the cab forces outside air through an M48 filter, causing an over-pressure condition, which also prevents gasses from entering around doors or other small openings. Finally, the cab interior has been modified so that the FCS, communications equipment, and controls and indicators required to operate the HIMARS launcher are adequately housed. Overall, the HIMARS and RSV/T crews were satisfied with cab design and functionality; 70% of all responses for the 11 cab-related questions were either a "1" (extremely satisfied) or a "2" (satisfied). HIMARS crews specifically expressed no less than 50% satisfaction in all questions except for question 10 (steering wheel design). For this question, all HIMARS crews expressed dissatisfaction.



Q1: How satisfied (83%) or dissatisfied (17%) are you that having a door, window or the commander's hatch open is sufficient for ventilation when the Chemical Filtration Unit (CAFU) is not operating?

Q2: How satisfied (81%) or dissatisfied (19%) are you that there is sufficient room in the FMTV crew cab for a three-man HIMARS crew to perform individual and crew tasks satisfactorily?

Q5: How satisfied (86%) or dissatisfied (14%) are you that all lighted indicator displays (LID) are easy to read during daytime and nighttime?

Q6: How satisfied (72%) or dissatisfied (28%) are you that the accelerator and brake pedals cannot be accidentally engaged at the same time?

Q7: How satisfied (46%) or dissatisfied (54%) are you with the design and function of the cab doors and windows?

Q8: How satisfied (63%) or dissatisfied (37%) are you that exhaust fumes from rocket and missile firings does not enter the cab and affect the crew in any way?

Q9. How satisfied (93%) or dissatisfied (7%) are you that the cab adequately protects the crew from launch hazards, debris, tube covers, plume pressures and from the flash of rocket and missile firings?

Q10: How satisfied (26%) or dissatisfied (74%) are you with the design of the steering wheel in the HIMARS launcher vehicle?

Q11: How satisfied (76%) or dissatisfied (24%) are you that the cab seats are sturdy, functioned as they were designed to function (i.e. handles worked, adjustments could be made, etc) and provided adequate comfort and support for all operations?

Q12: (For the HIMARS Vehicle Commander only) How satisfied (57%) or dissatisfied (43%) are you with the seating area for your position within the cab of the HIMARS vehicle?

Q19. How satisfied (100%) or dissatisfied are you that there is adequate space to access the Tactical Processor Unit (TPU) and the Mass Storage Unit (MSU) after folding the Gunner's seat forward?

Figure 1. Satisfaction/dissatisfaction: cab design and functionality.

The high overall satisfaction rating is nevertheless tempered with some interesting ratings of dissatisfaction. Three examples warrant mention:

- While the crews were overwhelmingly satisfied that the cab adequately protected them from launch hazards, debris, tube covers, plume pressures and from the flash of rocket

firings (Question 9), a high percentage of respondents (54%) were dissatisfied with the design and function of the cab doors and windows (Question 7). In addition, many (37%) were not satisfied that exhaust fumes from rocket and missile firings entered the cab and affected the crew (Question 8).

- A large percentage of crew members (74%) expressed dissatisfaction with the design of the steering wheel in the cab (Question 10). Almost half of the dissatisfied crew members expressed "extreme dissatisfaction" which qualified it as the single design issue to receive the highest rating of "extreme dissatisfaction". The fact that this is a design issue is not new, since it surfaced in other developmental and integrating testing.
- One third of the HIMARS section chiefs were dissatisfied with their seating position in the HIMARS cab (Question 12). An ammunition platoon sergeant expressed extreme dissatisfaction with this position.

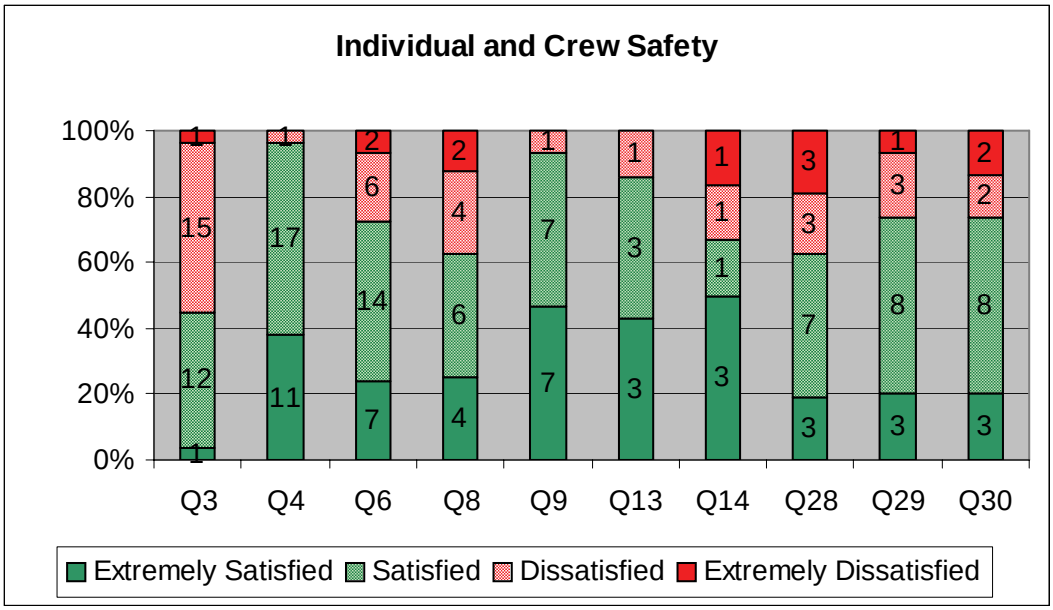
3.2.4 Individual and Crew Safety

The questions that are categorized and grouped under "Individual and Crew Safety" are shown in figure 2. They include questions 6, 8, and 9 cross walked from "Cab Design and Functionality" and discussed before. The questions address a variety of safety features and considerations for both the HIMARS and the RSV/T.

Overall, the crews were satisfied with individual and crew safety; 72% of all responses made to the 10 safety-related questions were either a "1" (extremely satisfied) or a "2" (satisfied). The satisfaction ratings for 9 of the 10 questions asked were at least 63%. The only exception was the 55% dissatisfaction rating for Question 3 (design of vehicle steps and hand-holds). This safety design feature recorded the second highest dissatisfaction rating of all the questions asked. The overall level of dissatisfaction for this safety concern increases when the six responses made by support platoon personnel (who did not regularly ride in or drive a HIMARS or RSV) are removed. Without these, the remaining 23 responses were from 12 HIMARS crew members and 11 RSV/T crew members. Of these, 58% (7 of 12) of the HIMARS crew members and 64% (7 of 11) of the RSV/T crew members registered dissatisfaction. In cross walking these ratings with the focused feedback portion of the survey, we noted the following:

- None of the HIMARS operators expanded on their discontent with additional comments. HIMARS operators had opportunities to elaborate on their dissatisfaction in Part II, Questions 2 (list three design features they least liked), 10 (list design problems encountered when operating in any mission-oriented protective posture [MOPP] level), 11 (list design problems encountered when operating at night), and 13 (record any additional comments or concerns about the HIMARS launcher).
- RSV operators provided additional comments to support their dissatisfaction ratings for this safety concern in Part III of the survey. In Part III, question 7 asked RSV operators to list any significant RSV/T system safety issues that were experienced. One respondent

commented *"Limited walking space on the cargo bed of the truck may lead to an accident."* Five comments specifically cited the ladder and hand-holds: *"The lack of handles on the ladder or adequate hand-holds to help crew members get on/off the cargo bed is unsafe."* (See appendix A.)



Q3: How satisfied (45%) or dissatisfied (55%) are you that vehicle steps and handholds are adequately designed and positioned to make boarding and exiting the vehicle easy and safe?

Q4: How satisfied (97%) or dissatisfied (3%) are you that cautions and warning labels are easy to locate and read throughout the cab, engine and body of the vehicle?

Q6: How satisfied (72%) or dissatisfied (28%) are you that the accelerator and brake pedals cannot be accidentally engaged at the same time?

Q8: How satisfied (63%) or dissatisfied (37%) are you that exhaust fumes from rocket and missile firings does not enter the cab and affect the crew in any way?

Q9. How satisfied (93%) or dissatisfied (7%) are you that the cab adequately protects the crew from launch hazards, debris, tube covers, plume pressures and from the flash of rocket and missile firings?

Q13. (For the HIMARS Vehicle Commander only) How satisfied (86%) or dissatisfied (14%) are you when seated in the commander's seat with your seat belt on and with your feet flat on the floor, that you felt safe and secure from possible injury during vehicle movement?

Q14. (For the HIMARS Vehicle Commander only) How satisfied (67%) or dissatisfied (33%) are you with the design of the Commander's hatch lock?

Q28. How satisfied (63%) or dissatisfied (37%) are you that the Remote Control Unit always provided reliable, controlled operation of the MHC.

Q29. How satisfied (73%) or dissatisfied (27%) are you that by using the Remote Control Unit you could always prevent the Material Handling Crane (MHC) from being slewed at full speed to its final position (to prevent damaging the slewing system)?

Q30. How satisfied (73%) or dissatisfied (27%) are you that by using the Remote Control Unit you could always prevent the inner boom from lowering at full speed (to prevent uncontrolled movement by the boom)?

Figure 2. Satisfaction/dissatisfaction: individual and crew safety.

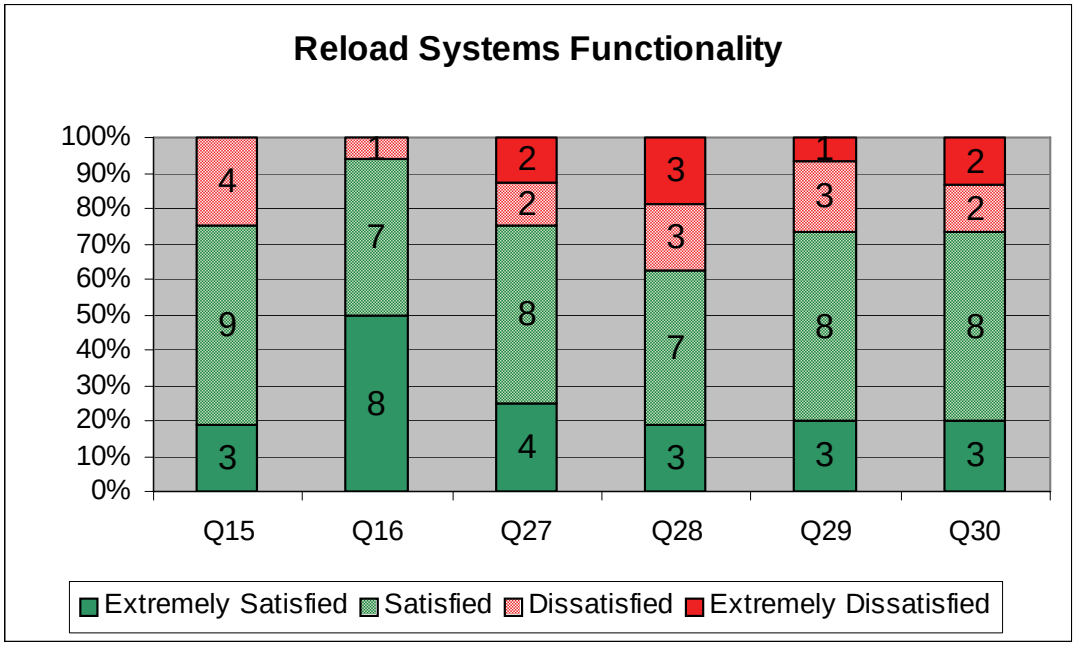
3.2.5 Reload Systems Functionality

The questions that are categorized and grouped under "Reload Systems Functionality" are shown in figure 3. They include questions 28, 29, and 30 cross walked from "Individual and Crew Safety" and discussed previously.

Overall, the crews were satisfied with the functionality of the reloading systems for both the HIMARS and RSV/T; 76% of all responses were either a "1" (extremely satisfied) or a "2" (satisfied). Questions 15 and 16 pertain to the HIMARS launcher and for these, 88% of the HIMARS crews' responses (21 of 24) were "satisfaction" responses. Questions 27 through 30 pertain to the RSV/T and for these, only 59% of the RSV crews' responses (26 of 44) were "satisfaction" responses. These questions also cross walk to the "Individual and Crew Safety" category with some interesting focused feedback that suggests the need for engineering improvements in the MHC.

- Three Soldiers cited the crane and the remote control as capabilities well liked (appendix A, Part III, Q1). However, nine Soldiers disliked the crane because of its limitations on reach and having vulnerable hydraulic lines and junction boxes (appendix A, Part III, Q2). Seven Soldiers highlighted that "*The crane had an unstable slew and would speed up or slow down by itself, would lock up for no apparent reason and the load would sometimes drop drastically"* (appendix A, Part II, Q3). One Soldier was not impressed that the crane could handle the stress and strain of heavy military operations because it *"Leaks too much and it is almost impossible to lift a pod without red lining*[5] *or locking up. It's just too weak"* (appendix A, Part III, Q3). Finally, one Soldier wrote that the heavy expandable mobility tactical truck (HEMTT) crane is better than the resupply vehicle (RSV) crane (appendix A, Part III, Q10).
- Regarding the RCU, although not specifically cited as such, the seven responses that addressed an unstable slew of the crane may also suggest an issue with the RCU. One Soldier cited that when he was operating the RCU, the crane hesitated at times during prolonged use (appendix A, Part III, Q4). Nine Soldiers' responses to Question 4 indicated that they had no problems with the RCU; it worked fine and was a good item. Two Soldiers identified that the crane is inherently unsafe with its uncommanded movements, and jerky movements that affect the load being raised or lowered (appendix A, Part III, Q7). Finally, many referenced concerns with the crane hydraulic lines not being protected.

[5]Red lining means the system was "maxed out".



Q15. How satisfied (75%) or dissatisfied (25%) are you that the Improved Reload System (IRS) is similar to the LLM Reload System on the M270, M270A1 or M270 IPDS Launcher?

Q16. How satisfied (94%) or dissatisfied (6%) are you that the handheld Boom Control Unit (BCU) is easy to use?

Q27. How satisfied (75%) or dissatisfied (25%) are you that the Materiel Handling Crane (MHC) on the M1084A1 Resupply Vehicle is easy to use?

Q28. How satisfied (63%) or dissatisfied (37%) are you that the Remote Control Unit always provided reliable, controlled operation of the MHC.

Q29. How satisfied (73%) or dissatisfied (27%) are you that by using the Remote Control Unit you could always prevent the Material Handling Crane (MHC) from being slewed at full speed to its final position (to prevent damaging the slewing system)?

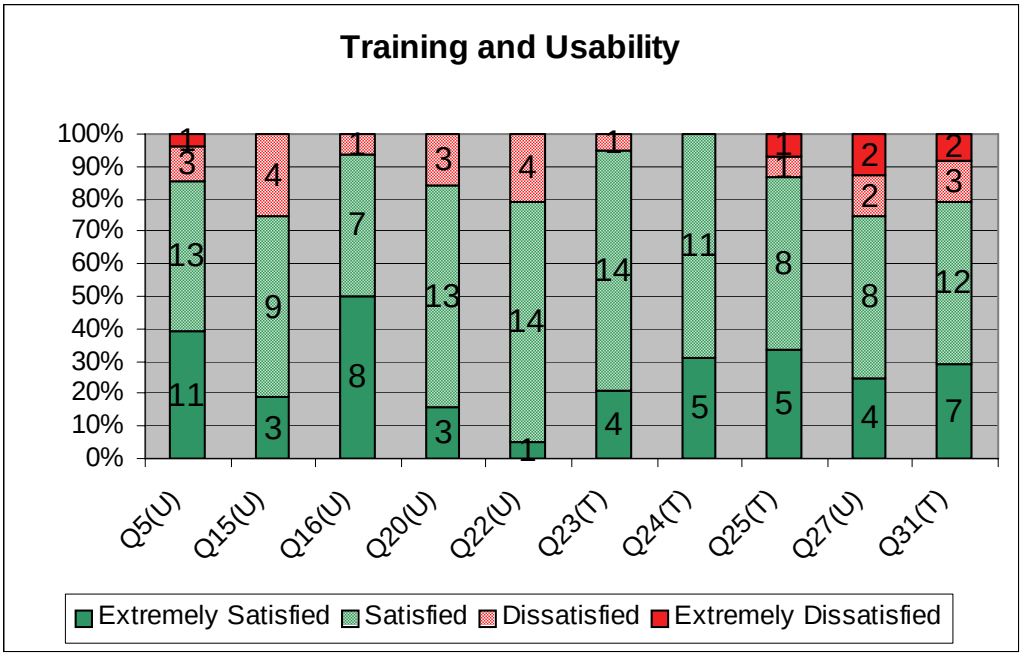
Q30. How satisfied (73%) or dissatisfied (27%) are you that by using the Remote Control Unit you could always prevent the inner boom from lowering at full speed (to prevent uncontrolled movement by the boom)?

Figure 3. Satisfaction/dissatisfaction: reload systems functionality.

3.2.6 Training and Usability

Figure 4 shows the questions that can be categorized and grouped under "Training and Usability". They include question 5 cross walked to "Cab Design and Functionality" and questions 15, 16, and 27, which can be cross walked to "Reload Systems Functionality". Overall, HIMARS and RSV/T crews were satisfied with the training they received and the ease of using the selected capabilities mentioned in the questions. Of all responses made for the 10 related questions, 85% were either a "1" (extremely satisfied) or a "2" (satisfied). Overall, satisfaction was the second highest rated of all the functional categories. This is further supported by the training assessments the Soldiers provided for themselves in Part II of the survey. All 12 HIMARS operators assessed that they fully understood how to perform their required tasks. Six of the 12 (50%) recorded that they could

even train someone else to meet the standard. Of the RSV operators, 11 of 12 (92%) assessed full understanding, with 8 of these 11 (73%) considering themselves knowledgeable enough to train others to meet the standard.



Q5: How satisfied (86%) or dissatisfied (14%) are you that all lighted indicator displays (LID) are easy to read during daytime and nighttime?

Q15. How satisfied (75%) or dissatisfied (25%) are you that the Improved Reload System (IRS) is similar to the LLM Reload System on the M270, M270A1 or M270 IPDS Launcher?

Q16. How satisfied (94%) or dissatisfied (6%) are you that the handheld Boom Control Unit (BCU) is easy to use?

Q20. How satisfied (84%) or dissatisfied (14%) are you that the Maintenance Support Device - Field Ready (MSD-FR) is easy to use?

Q22. How satisfied (79%) or dissatisfied (21%) are you that the Interactive Electronic Technical Manuals (IETMs) are easy to use?

Q23. How satisfied (95%) or dissatisfied (5%) are you that whenever the MSD was powered up that the IETMs could generally be accessed to perform maintenance tasks?

Q24. How satisfied (100%) or dissatisfied are you that anyone in the HIMARS crew can successfully remove and replace Line Replaceable Units (LRU)?

Q25. How satisfied (87%) or dissatisfied (13%) are you that anyone in the HIMARS crew can isolate to an LRU, and perform Preventive Maintenance Checks and Services (PMCS) using the IETM, Built In Test (BIT) self diagnostics, the MSD – FR and common tools?

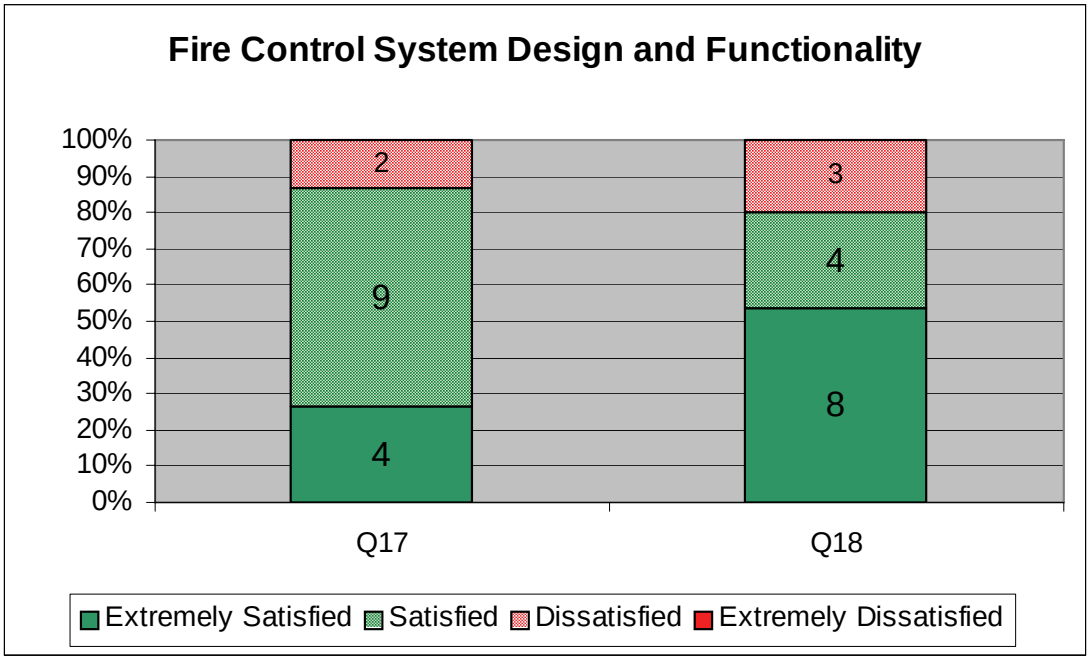
Q27. How satisfied (75%) or dissatisfied (25%) are you that the Materiel Handling Crane (MHC) on the M1084A1 Resupply Vehicle is easy to use?

Q31. How satisfied (79%) or dissatisfied (21%) are you that the Multiple Launch Rocket System Family of Munitions (MFOM) Weapons Simulator (MWS) adequately helps train the HIMARS crew to perform essential tasks?

Figure 4. Satisfaction/dissatisfaction: training and usability.

3.2.7 Fire Control System Design and Functionality

Figure 5 shows the questions that can be categorized and grouped under "Fire Control System Design and Functionality". The overall quantities of satisfaction ratings were high; 83% of all the responses were either a "1" (extremely satisfied) or a "2" (satisfied). Of the dissatisfaction ratings, only two were from HIMARS operators. The other three were from support platoon personnel. Since it can be assumed that the support platoon personnel did not regularly use the HIMARS FCS, we can remove three of the five dissatisfaction ratings to achieve revised percentages. These percentages improve the overall satisfaction rating markedly, from 83% to 93%. This high satisfaction rating is further corroborated by the fact that the low cost fire control panel and its software functionality was one of the two HIMARS capabilities the Soldiers liked the most (appendix A, Part II, Question 1).



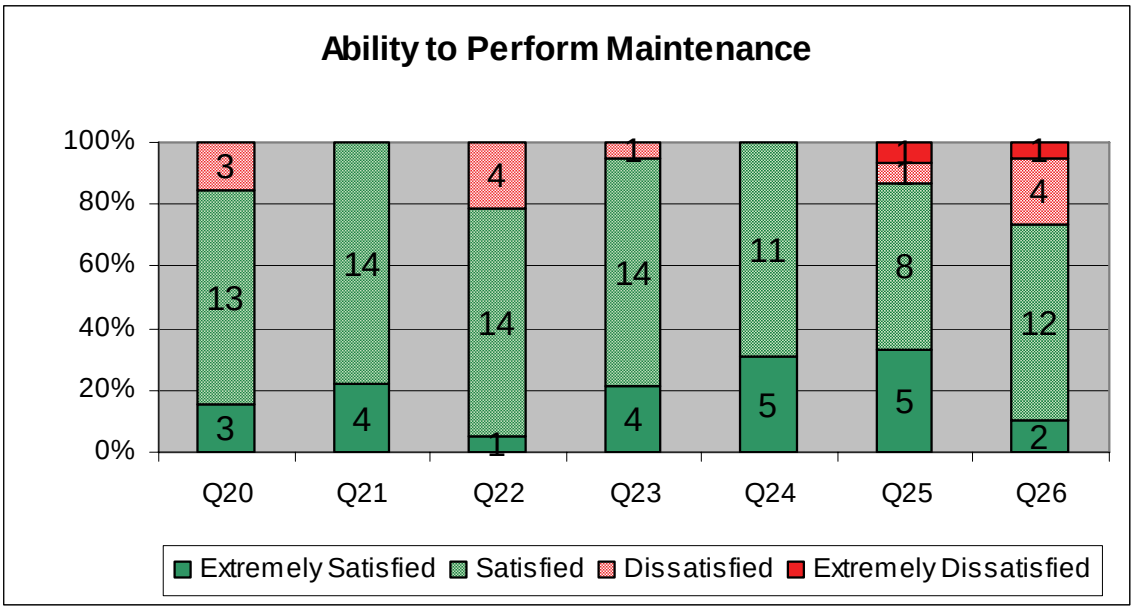
Q17. How satisfied (87%) or dissatisfied (13%) are you with the functionality of the Fire Control System (FCS) used in the HIMARS launcher?

Q18. How satisfied (80%) or dissatisfied (20%) are you that the Gunner's Display Unit (GDU) allows the gunner to accurately control the operation of the HIMARS Fire Control System?

Figure 5. Satisfaction/dissatisfaction: FCS design and functionality.

3.2.8 Capability to Perform Maintenance

The questions that can be categorized and grouped under "Capability to Perform Maintenance" are shown in figure 6. Six of the 10 maintenance related questions also crosswalk to the "Training and Usability" category discussed earlier. Overall responses showed a high satisfaction rate; 88% of all the responses were either a "1" (extremely satisfied) or a "2" (satisfied) rating. The two highest dissatisfaction ratings were recorded for Question 22 (Ease of use of IETM) (21%), and Question 26 (organization and understandability of IETM tutorials) (26%).



Q20. How satisfied (84%) or dissatisfied (16%) are you that the Maintenance Support Device - Field Ready (MSD-FR) is easy to use?

Q21. How satisfied (100%) or dissatisfied are you that the MSD - FR is easy to maintain?

Q22. How satisfied (79%) or dissatisfied (21%) are you that the Interactive Electronic Technical Manuals (IETMs) are easy to use?

Q23. How satisfied (95%) or dissatisfied (5%) are you that whenever the MSD was powered up that the IETMs could generally be accessed to perform maintenance tasks?

Q24. How satisfied (100%) or dissatisfied are you that anyone in the HIMARS crew can successfully remove and replace Line Replaceable Units (LRU)?

Q25. How satisfied (87%) or dissatisfied (13%) are you that anyone in the HIMARS crew can isolate to an LRU, and perform Preventive Maintenance Checks and Services (PMCS) using the IETM, Built In Test (BIT) self diagnostics, the MSD – FR and common tools?

Q26. How satisfied (74%) or dissatisfied (26%) are you that the IETM tutorials are well organized and easy to understand?

Figure 6. Satisfaction/dissatisfaction: capability to perform maintenance.

- For question 22, 3 of 12 HIMARS operators and one support platoon Soldier rated that they were dissatisfied that the IETMs were not easy to use. Neither elaborated on their discontent nor made any recommendations to improve the IETMs in the focused feedback portion of the survey.
- For question 26, 4 of 12 HIMARS operators and the same support platoon Soldier rated that they were dissatisfied with the IETM tutorials. Again, neither provided any focused feedback to explain their dissatisfaction nor made a recommendation to improve the IETM tutorials.
- Four Soldiers indicated that more instruction on trouble-shooting procedures was needed while another wrote that he thought HIMARS launcher training should include more time dedicated to the IETM portion (appendix A, Part II, Question 9).

3.2.9 Focused Feedback (HIMARS launcher operations)

The three HIMARS launcher design features most liked by the MOS 13M Soldiers were the following:

- The low cost fire control panel (LCFP) and software and the HIMARS' faster LLM movements and reloads. Both design features had nine responses each. Soldiers highlighted that the LCFP was easier to read and displayed more critical information needed to perform fire missions. In addition, they liked the Windows[6]-based GDU and the software being able to inform operators that there is a malfunction in the vehicle. Regarding the faster LLM movements and reloads, the Soldiers felt that reloads are faster than those of the M270 and they liked the increase in slew rates.
- The ease of vehicle maintenance and the design of the cab. Both design features were recorded in eight responses each. No additional commentary was made about the ease of vehicle maintenance. However, the strengths of the cab design included crew seating arrangements and storage compartments in the cab, the crew chief position being in the middle and raised up, which gives him more control over the crew and the overall room in the cab providing adequate space for crew members.
- The central tire inflation system (CTIS). Soldiers did not provide reasons for this capability being one of the three most liked design features.

The three HIMARS launch design features least liked by the MOS 13M Soldiers were in cab design, vulnerability of air lines and hoses, and two features that tied for third with six responses each: sponson doors and HIMARS' instability when traveling over rough terrain.

- Several shortcomings in cab design made it the least liked HIMARS feature by MOS 13M Soldiers (11 total responses). This contrasts sharply with the positive Soldier satisfaction discussed for "Cab Design and Functionality" earlier in this assessment. The cab design shortcomings included the following:
    - The lack of cab storage space (three comments). Further supported by Question 7 where Soldiers highlighted the need for more storage space for mission-essential equipment, i.e., binoculars, panel markers, first aid kit, NBC.
    - The position of the truck commander's hatch latch (two responses). This coincides with the associated dissatisfaction registered for Question 14 in Part I of the MOS 13M Soldier survey.
    - Poor design and functioning of the doors and windows (two responses). Further supported by Question 7 where Soldiers recorded that the doors need to open wider to allow easier entry and exit (one response) and that the windows need a locking pin (one

[6]Windows is a trademark of Microsoft Corporation.

response). Entry and exit issues were exacerbated when MOPP gear was worn (Question 10, four responses).

- Lack of armor for crew protection (two responses).
- The size of the steering wheel (two responses): Soldiers commented that the steering wheel size affects movement in the cab and may cause the transmission button to be accidentally pressed.

- Vulnerability of air lines and rubber hoses (eight responses) was the second least liked HIMARS design shortcoming. Soldier comments highlighted that the air lines need to be better protected, rubber hoses under carriage caught fire, some kind of fire retardant covering would help, and that hydraulic lines on top of the cage assembly should also be protected.

Two design features tied for the third place with six responses each:

- Design of the sponson boxes: Soldiers' concerns about the sponson boxes highlighted that even with the "combat lock" engaged on the sponson boxes, these locks became disengaged when the vehicle traveled over bumpy terrain. Also highlighted was that the boxes have poor seals that result in the crew's gear getting covered in rocket exhaust and dirt.
- Rough ride and instability off road: six commented that the HIMARS being a less stable platform than the tracked MLRS was a disadvantage, while nine additional comments listed as a disadvantage the inability of the HIMARS to go on all terrain as the M270 launcher can or as quickly. Cross-country travel is slow in HIMARS (Part II, Question 12). One Soldier commented, "*Vehicle bounces so much in rough terrain, the LRUs seem to not be able to withstand it"* (Part II, Question 13). The respondent did not elaborate further.

3.2.10 Focused Feedback (RSV/T operations)

MOS 13M Soldiers who operated the RSV/T liked the following three RSV/T design features or capabilities: (1) the smooth ride of and ease of maneuvering by the RSV/T combination (11 responses), (2) the CTIS (eight responses); and (3) the hydraulic cab lift (six responses each).

- Soldiers further characterized the smooth ride and ease of maneuvering of the RSV/T combination as an advantage when compared to the HEMTT-heavy expanded mobility ammunition trailer (HEMAT) combination (appendix A, Part III, Question 10). In three responses, Soldiers wrote that it was easier to back the RSV/T than the HEMTT-HEMAT. In an additional six responses, Soldiers commented that the RSV rides better, has better suspension, has a better turning radius, and is a better ride than the HEMTT.
- Two Soldier responses in Question 10 listed the CTIS as an advantage the RSV has over the HEMTT. No additional explanations were provided.

- One Soldier commented for Question 10 that the RSV's hydraulic manifold is an advantage over the HEMTT. Another Soldier pointed out that the RSV cab is better. Neither provided additional explanations for each.

The three RSV/T design features liked least by the MOS 13M Soldiers were the lack of storage space for crew gear and equipment (12 responses); the crane's limitations on reach and vulnerabilities of exposed hydraulic lines and boxes (nine responses); and two design features that garnered four responses each: unprotected CTIS hoses and selected cab design features.

- The lack of storage space for crew gear and essential equipment was a well-documented least-liked design feature with multiple related Soldier comments throughout Part III of the survey.
- One Soldier comment *"No stowage for crew gear"* was listed in Question 7, which asked Soldiers to list any significant RSV/T system safety issues.
- The same Soldier comment was recorded in Question 8, which asked what design problems were experienced when operating in and around the RSV/T in any MOPP level.
- The same Soldier comment was recorded in Question 9, which asked what RSV/T design problems were experienced when operating at night.
- Three Soldiers commented for Question 10 that the lack of storage space in the RSV is a disadvantage when compared to the HEMTT.

The following comments were registered by three Soldiers for Question 11 (list additional comments and concerns):

(a) *"Needs more storage – <u>there isn't any</u>."*

(b) *"My biggest concern with the RSV/T is the lack of storage space; this definitely needs to be remedied."*

(c) *"No stowage for crew gear."*

(d) *"Storing weapons behind the seat is good in theory but hard to reach when attacked."*

(e) *"There is nowhere to store nets and pole bags."* (a third Soldier's comment).

Crane limitations on reach and the vulnerabilities of exposed hydraulic lines and boxes were also design features that were well documented as "least liked" in many Soldier comments throughout Part III of the survey.

- In Question 2, four of the nine MOS 13M Soldier comments and the ammunition platoon sergeant's comment specifically addressed disliking the crane limitations on reach. The various comments were *"Longer reach on the crane"; "The crane needs more length to make uploads/downloads easier"; "Crane limitations"; "I don't like the length of the crane. It completely limits us to a specific downloading procedure."* The ammunition

platoon sergeant wrote, "*The MHC is overworked and too light and short. Recommend crane length [sic] at least (1ft) or eliminate chain on metal box to offer more distance on boom.*" The remaining five comments addressed the exposed hydraulic lines and boxes and included the following: *"Crane hydraulic hoses exposed (must fix)"; "Vital hydraulic lines and pumps are exposed on crane arm"; "Exposed hydraulic lines on the MHC"; "Hydraulic lines are too exposed on the crane. Very easily hit by the pods especially at night; would make the system better"; "Exposed junction boxes on the crane boom arms."*

- In Question 3, one Soldier wrote that the problem he experienced when operating the MHC on the RSV to load and unload ammunition was "*Difficulty with placement of pods because of limited crane length.*" Of the remaining 18 Soldier comments to question 3, 11 specifically addressed the vulnerabilities of hydraulic lines and boxes.
- In Question 7, three Soldiers listed their concerns about the vulnerabilities of exposed hydraulic lines on the crane as a potential safety hazard.

Soldier dislike of unprotected CTIS hoses was similar to that of the vulnerabilities to the hydraulic lines mentioned before. Several comments included "*CTIS hoses on the rims exposed and need a cover or shield to protect them (must fix)." "The CTIS hoses are unprotected this must be fixed." "CTIS system is too vulnerable to damage in an off-road environment. Would make the system better."*

Soldier dislike for selected cab design features included similar comments recorded for the HIMARS cab. Soldiers wrote that the steering wheel is too big, that there is not enough leg room on the truck commander's side of the truck, that the brake and gas pedals are too close together, and that the lights on the control panel cannot be dimmed for night vision goggle (NVG) use.

3.2.11 Focused Feedback (climate control in HIMARS cab)

Questions 14 through 17 in Part II of the MOS 13M Soldier survey gave an opportunity for the Soldiers to assess the need for a climate control system in the HIMARS cab and to provide specific comments to support their assessments. Although the HIMARS cab is similar to the RSV cab (both are FMTVs), RSV operators were not asked to provide a similar assessment. In retrospect, this probably should have been done. The reason for including this series of questions for the HIMARS operators to answer is that the issue of the HIMARS cab lacking a climate control system to cool or heat the cab in hot and cold weather has arisen in previous developmental and integration testing of the HIMARS. In addition the HIMARS was rated amber for HFE before its Milestone C decision for the major concern identified in the area of heat stress (i.e., no air conditioning) in the HIMARS cab. The 3 December 2003 response of the PM to this issue was

> An environmental conditioning unit (ECU) is currently planned to be part of the Block II Increased crew protection design solution. This PM is requesting funding as part of the FY06 POM. Please note that currently neither the M270 nor the M270A1 has an ECU.

The IOT therefore presented an opportunity to obtain current Soldier assessments regarding the issue of the HIMARS cab lacking a climate control system to cool or heat the cab in hot and cold weather.

- 100% (12 of 12) of the HIMARS operators indicated that there IS AN URGENT NEED for a climate control system in the HIMARS cab that will keep it cooler or warmer than the outside temperature when required (appendix A, Part II, Question 14).
- 83% (10 of 12) of the HIMARS operators indicated that the daytime temperatures the crew experienced in the cab (during the IOT) HAD AN EFFECT on crew performance. Nine Soldier comments written for Question 17 further characterized the effects high temperatures within the cab had on crew performance (see appendix A, Part II). The two responses that indicated that the daytime temperatures DID NOT HAVE AN EFFECT were not supported with additional comments in Question 17.
- 58% (7 of 12) of the HIMARS operators indicated that the nighttime temperatures the crew experienced within the cab (during this IOT) HAD AN EFFECT on crew performance. Only one Soldier comment in Question 17 seemed to address the nighttime temperature issue, but it referenced a heater in the cab that did not keep the chief standing in the hatch warm and made the driver and gunner very hot. This comment was puzzling.

3.3 MOS 27M (MLRS Repairman) Survey Results

In Part I of the MOS 27M survey, Soldiers were asked to provide feedback and comments about maintaining and repairing the HIMARS launcher system. In Part II they were asked to provide feedback and comments on performing troubleshooting and maintenance-related tasks for the XM30 GMLRS rocket. The analysis and discussion of Soldier comments about Part II are reported in the HFE report for the GMLRS IOT and published separately. The Part I survey insights follow.

Features that the MOS 27M Soldiers liked most about the troubleshooting procedures for the HIMARS launcher were that the procedures were easy and that the IETM had everything they needed to perform their tasks, from troubleshooting steps to the maintenance steps. The support platoon leader's feedback gave strong indication that the troubleshooting procedures were accurate enough to enable the 27M Soldiers to successfully identify the maintenance problems and to develop the right solution.

Features that the MOS 27M Soldiers liked least about the troubleshooting procedures for the HIMARS launcher were that some of the steps in the IETM were out of order or wrong and the procedures were not more specific in diagnosing what the launcher was or was not doing. The support platoon leader provided feedback that perhaps not all launcher problems should exclusively require the MOS 27M Soldier to troubleshoot and repair. Specifically he wrote,

"Certain things required 27M and in the end it felt that the operators could have trouble shot and fixed the problem. However, the IETM said to seek higher maintenance."

No significant safety issues were identified by the MOS 27M Soldiers for the HIMARS. One Soldier wrote that he had concerns about having to crawl under the launcher to fix the azimuth travel lock. He provided no additional details for this concern.

Recommendations made to improve the ease with which repairs to the HIMARS launcher can be accomplished included the following:

- *"The azimuth travel lock needs to be flipped or a different configuration is needed." "A cover would prevent mud and water for causing problems with the travel lock."*
- Improve or upgrade the IETM or GDU software. *"The software on the GDU needs to be upgraded." "There were too many times that it froze or gave false prompts of errors. They do have some software issues that need to be worked out. After you go into Maintenance Manager and try to reboot the system, it always came up with no image available."*

The support platoon leader opined that since some of the connectors between systems required cleaning even though they had never been removed in the first place, better connections between systems are needed.

All four of the MOS 27M Soldiers assessed that all necessary tools and maintenance equipment were provided and that they all functioned properly. The support platoon leader's comments contrast with this assessment with the following: *"Not enough tools. Certain tools needed to be picked up at Mow Way[7] in order to fix a launcher. Should have all tools at both field team and Mow Way team."*

Finally, the MOS 27M Soldiers offered the following training self-assessments. In total, the comments do not highlight an issue with MOS 27M training. All Soldiers were certified as trained before the IOT began.

- One MOS 27M Soldier indicated that he has a general understanding of how to perform required HIMARS launcher maintenance tasks and at times requires assistance.
- One MOS 27M Soldier indicated that he understands how to perform required HIMARS launcher maintenance tasks and does not require assistance to perform them.
- The remaining two MOS 27M Soldiers indicated that they completely understand how to perform required HIMARS launcher maintenance tasks, that they can perform them without assistance, and can supervise or train others to perform them to meet the standard.

[7]Mow Way is a short-hand Indian name for the training area (grandstand and parking lot area) where ATEC set up its headquarters for the operational test. The training area is actually called "Mow-Way House" training area.

3.4 MOS 63 Series (Vehicle Maintenance) Survey Results

In Part I of the MOS 63 series survey, Soldiers were asked to provide feedback and comments about maintaining and repairing the HIMARS vehicle. In Part II they were asked to provide feedback about maintaining and repairing the RSV/T vehicles. All four Soldiers were Sergeant (E5) noncommissioned officers (NCOs).

3.4.1 HIMARS Vehicle Maintenance

The features that the MOS 63 series NCOs liked most about the troubleshooting procedures for the HIMARS vehicle were the simplicity of the vehicle and the fact that the MSD made their jobs easier. The MSD was specifically highlighted as making trouble shooting the HIMARS very easy because of the step-by-step procedures it provided.

Features that the MOS 63 Series NCOs liked least were shortcomings experienced using the MSD. One Sergeant wrote that some MSD tasks in the computer were wrong and that illustrations were not accurate. Two Sergeants found it troublesome to keep the electrodes calibrated and not use a multimeter instead. Regarding non-use of a multimeter, one Sergeant wrote, *"Parts where you could use a multimeter, you were not allowed to and sometimes it would take you around a problem the long way and then you would go to the problem (i.e., instrument gauges)."*

Two MOS 63 series NCOs did not experience or document any safety issues. The remaining two referred to the grass fires that occurred during live firing when air lines and hydraulic lines were damaged as being a safety issue. They recommended that air hoses need to be protected by a metal plate or made of metal tubing (Question 3). The same recommendation was in Question 4 as a recommendation to improve the HIMARS vehicle in order to make repairs better/easier. The support platoon leader's comments in Question 3 also highlight the seriousness of the safety implications for this issue: *"Air hoses underneath the air tanks. During IOT, two vehicles went down because the fires melted or weakened the hoses so they burst. Fortunately, there was enough air pressure to move the HIMARS out of the fire before the brakes seized up. If enough pressure was lost, the vehicle would not have been able to move off the fire point and out of the fire."*

Three of the four MOS 63 series NCOs wrote that all necessary tools and other maintenance equipment provided to them allowed them to properly complete repairs on the HIMARS vehicle and that everything functioned properly. Although these three generally felt that maintenance was quick and easy, the fourth NCO wrote that maintenance took much more time than usual because special tools (i.e., torque wrenches, large wrenches, etc.) were not available. The NCO wrote that they were not available because a test support unit did not provide a tool truck, but he did not make an associated recommendation that these special tools need to be a part of the general mechanics tool kit for the HIMARS.

Finally, the MOS 63 series NCOs offered the following training self-assessments. In total, the comments do not highlight an issue with MOS 63 series training. All MOS 63 series Soldiers were certified as trained before the IOT began.

- Two sergeants indicated that they have a general understanding of how to perform required HIMARS vehicle maintenance tasks and at times require assistance to perform them.
- Two sergeants indicated that they understand how to perform required HIMARS vehicle maintenance tasks and do not require assistance to perform them.
- Three of the four offered that they would have liked to have more training on electrical trouble shooting as well as on the HIMARS truck. The fourth felt that the only problem that should have been covered in training was related to the range fire that damaged and melted air hoses.

3.4.2 RSV/T Vehicle Maintenance

MOS 63 series NCO responses to the survey questions that addressed RSV/T maintenance were similar in all areas to those already expressed for HIMARS vehicle maintenance. The ease and accuracy of the MSD was again highlighted as a well-liked capability.

The predominant recommendation made for improving the RSV/T to make maintenance easier was adding wheel covers to protect CTIS components. Two comments said that the crane was too technical for the average Soldier and "*touchy and temperamental"*. However, no recommendations were made for improving the crane.

The training self-assessments mirrored those made for HIMARS maintenance. The NCOs would have liked to have received additional training on overall general maintenance (i.e., "everyday care") of the truck.

Finally, as additional comments and concerns about performing maintenance on the RSV/T, the NCOs reiterated their concerns about the vulnerability of air hoses to fire damage and recorded that there was a little trouble with crane operations.

4. Conclusions

4.1 General

The four survey instruments that were jointly developed by FSTD and the Fort Sill Field Element of ARL's HRED succeeded in obtaining Soldier comments and recommendations for the HIMARS and RSV/T systems in the areas of design, human factors, training, and safety.

4.2 Design

Soldier satisfaction with HIMARS and RSV/T designs and capabilities was far greater than their dissatisfaction. The highest satisfaction ratings (100%) were recorded for the following individual system designs and capabilities: (1) access to the TPU and MSU, (2) ease of maintaining the MSD-FR, and (3) aility to remove and replace the LRU. Those system designs and capabilities that received between 90% and 99% satisfaction ratings included (1) crew protection within the cab during firing (93%), (2) ease of using the hand-held boom control unit (94%), (3) using the IETM to perform maintenance tasks (95%), and (4) the placement of warnings and caution labels on the vehicle (97%).

The highest dissatisfaction ratings (50% to 74%) were registered for the following individual system designs and capabilities: (1) design of the steering wheel (74%), (2) design and function of the cab doors and windows (54%), and (3) design of vehicle steps and hand-holds (55%). Those system designs and capabilities that received the next highest range of dissatisfaction (30% to 46%) included (1) cab design that ensures that exhaust fumes from rocket firings do not enter and affect the crew in any way (33%), (2) vehicle commander's hatch lock (33%), (3) seating area for the vehicle commander (43%), and (4) RCU always providing reliable, controlled operation of the MHC (46%).

- The most-liked HIMARS launcher design features were the LCFP and software, the HIMARS' faster LLM movements and reloads, the ease of vehicle maintenance, and the CTIS.
- The least-liked HIMARS launcher design features were several aspects of the cab design, the vulnerability of air lines and hoses, the design of the sponson doors and HIMARS' instability when traveling over rough terrain.
- The most-liked RSV/T design features were the smooth ride and ease of maneuvering the RSV/T combination, the CTIS, and the hydraulic cab lift.
- The least-liked RSV/T design features were the lack of storage space for crew gear and equipment, the crane's limitations on reach, the vulnerabilities of exposed hydraulic lines and boxes, and the unprotected CTIS hoses.

4.3 Human Factors

The IOT presented an opportunity for obtain current Soldier assessments regarding the issue of the HIMARS cab lacking a climate control system to cool or heat the cab in hot and cold weather (MOS 13M Survey, Part II, Questions 14 through 17). The following comments and similar results from previous developmental and integration testing support a recommendation that a cab cooling and heating system for the HIMARS cab should be developed for its potential to enhance crew performance.

- 100% (12 of 12) of the HIMARS operators indicated that there IS AN URGENT NEED for a climate control system in the HIMARS cab that will keep it cooler or warmer than the outside temperature when required (see appendix A).
- 83% (10 of 12) of the HIMARS operators indicated that the daytime temperatures the crew experienced in the cab HAD AN EFFECT on crew performance. Nine Soldiers provided additional comments to characterize the effects that high temperatures within the cab had on crew performance (appendix A). The two responses that indicated that the daytime temperatures DID NOT HAVE AN EFFECT were not supported with additional comments in Question 17 (appendix A).
- 58% (7 of 12) of the HIMARS operators indicated that the nighttime temperatures the crew experienced within the cab HAD AN EFFECT on crew performance (appendix A)

4.4 Training

Soldier training was not an issue for the IOT. Every Soldier in every MOS participating in the IOT indicated that the training they received before the IOT adequately trained them to perform individual and crew tasks successfully.

- All MOS 13M (HIMARS and RSV/T) operators assessed that they did not need additional training or assistance to perform their individual and crew tasks successfully. Half of the HIMARS operators (six) and 8 of 12 RSV/T operators assessed that they could even train others to meet the standard.
- All MOS 27M Soldiers assessed themselves as being able to perform their maintenance tasks successfully and without assistance. Half (two) indicated they could even train others to meet the standard.
- All MOS 63 series Soldiers assessed that they could perform their individual and crew tasks successfully with and without assistance.

4.5 Safety

A number of safety concerns expressed by the Soldiers are insightful from a user perspective. These should not be discounted unless applicable corrective actions are taken.

- The design of the cab has potential safety issues associated with the large steering wheel. Soldiers are concerned that the large steering wheel may cause hand injuries, may result in torn gloves, restricts entry and exit when they are in full battle gear, and may cause a driver to accidentally hit the transmission button. The key safety theme for corrective action to be considered in this area is a revised steering wheel design that could minimize interruptions in the driver's actions that will prevent a vehicular accident while the HIMARS launcher vehicle is being operated.

- The design of storage doors may need modification to add a retaining bar or strap to keep them from swinging open at high speeds and possibly injuring personnel.
- The truck commander's hatch lock may need to be repositioned to prevent injury to the vehicle commander.
- Hand-holds on the RSV/T may be needed to make climbing the vehicle ladders safe.
- The brightness of light-emitting diode (LED) lights on the RSV dash may need to be reduced (or changed to another color) to accommodate the crew wearing NVGs. A blue light that lit very brightly in the cab and made seeing difficult was particularly bothersome.
- The RSV crane may need improvements to strengthen it, increase its reach, and reinforce and protect hydraulic lines. Soldiers were noticeably concerned about dropping loads while using the RSV crane when the crane demonstrated jerky movements, allowed drastic drops when the "lower" lever was barely pushed, and exhibited leaking hydraulic lines.

5. Recommendations

Recommend that the ATEC accept the findings and conclusions presented in this report and include the conclusions in the system evaluation report for the HIMARS.

6. References

1. Headquarters, Department of the Army. *The HIMARS Tactics, Techniques, and Procedures (TTP),* Special Text (ST) 6-60-10, Fort Sill, OK, 24 June 2002 (UNCLASSIFIED).

2. Headquarters, Fire Support Test Directorate, High Mobility Artillery Rocket System (HIMARS) Initial Operational Test and Evaluation (IOT&E) Doctrinal and Organizational test Support Package (D&OTSP), Fort Sill, OK, 15 January 2004 (UNCLASSIFIED).

3. Headquarters, U.S. Army Test and Evaluation Command (ATEC) System Evaluation Plan for the High Mobility Artillery Rocket System (HIMARS), Alexandria, VA, August 2003 (UNCLASSIFIED).

4. Precision Fires Rockets and Missile Systems Project Management Office. *Milestone C, Test and Evaluation Master Plan for the Block I High Mobility Artillery Rocket System (HIMARS),* 13 February 2003 (UNCLASSIFIED).

5. Hernandez, C.L. *Human Factors Evaluation of the XM30 Guided Multiple Launch Rocket System (GMLRS) in the Combined High Mobility Artillery Rocket System (HIMARS)-GMLRS Initial Operational Test*; ARL-TR-XXXX; U.S. Army Research Laboratory: Aberdeen Proving Ground, MD, 2007 (UNCLASSIFIED).

6. TRADOC System Manager, *Operational Requirements Document for the High Mobility Artillery Rocket System (HIMARS) Prepared for Milestone II Decision (U)*; October 1999 (CONFIDENTIAL).

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Appendix A. MOS 13M (MLRS Crewman) Survey Data

Demographics

A total of 30 player personnel answered the MOS 13M Soldier survey. Of the total, 24 personnel were evenly split (12 each) as crews for the RSV/Ts and crews for the HIMARS launchers. The remaining six were additional support platoon personnel with the following duty positions: Ammunition Section Chief, Reconnaissance Driver/Backup HIMARS Driver, Admin Logistics Operations Center (ALOC)/Battery Operations Center (BOC) Specialist, Firing Platoon Leader, Reconnaissance Sergeant and Ammo Platoon Sergeant. Of the total population, 18 (60%) were enlisted Soldiers (E3s and E4s), 11 (37%) were NCOs (E5 through E7), and one (3%) was a commissioned officer (O2).

The lowest time in service (TIS) recorded by the 24 MOS 13M Soldiers who comprised the HIMARS and RSV/T crews was 12 months, while their highest TIS was 182 months (15 yrs, 2 months). The lowest and highest times in MOS (TIMOS) for this segment of the population were also 12 months and 182 months.

The average and median months of TIS and TIMOS for the RSV crews and the HIMARS crews are shown in the following tables.

Table A-1. TIS and TIMOS (RSV crews).

13M RSV Operator Population		
	TIS	**TIMOS**
AVG	30	27
Median	27	26

Table A-2. TIS and TIMOS (HIMARS crews).

13M HIMARS Operator Population		
	TIS	**TIMOS**
AVG	77	67
Median	68	41

The complete demographic portrayal is shown in table A-3. The average and median TIS and TIMOS for the combined populations of MOS 13M HIMARS and RSV operators (exclusive of the support personnel) are included in the table.

Table A-3. MOS 13M survey demographic data.

Duty Positions	Identifier	Rank/Grade	TIS (Months)	TIMOS (Months)
RSV/RST Operators				
RSV#5 Ammo Specialist	R1	E4	51	51
RSV Asst Driver	R2	E4	24	24
RSV Crew Member	R3	E4	28	24
Driver, RSV 2	R4	E4	26	26
RSV #7 TC	R5	E4	23	23
Ammo Specialist	R6	E3	13	13
Ammo Specialist	R7	E4	28	28
Ammo Specialist	R8	E4	38	38
RSV Driver	R9	E3	13	13
RSV Crew Member	R10	E4	25	25
RSV Driver	R11	E4	30	30
RSV/RST Driver	R12	E4	64	28
HIMARS Operators				
HIMARS Driver	H1	E4	27	27
HIMARS Driver	H2	E3	12	12
HIMARS Gunner	H3	E5(P)	97	97
Launcher Chief	H4	E5	101	101
Launcher Chief	H5	E6	182	182
HIMARS Driver	H6	E4	26	26
HIMARS Driver	H7	E4	27	27
Section Chief	H8	E6	124	124
Gunner	H9	E6	156	36
Gunner	H10	E5	38	38
Gunner	H11	E5	44	44
HIMARS Section Chief	H12	E6	92	92
		13M Population AVG	**54**	**47**
		13M Population Median	**29**	**28**
Others				
Ammunition Section Chief	X1	E6	305	127
Recon Driver/Backup HIMARS Driver	X2	E3	40	10
ALOC/BOC	X3	E4	27	24
Fire Platoon Leader	X4	O2	31	23
Recon Sergeant	X5	E5	51	51
Ammo PSG	X6	E7	240	220

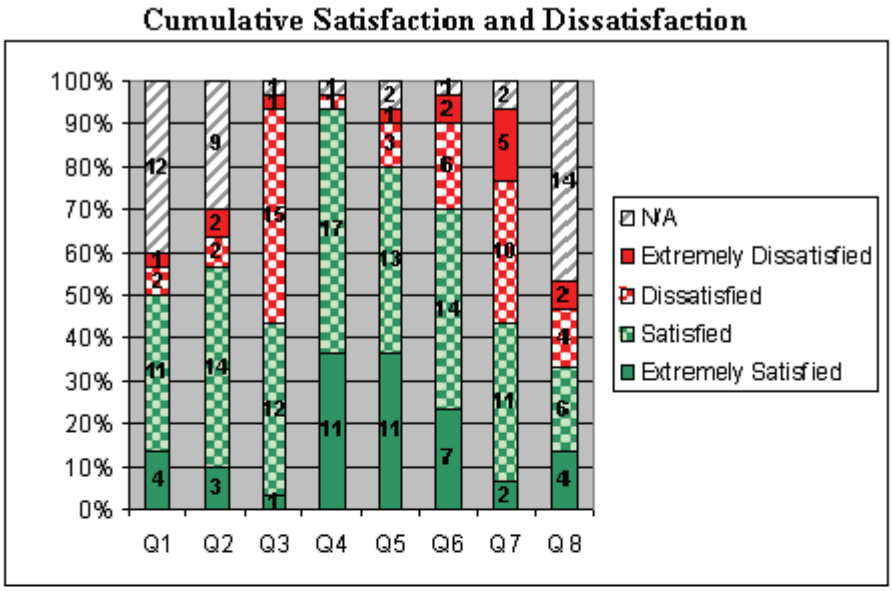
Part 1: Soldier Satisfaction/Dissatisfaction

For Part I of the MOS 13M survey, player participants were instructed to use the 1-5 Likert scale shown in table A-4 to indicate their level of satisfaction or dissatisfaction with the particular HIMARS and RSV/T system design or capability described by each of the questions asked. A total of 31 questions comprised this section of the survey.

Table A-4. Likert scale.

Scale	Description
1	**Extremely Satisfied:** This system design and capability are excellent in every respect.
2	**Satisfied:** This system design and capability are satisfactory. Any problems I encountered were very minor and did not prevent me from being able to perform my required tasks and duties.
3	**Dissatisfied:** This system design and capability are marginally satisfactory and it bothers me enough to cause me to feel like something could be done to improve the design.
4	**Extremely Dissatisfied:** This system design and capability are a problem that absolutely must be fixed. I could not perform my required tasks and duties satisfactorily all the time.
5	**N/A:** (only if you had absolutely no opportunity to use or experience the specific design or capability mentioned in the question)

The scaled numeric of "5" provided the option of indicating that a particular question was not applicable because the respondent neither used nor experienced the specific design or capability mentioned in the question. The most important goal in Part I of this survey was determining how strongly the Soldiers were satisfied or dissatisfied with the HIMARS and RSV/T, based on their real IOT experiences. As such, by providing the option to select "N/A," we hoped that the inclination by player participants to indicate satisfaction or dissatisfaction without substantiation would be minimized. The extension of this rationale is that all "N/A" answers therefore would not have a bearing on the strength of the level of satisfaction or dissatisfaction the test participants had for the system design or capability in question. As such, although the "N/A" answers are shown in this appendix, which provides summarized totals for all the questions asked in Part I of this survey, they (the "N/A" answers) are omitted from Part IV, a discussion in the body of the report which postulates what the responses indicate and how they should be interpreted. Figures A-1 through A-4 depict the responses made for each question asked. These data were previously discussed (in a different format) in Part IV of the report.



Q1: How satisfied or dissatisfied are you that having a door, window or the commander's hatch open is sufficient for ventilation when the Chemical Filtration Unit (CAFU) is not operating?

Q2: How satisfied or dissatisfied are you that there is sufficient room in the FMTV crew cab for a three-man HIMARS crew to perform individual and crew tasks satisfactorily?

Q3: How satisfied or dissatisfied are you that vehicle steps and handholds are adequately designed and positioned to make boarding and exiting the vehicle easy and safe?

Q4: How satisfied or dissatisfied are you that cautions and warning labels are easy to locate and read throughout the cab, engine and body of the vehicle?

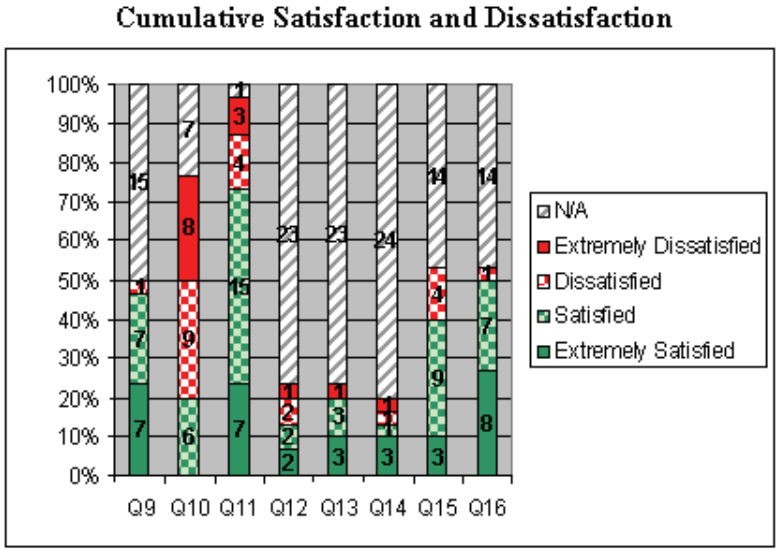
Q5: How satisfied or dissatisfied are you that all lighted indicator displays (LID) are easy to read during daytime and nighttime?

Q6: How satisfied or dissatisfied are you that the accelerator and brake pedals cannot be accidentally engaged at the same time?

Q7: How satisfied or dissatisfied are you with the design and function of the cab doors and windows?

Q8: How satisfied or dissatisfied are you that exhaust fumes from rocket and missile firings does not enter the cab and affect the crew in any way?

Figure A-1. 13M survey Part I (Questions 1 through 8) responses.



Q9. How satisfied or dissatisfied are you that the cab adequately protects the crew from launch hazards, debris, tube covers, plume pressures and from the flash of rocket and missile firings?

Q10: How satisfied or dissatisfied are you with the design of the steering wheel in the HIMARS launcher vehicle?

Q11: How satisfied or dissatisfied are you that the cab seats are sturdy, functioned as they were designed to function (i.e. handles worked, adjustments could be made, etc) and provided adequate comfort and support for all operations?

Q12: (For the HIMARS Vehicle Commander only) How satisfied or dissatisfied are you with the seating area for your position within the cab of the HIMARS vehicle?

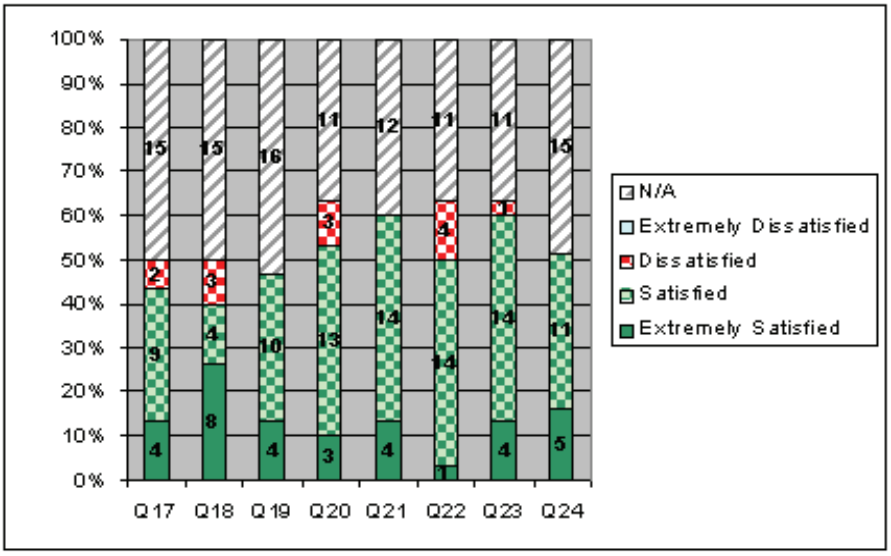
Q13. (For the HIMARS Vehicle Commander only) How satisfied or dissatisfied are you when seated in the commander's seat with your seat belt on and with your feet flat on the floor, that you felt safe and secure from possible injury during vehicle movement?

Q14. (For the HIMARS Vehicle Commander only) How satisfied or dissatisfied are you with the design of the Commander's hatch lock?

Q15. How satisfied or dissatisfied are you that the Improved Reload System (IRS) is similar to the LLM Reload System on the M270, M270A1 or M270 IPDS Launcher?

Q16. How satisfied or dissatisfied are you that the handheld Boom Control Unit (BCU) is easy to use?

Figure A-2. 13M survey Part I (Questions 9 through 16) responses.



Q17. How satisfied or dissatisfied are you with the functionality of the Fire Control System (FCS) used in the HIMARS launcher?

Q18. How satisfied or dissatisfied are you that the Gunner's Display Unit (GDU) allows the gunner to accurately control the operation of the HIMARS Fire Control System?

Q19. How satisfied or dissatisfied are you that there is adequate space to access the Tactical Processor Unit (TPU) and the Mass Storage Unit (MSU) after folding the Gunner's seat forward?

Q20. How satisfied or dissatisfied are you that the Maintenance Support Device - Field Ready (MSD-FR) is easy to use?

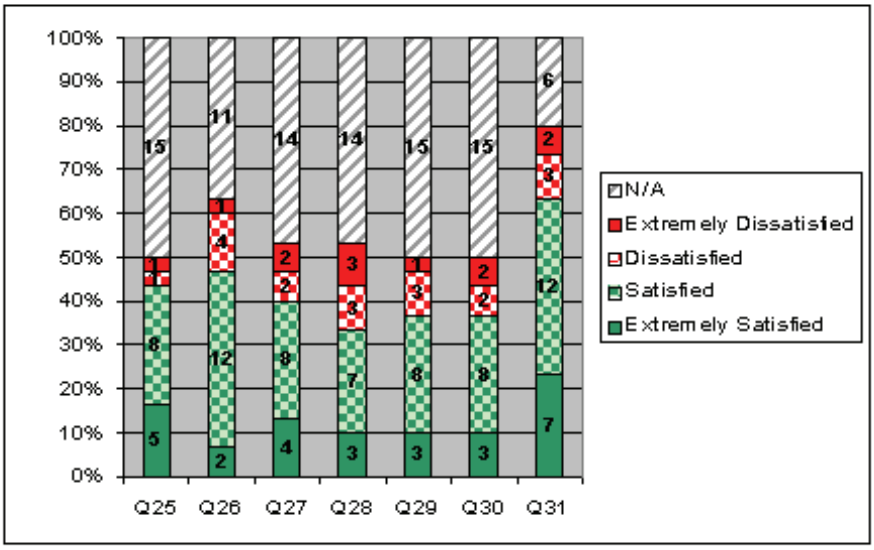
Q21. How satisfied or dissatisfied are you that the MSD - FR is easy to maintain?

Q22. How satisfied or dissatisfied are you that the Interactive Electronic Technical Manuals (IETMs) are easy to use?

Q23. How satisfied or dissatisfied are you that whenever the MSD was powered up that the IETMs could generally be accessed to perform maintenance tasks?

Q24. How satisfied or dissatisfied are you that anyone in the HIMARS crew can successfully remove and replace Line Replaceable Units (LRU)?

Figure A-3. 13M survey Part I (Questions 17 through 24) responses.



Q25. How satisfied or dissatisfied are you that anyone in the HIMARS crew can isolate to an LRU, and perform Preventive Maintenance Checks and Services (PMCS) using the IETM, Built In Test (BIT) self diagnostics, the MSD – FR and common tools?

Q26. How satisfied or dissatisfied are you that the IETM tutorials are well organized and easy to understand?

Q27. How satisfied or dissatisfied are you that the Materiel Handling Crane (MHC) on the M1084A1 Resupply Vehicle is easy to use?

Q28. How satisfied or dissatisfied are you that the Remote Control Unit always provided reliable, controlled operation of the MHC.

Q29. How satisfied or dissatisfied are you that by using the Remote Control Unit you could always prevent the Material Handling Crane (MHC) from being slewed at full speed to its final position (to prevent damaging the slewing system)?

Q30. How satisfied or dissatisfied are you that by using the Remote Control Unit you could always prevent the inner boom from lowering at full speed (to prevent uncontrolled movement by the boom)?

Q31. How satisfied or dissatisfied are you that the Multiple Launch Rocket System Family of Munitions (MFOM) Weapons Simulator (MWS) adequately helps train the HIMARS crew to perform essential tasks?

Figure A-4. 13M survey Part I (Questions 25 through 31) responses.

Part 2: Launcher Operations

Focused feedback on HIMARS launcher operations from the MOS 13M crews who worked with the HIMARS launcher is presented.

Questions and Answers	No. of Responses
Q1: List three design features or capabilities that you liked most about the HIMARS launcher.	
#1a: Low-cost fire control panel and software	9
#1b: Faster LLM Movements and Reloads	9
#2a: Ease of vehicle maintenance	8
#2b: Cab Design	8
#3 CTIS	5
C130 Transport	2
Drive on paved roads	2
Push button transmission	1
Working heater	1
MSD	1
Durability	1
Ability to shoot entire MFOM, Army tactical missile family of munitions (AFOM)	1
IETM	1
Q2: List three design features or capabilities that you liked least about the HIMARS Launcher. (Please indicate if these features or capabilities "must be fixed" or are "recommendations that would make a good system better".)	
#1: Vulnerability of air lines and rubber hoses	8
#2a: Design of short-no-voltage test (SNVT) and sponson doors	6
#2b: Rough ride and instability off road	6
#2c: Steering wheel size	6
#3a: Exposure of vehicle and LLM components	3
#3b: Lack of cab storage	3
#3c: Malfunctions and power failures	3
Position of truck commander (TC) hatch lock	2
Poor design and functioning of doors and windows	2
Lack of armor for crew protection	2
Lack of winch for self recovery	1
Need M240 mount	1
Too many maintenance problems require 27M support	1
GDU too slow	1
No spare tire on launcher	1
Poor steering in mud	1
Crane lockout; limits crew	1
Q3: List any launcher software problems (if any) that you experienced while operating the system.	
Unexpected failure indications	6
Azimuth travel lock failures	5
LLM not responding; odd movements	3
Too many "soft zeros" and shutdowns required	2

LIDAS (launcher instrumentation data acquisition system)	1
Inaccurate SNVT tests	1
FCP (fire control panel) lockup when scrolling menus	1
Q4: List the problems (if any) that you experienced while operating the launcher's boom controller.	
Disengage switch easy to hit by accident	1
Experienced stuck switch problems and software failures	2
LLM had a tendency to "jump" a few inches in the wrong direction before going in the intended direction.	1
I did not experience any problems	3
Boom controller would enable then disenable	4
Inaccurate Jury strut prompt	1
It needs to be located on the bottom for short people.	1
Q5: What (if any) are the significant HIMARS safety issues that you experienced? Your answer should address new safety issue(s) that were not noted in an IETM or training or an existing safety issue that must be fixed by improving the design of the HIMARS.	
Shifting in a hurry difficult, given the size of steering wheel combined with location of gear selector	1
Doors opening while driving are a safety issue; need better latches	2
Snagging leg on pamphlet bag pin on driver's side door can cause a soldier to miss his step when exiting vehicle	1
Burned hydraulic lines can prevent launcher from stowing, thereby putting the crew at risk when launcher cannot move away from the firing position	3
No safety problems experienced and N/A entries made	22
Miscellaneous concerns not based on IOT experiences - Lack of armor protection for the crew - Risk of crew chief being thrown out of vehicle during cross-country movement	2
Q6: What are your concerns or comments about the procedures for loading or unloading the launcher?	
Hoist cable wears out easily	3
Positioning tolerances for reloads are a problem	7
W531 is too long and needs to be repositioned	1
Simple and can be accomplished in a short amount of time	1
Why can't the chief and gunner be in 4-meter circle at same time? Get rid of requirement. There is no safety issue.	2
Encountered no problems and no entries made	17
Q7: Refer to your answer in Part 1, question 2 (cab space for the crew). What are your comments or concerns (if any)?	
Not enough head room for the chief. When the hatch is closed; have to crouch down	1
Not enough storage space for items needed (binoculars, panel markers, first aid kit, NBC gear).	3
Terminator cables in cab can easily be broken by foot of chief.	1
Also it is impossible for a driver or gunner to get into MOPP 4 inside the cab.	2
Steering wheel is too big and when wearing full gear, it is hard to move in the cab. May also cause accidental pressing of trans buttons.	2
Chief should be repositioned to the right side; Gunner has to move for the chief to get out.	2
Add 2 to 3 inches in leg room to prevent knees from hitting dash	2
There is sufficient space to operate, plenty of space for crew, great improvement from M270.	8
Doors need to open more to allow Soldiers with gear to easily enter and exit	1
Windows need a locking pin	1

Q8: Please place an "X" on one of the following statements that best describes your ability to perform required HIMARS launcher individual and crew tasks.	
a. I would like more training	0
b. I have a general understanding of how to perform required HIMARS launcher individual and crew tasks and at times I require assistance	2
c. I understand how to perform required HIMARS launcher individual and crew tasks and I do not require assistance to perform them	8
d. I completely understand how to perform required HIMARS launcher individual and crew tasks. I can perform them without assistance and I can supervise or train others to perform them to (meet) standard	8
Q9: What do you think is needed to be covered in HIMARS launcher training that was not covered?	
More instruction on trouble shooting procedures	4
I think more time should be dedicated to the IETM portion.	1
Less classroom time and more hands-on field time.	1
Training was sufficient.	5
No comment or entry made	19
Q10: What HIMARS launcher design problems (if any) did you encounter when operating in and around the HIMARS launcher in any MOPP level?	
Door latches on SNVT and boom controller. Ripped my gloves.	2
Doors do not open wide enough for easy entry and exit.	1
SNVT difficult to engage. Hard to press button when wearing MOPP.	1
In any MOPP level plus flak vests and LBU, it was hard to maneuver inside the cab. Also with the size of the boots, it was difficult entering and exiting the cab.	3
Seat belts would catch on mask carriers.	1
It is hard to see through louvers in MOPP 4 and extremely hard at night with NVGs.	1
Q11: What HIMARS launcher design problems (if any) did you have when operating in and around the HIMARS launcher at night?	
Too many lights in cab made driving and gear selection while using NVGs hard.	5
Chief needs a light above him also.	1
Hard to see through louvers with NVGs and it is hard to find proper transmission button in black-out drive.	1
It was difficult to find the latches to open the doors on storage boxes.	1
When in MOPP at night its hard to hear and see hand signals and voice commands when reloading.	1
Q12: List any significant advantages or disadvantages (if any) that you feel the HIMARS launcher has when compared to the M270, M270A1, or M270 IPDS.	
Advantages:	
HIMARS easier to maneuver	1
Better air transportability	3
Better digital comms	2
Reliable ways to trouble shoot	1
More room than M270	1
Faster mission cycle times	2
Disadvantages	
Less stable and more vulnerable.	6
M270 IPDS superior	1
HIMARS cannot go on all terrain that the M270 launcher can or as quickly. Cross-country travel is slow in HIMARS.	9
Vulnerability of tires	1

Lack of armor protection	1
Q13: Record any additional comments or concerns that you have about the HIMARS launcher.	
WS13 cable needs to be moved	1
Vulnerability of undercarriage to fire caused by firing rockets.	2
Need to turn off all lights during black-out drive and use an alarm instead of warning lights.	1
HIMARS is a great piece of equipment all around although it can use a lot of work getting some additional "bugs" out and can still be more Soldier friendly.	1
Vehicle bounces so much in rough terrain, the LRUs seem to not be able to withstand it.	1
Q14: Indicate which of these two comments you most agree with. (Mark only the most appropriate comment with an "X".)	
There IS NOT AN URGENT NEED for a climate control system in the HIMARS cab which will keep it cooler or warmer than the outside temperature when required	0
There IS AN URGENT NEED for a climate control system in the HIMARS cab which will keep it cooler or warmer than the outside temperature when required.	12
Q15: Indicate which of these two comments you most agree with. (Mark only the most appropriate comment with an "X".)	
The daytime temperatures the crew experienced within the cab (during this IOT) HAD AN EFFECT on crew performance.	10
The daytime temperatures the crew experienced within the cab (during this IOT) DID NOT HAVE AN EFFECT on crew performance.	2
Q16: Please indicate which of these two comments you most agree with. (Mark only the most appropriate comment with an "X".)	
The nighttime temperatures the crew experienced within the cab (during this IOT) HAD AN EFFECT on crew performance.	5
The nighttime temperatures the crew experienced within the cab (during this IOT) DID NOT HAVE AN EFFECT on crew performance.	7
Q17: If you indicated in questions 15 and 16 that the temperature within the enclosed cab during operations affected your performance of tasks, please describe how or why your performance was affected. *(Soldier comments [italicized] shown verbatim.)*	
"Extremely hot when buttoned up."	
"Daytime temp drained my crew's performance capabilities. During daytime operations high tem would make the crew drowsy and a little lethargic."	
"During the day time the temp inside the cab was too hot and it slowed down the crew drills."	
"The heat in the daytime exhausts the crew and makes them more tired which affects nighttime reliability on crew alertness."	
"Cab temps often were over 100 ^{0}F. with the wearing of flak vests and other gear. Having the cab closed for a mission then going to rearm and missions[sic] again, that slowed down the crew in order to avoid a bad injury."	
"The heat makes it harder to perform up to par all day and we did not experience cold weather but that would also slow the crew down."	
"The cab reached temperatures of over 100^0 inside the cab. While wearing MOPP 4, the temp rose to 130^0 inside our suits. That's too hot to function normally."	
"The cab traps the heat in. At times it would be 10^0 hotter than the outside in a flak vest and full battle rattle it is very intolerable." (@Sill) "The rise in temperature became unbelievable in the cab on just a normal spring [sic] day. If I deploy to a place like Iraq, the temps would just be unbearable". (@WSMR)	
"If it was too hot during the day the crews would become irritated with each other."	
"At night with the heater on the commander still freezes in hatch while the driver and gunner get too hot."	
Q18: (OPTIONAL) During this test, grass fires on the firing point were experienced during live firing, which also resulted in some damage to HIMARS launchers. In every instance, the Fort Sill fire department was on hand to prevent the spread of the fire. New firing points were not obtained for the IOT and therefore, HIMARS launchers were required to use the same burned out firing points for all live firings. If you were involved in any of these range fire situations, please comment about how training was affected and what could be done to counter similar situations in the future. *(Soldier comments [italicized] shown verbatim.)*	

"(Same as in question 5) HIMARS may catch fire while on firing point. And a "unable to stow" or "stow point not reached" critical failures would cause the crew troubles to move off the point and extinguish any fires."
"The fire suffered by my launcher (HIMARS 12) directly affected training by putting me out of the fight for 3+ hours and caused me to miss several fire missions. In addition, only using one firing point made op area management non-effective."
"We waited in our hide position for over an hour while the fire department attempted to control a fire. They should have done a control burn prior to us shooting. Also we weren't allowed to move like a real world situation would dictate. We had to fire from the same burned out spot just so we wouldn't cause any more fires."
"Make all hoses covered and unable to be damaged due to fire."
"The fire under the cab was very large. It burned out our air lines. We got the alarm and had to drive off the firing point with the LLM still pointed at the target. We made it 30 meters from the firing point before the brakes locked up. If we would wait [sic] we would have been trapped in the fire."
"Pre-burn the area."
"Using the same firing point over and over again made training unrealistic. Firing points should be burned off before firing."
"I was one of the launchers who [sic] had hoses burn up, we almost could not drive off the point. Fire proof hoses or a cover for some of the equipment that could stop [sic] operations if damaged or burnt could help the situation."
"No significant fire during operation of my HIMARS during live fire."
"The reason it was a major problem was because the hoses melted causing air pressure loss. The vehicle would not move. A fire retardant wrap would be sufficient to be able to get you off the point where it wouldn't cause a problem."

Part 3: RSV/T Operations

Focused feedback on HIMARS RSV/T operations from the MOS 13M personnel who worked with the RSV/T is presented.

Questions and Answers	No. of Responses
Q1: List three design features or capabilities that you liked most about the HIMARS RSV/T.	
#1: Ease of ride and easy to maneuver truck and trailer	11
#2: CTIS	8
#3: CAB functional features: tilt, hydraulic cab lift, CVC (combat vehicle crewman) helmet in cab	6
Hydraulic spare tire lift	4
Crane and remote control for crane	3
Ease of lifting trailer, crew level maintenance, optional side panels, push button transmission	1
Q2: List three design features or capabilities that you liked least about the HIMARS RSV/T. (Please indicate if these features or capabilities "must be fixed" or are "recommendations that would make a good system better".)	
Very little storage space for crew gear and equipment. (Must be fixed).	12
Crane limitations on reach and vulnerabilities of exposed hydraulic lines and junction boxes.	9
Unprotected CTIS hoses.	4
The RSV doesn't handle well off road with full combat load, the fact that you can't go up any hills or bumps for that matter because it feels like its about to tip over, or take any turns at any rate of speed because of the same thing.	2
Lights on the light control panel can't be dimmed for NVG use. That must be fixed.	1
The brake and gas pedals are too close together	1
Not enough leg room on TC side of truck	1
The fact that you have to find almost perfectly flat ground to drop your pods	1
Weak charging system in the engine. Vehicle power was lost several times when mic was keyed - must be fixed.	1

The steering wheel is too big.	1
Fact that the pod exceeds the length of the cargo bed	1
Vulnerability of air tanks to damage	1
Q3: What problems (if any) did you experience when operating the MHC on the RSV to load and unload ammunition and what needs to be done (if anything) to improve the crane?	
The crane had an unstable slew and would speed up or slow down by itself. It would lock up for no apparent reason even if it was not over loaded. The load would sometimes drop drastically when the "lower" lever was barely pushed.	7
The crane hydraulic lines were exposed and suffered damage from contact with trees while moving in/out of hiding positions. Hydraulic lines leaking and bursting.	3
Difficulty with placement of pods because of limited crane length.	1
Soldier comments that are impressions not strongly based on actual IOT experiences:	
The hoses exposed on the crane are a constant worry. They are too easy to pinch with the ammunition and cause the load to come down.	1
No complaints on the crane. It is vulnerable to damage more than it should be when doing upload and download. There are only inches between the hydraulic lines and the pod when lifting.	1
Put covers over the junction boxes on the boom arms of the crane.	1
Protect the hydraulic lines better. The hydraulic lines are entirely too exposed and too easily damaged.	4
It's a good crane. I think it would do very well "In the civilian world" (underlined for emphasis) but it just can't handle the stress and strain of heavy military operations. Leaks too much. It is almost impossible to lift a pod without red lining or locking up. Its just too weak.	1
Q4: What problems (if any) did you experience when operating the RCU on the crane and what needs to be done (if anything) to improve the remote control unit?	
PROBLEM: The crane would hesitate at times during prolonged use. Switching remote boxes was the only way to fix the problem.	1
PROBLEM: Cable storage is time consuming	1
RECOMMENDATION for improvement: Some type of cover for the crane speed switch so that it doesn't get accidentally switched.	1
No problems, good item, worked fine, no entry made	9
Q5: Please put an "X" on one of the following statements that best describes your ability to perform required HIMARS RSV/RST individual and crew tasks.	
a. I would like more training	0
b. I have a general understanding of how to perform required HIMARS RSV and RST individual and crew tasks and at times I require assistance	1
c. I understand how to perform required HIMARS RSV and RST individual and crew tasks and I do not require assistance to perform them	3
d. I completely understand how to perform required HIMARS RSV and RST individual and crew tasks. I can perform them without assistance and I can supervise or train others to perform them to (meet) standard.	8
Q6: What do you think needs to be covered in RSV/RST training that was not covered?	
Need more off-road driver's training in the vehicle	1
Need instruction on where, how to store nets, gear, etc	2
Need instruction on changing tires on the vehicle and dismantling the CTIS	1
Everything was covered, covered very well; instructors were very precise.	7
Need accurate instruction: *At first correct dimensions for pod placement were not given. It needs to be correct the first time.*	1
Q7: What (if any) are the significant RSV/RST system safety issues that you experienced? Your answer should address new safety issue(s) that were not noted in an IETM or training or an existing safety issue that must be fixed by improving the design of the RSV/RST system.	
Safety issues experienced without injury occurring	

(1) Limited walking space on the bed of the truck (presumably when there is a pod loaded onto it and Soldiers are required to get on the cargo bed and walk around the pod) may lead to an accident.	1
(2) The closeness of the brake and accelerator pedals may lead to accidentally depressing the wrong pedal thereby causing an accident.	2
(3) The lack of handles on the ladder or adequate handholds to aid crew members get on/off the cargo bed is unsafe.	5
(4) The crane is inherently unsafe with its un-commanded movements, jerky movements that affect the load being raised or lowered.	2
Soldier sentiments that they felt unsafe and something needs to be fixed/improved	5
There is a valve system on the exterior of the crane that if you hit it with a pod the load will fall. I think you need to place this valve	
system on the inside of the crane. MHC safety valves unprotected.	
The exposed hoses on the crane need to be covered to prevent them from being crushed and dropping the load.	
Something between the crane and the pods to prevent damage to the hydraulic lines.	
This truck is just too easy to tip over	
No stowage for crew gear.	
I experienced no safety issue that wasn't covered already.	1
Q8: What RSV/T [sic] design problems (if any) did you encounter when operating in and around the RSV/T [sic] in any MOPP level?	
None / N/A. No entry made.	8
Getting in/out of the cab was difficult; door needs to open wider, steering wheel too big.	2
Limited space behind the steering wheel. Wheel is too big	1
Difficulty using the ladder	1
No storage for crew gear	1
Q9: What RSV/T [sic] design problems (if any) did you have when operating at night?	
The LED lights on the dash are too bright when I'm wearing NVGs. The same for the light switch. The blue light on the black-out switch impairs driving with NVGs on. The light pad itself had a blue light that lit up, which was way too bright in the cab and made it difficult to see. The light panel has the blue indicator light that is way to [sic] bright during the night.	6
No problems / None / N/A / Just had to move slower	4
The lights on the crane control box would illuminate during night ops	2
No storage for crew gear	1
Being able to see the LED warning limit lights on the crane display. Seeing the pod being uploaded on the RSV/RST.	1
Q10: List any significant advantages or disadvantages (if any) that you feel the RSV and RST have when compared to the HEMTT and HEMAT.	
Advantages:	*15*
Easier to back up the RSV/RST than the HEMTT/HEMAT	3
RSV has a good remote control	1
RSV drives better, has better suspension, has a better turning radius/is a better ride than HEMTT	6
CTIS	2
RSV's hydraulic manifold	1
Easier PMCS	1
RSV cab is better	1
Disadvantages:	
RSV lacks storage space	3
HEMTT crane better than RSV crane.	1

RSV has smaller wheel base than HEMTT, can't go where HEMTT can go, RSV is smaller and top heavy	3
RSV has limited leg room in cab	1
HEMTT is better suited for the job, can carry more ammo, is better built and more durable in field environment	8
HIMARS cannot reload off the RST	2
Q11: List any additional comments or concerns that you have about the RSV and RST. *(Soldier comments [italicized] shown verbatim.)*	
"Needs more storage - there isn't any." "My biggest concern with the RSV/RST is the lack of storage space this most definitely needs to be remedied."	1
"Need to concentrate more on making this vehicle last. They will be trash in about 5 or 6 years due to the weaknesses in the design. If it can be broke, it will be."	1
None. No comment made. N/A entry.	3
Don't buy them	1
"The Army needs to find a better ammo carrier for the HIMARS. The RSV in not the vehicle for the job!"	1
"No storage for crew gear. Beds need to be longer for safer move ability [sic]. Putting the pods in an open field isn't very safe in a combat environment. Storing weapons behind seat is good in theory but hard to reach if attacked. Cannot sleep in cab like you could in a HEMMT."	1
"There is nowhere to store nets and pole bags. The combat lock engages too easily. There is no leg room unless you are under 5ft 7in."	1
"Too much plastic in the cab. Everything seems easy to break."	1
"This vehicle handles very poorly in mud even in x-c(?) and made you try turning and you just keep going straight with or without pods. And it's too top heavy."	1

Part 4: GMLRS Operations

Focused feedback by the MOS 13M personnel who received XM30 GMLRS training and performed GMLRS-related missions and tasks using the HIMARS and RSV/T is presented.

Questions and Answers
Q1: Do you feel the training you received prepared you to properly upload a GMLRS LPC on the HIMARS launcher?
YES: 11
NO: None
Q2: Do you feel that the training you received prepared you to properly execute a GMLRS fire mission?
YES: 11
NO: None
Q3: What can be done to make the training better?
Have a better PowerPoint presentation plus show a real pod.
Shoot live GMLRS. *(Same respondent at WSMR)* During training they should have a portion on the difference of a regular pod compared to a GMLRS pod that would be useful during pod inspection prior to uploading. Such as different cables on the GMLRS that could be inspected.
Faster paced lessons to prevent boredom. *(Same respondent at WSMR)* Fire more live rounds.
I think the training was sufficient with the hands-on portions. Training was good. *(Same respondent at WSMR)* Training was done to standard
More hands-on
It seems the IOT was set up for success. The platoon and crews need more latitude. FM 6-60 is there for a guideline not a book of instruction. The op areas cannot always be set up at perfect distance due to terrain and vegetation.

Q4: Did you experience any problems or challenges when using the launcher FCS to process GMLRS fire missions or communicate the fire mission with the AFATDS (i.e., problems with TLE [target location error], message formats, manual entry of information, readability of the digital display, etc)?
YES: 2 Responses
NO: 11 Responses
If yes, please briefly describe the problem(s) or challenge(s), how you dealt with them and indicate whether the problem(s) or challenge(s) were resolved.
Cannot reload software if GMLRS was last selected.
When my gunner loaded the weapons after a reload we had six rounds. When he hit launcher lay we had a dud. I told him to cancel the mission and stow. I conducted another SNVT and the FCS registered the round. I had a dud in tube 6 but tube 6 fired. After I fired the last round and conducted a reload the dud on tube 6 went away. Possible software problem.
Q5: In your opinion, is there anything that should be done to improve the software interoperability between the HIMARS FCS and AFATDS for GMLRS fire mission processing?
None/No: 5 Responses
No, it seemed to be fine
Make free text messages able to be sent and received from HIMARS instead of just being able to receive. Yes but I have no input to improve the system.
Yes, the software came a long way from when we first started the IOT and many improvements were made. They need to continue on this.
EOM commands need to be updated after every F.M.
Not that I am aware of.
The problems we had were because of LIDAS. *(Same respondent at WSMR)* The system works well.
Q6: Were there any work-around procedures that you had to use in order to:
a. Successfully process a GMLRS fire mission?
YES: 2 Responses
NO: 10 Responses
b. Successfully handle and load GMLRS LPCs?
YES: 1 Response
NO: 11 Responses
c. If you answered yes to either or both 6a and 6b, please describe the work-around procedure(s), when you had to use these procedures, and (if possible) how GMLRS operations were affected.
Two bays with right bay having rockets. Two JEG* uploaded after reload.
(@WSMR) After uploading we had six rockets on board. Once we pressed launcher lay, rocket 1 became a dud and we could only fire five rounds on a six-round mission. We had to stow the LLM, disconnect the cables, re-hook up the cables and do a manual reload. After the LLM was, [sic] rocket 1 came up good, but rocket 6 came up as a dud. Rocket 6 was an empty bay from firing it on the first mission.
This is my personal work-around: When a dud occurs. *(Same respondent at WSMR)* Simply complete the fire mission, stow, conduct a reload and continue the mission.
Q7: Please provide any additional comments or concerns (if any) that you have regarding the training and employment of the GMLRS rocket, that have not already been mentioned.
Good system worked every time
Training would have been better if there were more live GMLRS fire missions (@WSMR).
No additional concerns
Having been to war we would [like] to see ammo that doesn't take so long [to] process. Speed is the key to our success.
More training on the load angle of pod

*JEG is a "J-code" in the AFATDS for the XM-30 GMLRS rocket with dual purpose improved conventional munitions (DPICM).

Appendix B. MOS 13P (Fire Direction Specialist) Survey Data

Demographics

A total of 20 Soldiers answered the MOS 13P survey. They provided the critical fire direction functions from the Platoon Operations Center, the BOC, and the Battalion Operations Center. Of the total population, nine (45%) were enlisted Soldiers (E2 and E4), nine (45%) were NCOs (E5 through E7), and two (10%) were commissioned officers (O2).

The lowest TIS recorded by the 18 MOS 13P Soldiers (less the commissioned officers) was 9 months, while the highest recorded TIS was 232 months (19 yrs, 4 months). The lowest and highest recorded TIMOS were 6 months and 140 months (11 years, 8 months), respectively.

Survey Responses

In this appendix, focused feedback by MOS 13P Soldiers who received GMLRS training and supported the IOT is presented.

Questions and Answers
Q1: Were you required to receive GMLRS-specific 13P training prior to this test?
Yes: 17 Responses
No: 3 Responses
If not, why not?
As far as it works on the FDC side of the house - GMLRS is no different than the actual A270 [sic] MLRS. It's a good thing, because it allows us to cross train from HIMARS to launchers.
I'm not a 13M. I process missions. It doesn't matter what type of munition we fire. My job is to send it to the launchers.
I was not yet assigned to the unit. However, once assigned, I received on-the-job training.
The GMLRS munitions were discussed so that I would understand how it works. I do not know if it was required knowledge.
Gave a better understanding of what we were getting into (familiarization) of the HIMARS launcher and its equipment.
BN FDC section with Alpha Battery was tasked out for about two weeks learning the fire direction side of the HIMARS, which was really interesting. Knowing that the HIMARS can fire any type of munitions and are really quicker on reloads as well get to the FP faster than the MLRS launchers.
We received training at the I-See-O[8] hall training area
Some of the 13P HIMARS team trained us on the GMLRS before the test got started
Two weeks in July 2004 was allocated specifically for training on the GMLRS (M30) rocket. The training was both classroom discussion and hands-on type training.
Q2: Do you feel that the training you received prepared you to properly execute a GMLRS mission?
Yes: 18 responses
No: 2 responses
If not, why not?
Not really. Most of the material covered in class we already knew from our advanced individual training (AIT). This class doesn't cover anything new to us.

[8]Indian name of building at FA school where training took place.

No, I did not process one fire mission during the 96-hr IOT. Both of them!
Fire missions were sent to FDC with guided munitions. I became familiar with the nomenclature and the rest of the fire mission was handled as they normally are.
Because the training received gave us a better understanding of what we were going to be working with and at the same time how much change there was in our part 13P/AFATDS.
That's a big “Roger”.
Yes, because knowing how the AFATDS works with the HIMARS was pretty easy, once you got comms with them. One thing that we as 13P's had to get used to was the HIMARS only having one pod and not two so we couldn't shoot as fast as we normally do.
Yes, the instructors broke everything down easily to understand. Any questions I did have, they were around to answer them.
Yes, I have been processing missions for 36+ months now. This is just another type of munition to be fired. I feel better, however, after having some training with M30's.
Yes! Processing the GMLRS mission is the same as any other missile/rocket type mission.
Yes, fired like any other mission.
Yes, plus I already knew what they taught.
Yes, it is pretty simple. Just change the munitions on AFATDS.
Yes the training that we received did help with the mission and made it easy to understand.
Q3: What can be done to make training better?
I felt like the training I received was sufficient for the test. I don't feel there is anything to make it better.
Better briefings at the beginning of the training exercise to better understand the set of events we are supposed to encounter. Same as having a better, set training schedule. Also a better plan can be worked out to allow a better sleep plan for the HIMARS crews.
Training for the fire direction portion could be maintained. As for the actual GMLRS crew members, better and faster ways to troubleshoot problems.
One problem that I thought could be changed was take all the simulators out the picture and concentrate only on the subject at hand which was the HIMARS performing. There was no reason to be running 24 hour ops
Take away the simulations and add real personnel
Have a separate block of instructions for the 13P's. A lot of briefings we had were directed at the 13M’s.
More time in IOT with the HIMARS with live rounds.
Scenario base training, with battle damage assessments. The training was very straightforward, fire mission processing easy.
For skill level 1, emphasize the fact that GMLRS round effects are interchangeable with AFATDS similar to the way a Block 1 and Block 1A are. The difference for AFATDS is range. Also emphasize that although GMLRS meteorological data are still important, they are nowhere near as necessary as long as the round is not jammed.
Possibly some more hands-on training with the AFATDS and actual launcher to ensure that the process is understood and how it works properly. Maybe a little more hands-on of actually processing the missions
Fire more live rockets, to include GMLRS
Professors who actually know about the subject at hand. The instructors should be hand picked straight out of either the schoolhouse or a line battery. It needs to be someone that's been doing the job recently, not someone that hasn't been at the box for quite a bit
Well instead of the days when we came in at 3 in the morning and left at 7 just make it a week in the field.
The trainers should take more time to explain the equipment.
Excellent training
Simulation training using the mission driver before going to the field.
Myself, I thought the training we received was helpful but maybe at first we should make the classes a little longer because at first it was a little hard to understand. But after a week I did start to pick up on it with the time I had
Include the support PLT FDC into the equation. Don't waste the resources.

Q4: Did you experience any problems or challenges when using the AFATDS to process GMLRS fire missions or communicate the fire mission with the HIMARS FCS (i.e., problems with TLE, message formats, etc?)
Yes: 7 Responses
No: 13 Responses
If yes, please briefly describe the problem(s) or challenge(s), how you dealt with them and (if possible) how the GMLRS mission was affected.
I had numerous times when I lost connections through my modem and had to keep a constant watch on my connections. There was a time in which the AFATDS did not start up for 5 hours as we later found out our TCIM (tactical communications interface module) cards had gone bad.
Sometimes they would come down without round or the battery would receive them without rounds. We would have the battery put rounds in the mission.
The CCU wanted to transmit position area hazard (PAH)/target area hazard (TAH) geometries to the launchers. During the test, missions would come to us with no FS systems type, no round type, no number of rounds and AFATDS did its job to fill parameters of fire mission. However, it would split a fire mission. Solution seemed to be to individually manage launchers and of messed up missions etc. to select fire support system and select plain MLRS DPICM six rounds, do not select specific type of munition, and let AFATDS do what it was meant to, find the best choice.
Well, the missions would sometimes be sent down intentionally with "red gumball"[9] because the fire support systems were not marked and the shell was not chosen nor the rounds. So I simply filled them in. We eventually sent them down after reprocessing.
While we were receiving fire missions, our box would sometimes lock up or shut down. The problem was fixed by reloading software with new info.
JEG missions were being sent without weapon model or type of rounds. We would recalculate the mission and send it back to the launchers.
Weapon model, type, count were not included when receiving JEG missions from higher causing the BOC in turn to input the information/data, and recalculate prior to sending the mission to the launcher.
I had no problems with processing missions with guided munitions on board.
Every mission seemed to have gone down perfectly with the same issues at a normal cycle of fire.
No problems whatsoever
The problems or challenges we faced were minor dealing with the system itself, by having modem failures periodically.
No, our end went according to plan. We never lost a mission nor did we ever lose comms, due to the type of munition we were firing.
Fire mission processing went well.
It went pretty smooth and was actually not a problem. The only thing we did have problems with was comms.
Did not use the AFATDS. It got shut down on the second day of the first week.
Q5: In your opinion, is there anything that should be done to improve the software interoperability between AFATDS and the HIMARS FCS for GMLRS fire mission processing?
There is nothing that I can recall at this time. I did not experience any difficulties.
No not really. We would always receive updates when the FCS sent it. At the same time the BOC would receive missions.
Since the GMLRS [sic] would end up being a lighter version of the A270 MLRS LNCHR maybe they can work out a lighter version of the FDC vehicle. Instead of a track maybe run it all out of a HMMWV.
Not really because in my opinion once we received the HIMARS data and updates and if they were correct we were ready to send rockets down range.
Other than what I have listed above, no
No, I personally don't think so. Once again I state, I'm a 13P so once we receive a mission our procedures are the same. On the other hand if there isn't anything seriously wrong, why fix it?
No the HIMARS received the mission and that's the biggest thing with MLRS.

[9] a term common in computer interfaces to depict bad data; good data are designated as "green gumball".

Yes. But not with just GMLRS type missions. All AFATDS processing should be simpler and quicker, with less call for fire pages to thumb through.
Find out why when data distribution is off why AFATDS tries to push Geometries to Launchers.
No. I experienced no problems at all while processing GMLRS fire missions, the process was the same as when shooting any other type of munition.
In the BOC we encountered the problem of model and type of round not matching, missions would come in saying MLRS DPICM with a model type of M30. The mission processed the same going off of round type.
No.
Yes update it because it seems like we were running into some problems that were not our fault. There should be no reason for error if we are not at fault.
Make it so the AFATDS can accept digital messages from the Launcher.
Yes, I'm not too sure on what to improve on the software but something needs to been [sic] done about it.
Yes, travel lock failure on HIMARS. May be already taken care of.
For some reason AFATDS tried to send the PAH's and TAH's geometry for JEG down to the launcher.
Other than the issue raised in Q4 no necessary improvements seem imperative, upon completion of the two wk field problem.
No not really. I think that the systems are pretty much the same. I think that the system is probably better.
I don't know didn't use it.
Q6: Were there any work-around procedures required to successfully process a GMLRS fire mission?
Yes: 6 Responses
No: 13 Responses
If yes, please describe the work-around procedure(s), when you had to use these procedures, and how GMLRS fire mission and FDC operations were affected.
Sometimes when a fire mission was received, the mission came up in my box with no munitions, so I had to go to the attack options tab and go through order to fire to give the proper munitions. This had also occurred with various other munitions, which would lead me to believe that was an AFATDS issue, not a munitions issue.
One thing that I could say was troubleshooting the radio at one time.
The battery would receive the mission without rounds and would have to insert rounds in the mission.
On occasion, a launcher would not be a viable attack option and the status we saw was correct. So we sent it down using the send selected button from the Attack Options Tab. Launcher processed mission correctly but had to hold a mission in our IP where the radio buttons turned black until mission was completed, or launcher received an end of mission/denied fire mission.
Refer to question 4's answer on that. Refer to Q4.
IOT seemed to have went perfectly in regards to the actual HIMARS launchers
None whatsoever.
No, Not at all to my knowledge.
Q7:Please provide any additional comments or concerns (if any) that you have regarding AFATDS software and training for processing a GMLRS fire mission, which have not already been mentioned.
No further comments at this time. I have no additional comments.
AFATDS software was all fine except when dealing with the simulators, when we would come across commo problems.
Job purpose, Since the 13P had more involvement with fire mission processing, Soldiers who excelled should have been the ones to be recognized instead of the personal [sic] who just drove around (data collectors) [awards/coins]
None. None at this time.
I think training and learning how HIMARS work was pretty interesting and not that difficult to adapt to.
I thought the test went on very smoothly. There are some bugs to be worked out of the launcher but other than that the launcher seems to be pretty reliable.
Like everything else in life, there will be glitches. Just keep researching and testing these systems. I'm convinced everything will be fine. "STEEL"
The test ran very smooth and in a timely manner.

We spent 3 months completely dedicated to this HIMARS test. Not consecutive but 3 months. We have Soldiers who did not receive an award or a coin for their time, something to look back on and say they were a part of the initial testing for an military hardware/software equipment. Tell me, what does a section chief say to a Soldier who receives nothing, but works just as hard as anyone else on the testing?
I do believe for the most part AFATDS in this version works well with GMLRS and it will improve with the next version of AFATDS
As earlier stated, I think there should be more hands-on training so that not only 13P's but 13M's also have time to experience the full process of shooting a GMLRS mission.
The AFATDS can send digital messages to the launchers, but it can't receive them back. I feel that the AFATDS should be able to receive those messages.
When receiving MET the AFATDS would sometimes shut down. What is up?
Safety data calculator - sometimes software didn't work - we had to input MET data - but after then no problem.
No not any. I think that this new GMLRS is pretty good but could be better.
If you include a support PLT FDC in an IOT, then use them for just that.

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Appendix C. MOS 27M (MLRS Repairman) Survey Data

Demographics

A total of four Soldiers (80%) and one commissioned officer (20%) answered the MOS 27M survey.

The lowest TIS recorded by the four MOS 27M Soldiers (less the commissioned officers) was 23 months (1 year, 11 months), while the highest recorded TIS was 61 months (5 yrs, 1 month). The lowest and highest recorded TIMOS were 19 months (1 year, 7 months) and 42 months (3 years, 6 months), respectively. All four MOS 27M Soldiers were Enlisted Specialists (E4).

Part 1: HIMARS Maintenance

In this appendix, focused feedback by MOS 27M Soldiers on maintaining and repairing the HIMARS launcher system is presented. For the purposes of the HIMARS IOT, Part II of this survey, which solicits feedback on maintaining the GMLRS rocket, is not applicable.

Questions and Answers	No. of Responses
Q1: What did you like the most about troubleshooting procedures for the HIMARS launcher?	
(1) The troubleshooting is good; it flows pretty easily. The only down side is that you only have one MSD so you have to get in and out of the cab constantly. (2) I liked how everything that you needed was on the IETM, such as troubleshooting steps along with maintenance procedures. IETM was very helpful (@WSMR)	2
(1) It's easier to isolate problems that occur using computerized built-in test (CBIT) and the maintenance manager. (2) It was easy to follow. *(Same respondent at WSMR)* It was easier.	2
The 27M were able to identify the problem and come up with a solution	1 (PLT LDR)
Q2: What did you like least about troubleshooting procedures for the HIMARS launcher?	
The procedures are not more specific in diagnosis with what the launcher is doing and what it is not doing.	1
Some of the steps in the IETM are out of order or wrong steps. It makes some of the faults that you troubleshoot hard.	1
The software still has many problems in it. The launcher has too many components in the wrong place so it's hard to work with.	1
Nothing	**1**
Certain things required 27M and in the end it felt that the operators could have trouble shot and fixed the problem. However, the IETM said to seek higher maintenance.	1 (PLT LDR)
Q3: What (if any) are the significant HIMARS safety issues that you experienced?	
I see no issues with safety other than you must crawl under the launcher to fix azimuth travel lock repairs	1
(1) I have no safety issues with this launcher that are not already noted. (2) None	3
Q4: What needs to be improved on the HIMARS launcher to make repairs better/easier?	
Launcher: (1) The azimuth travel lock needs to be flipped or a different configuration is needed and a cover would prevent mud and water for causing problems with the travel lock. (2) The jury strut release is very hard to operate and slow repair time. (3) A cover is needed for the bottom of the hoist carriage; it would keep heat and exhaust from rockets off cables and hoses.(4) Make the	4

azimuth travel lock so you can get to the cable easier, and the hoist drum is difficult. (5) *(Same respondent @ WSMR)* Make cable more accessible on the azimuth travel lock.	
IETM or GDU Software: (1) Some of the steps in the IETM are messed up, such as they tell you to go to the wrong place on the GDU. (2) They do have some software issues that need to be worked out. After you go into Maintenance Manager and try to reboot the system it always comes up with no image available. (3) The software on the GDU needs to be upgraded. There are too many times that it freezes or gives false prompts of errors.	3
Need better connections between systems. Some connectors required cleaning even though they were never removed in the first place.	1 (PLT LDR)
Q5: Were necessary tools and maintenance equip provided and functioned properly?	
(1) Yes (2) Yes we were equipped with the right tools and everything functioned properly.	4
Not enough tools. Certain tools needed to be picked up at Mow Way in order to fix a launcher. Should have all tools at both field team and Mow Way team.	1 (PLT LDR)
Q6: Please place an "X" on one of the following statements that best describes your ability to perform required HIMARS launcher maintenance tasks.	
a. I would like more training	0
b. I have a general understanding of how to perform required HIMARS launcher maintenance tasks and at times I require assistance.	1
c. I understand how to perform required HIMARS launcher maintenance tasks and I do not require assistance to perform them.	1
d. I completely understand how to perform required HIMARS launcher maintenance tasks. I can perform them without assistance and I can supervise or train others to perform them to (meet) standard.	2
Q7: In what areas do you need more training time in order to better prepare you or your section to perform required maintenance operations on the HIMARS launcher?	
None that I found. None.	4
Q8: List any additional comments and concerns that you have about performing maintenance on the HIMARS launcher.	
None	3
The HIMARS is a great idea but I think the software should be upgraded or changed.	1

Part 2: GMLRS Maintenance

Questions and Answers	No. of Responses
Q1: Do you feel training prepared you to properly conduct diagnostic tests on the GMLRS LPC with the MFOM common test device (MCTD)?	
Yes?	4
No?	0
If not, why?	0
Q2: What can be done to make training on the GMLRS LPC and MCTD better?	
More time on maintenance of the MCTD since it is a tool given to 27M's.	**1**
Nothing (@Sill). Longer than a week training (@WSMR)	1
Make the training more narrowed down to specifics to all the testing devices instead of making it a broad discussion. None (@WSMR)	1
A little more time to train, not rushing us through it. Nothing (@WSMR)	1
Q3: What would you change to make the operations/maintenance of the MCTD better?	
None / Nothing	4
Q4: What would you change to make maintenance of the GMLRS better?	
None	2
Update the GMLRS IETM	1
The software. Nothing (@WSMR)	1
Q5: Please provide any additional training and maintenance related comments or concerns (if any) that you have regarding the GMLRS rocket that have not already been mentioned.	
None/Nothing	**4**

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Appendix D. MOS 63 Series (Vehicle Maintenance) Survey Data

Demographics

A total of four Soldiers (80%) and one commissioned officer (20%) answered the MOS 63 series survey.

The lowest TIS recorded by the four MOS 27M Soldiers (less the commissioned officer) was 72 months (6 years), while the highest recorded TIS was 170 months (14 years, 2 months). The lowest and highest recorded TIMOS were 72 months (6 years) and 108 months (9 years), respectively. All four MOS 63 series Soldiers were sergeants (E5).

Part 1: HIMARS Vehicle Maintenance

In this part of appendix D, focused feedback from MOS 63 series Soldiers on maintaining the HIMARS vehicle is presented.

Questions and Answers	No. of Responses
Q1: What did you like the most about the troubleshooting procedures for the HIMARS vehicle?	
Problems were more easily identified with the MSD. The MSD made trouble shooting the HIMARS very easy and walked through each as what to do.	2
The simplicity of the vehicle and MSD makes our jobs easy.	1
It was very informative.	1
Q2: What did you like least about the troubleshooting procedures for the HIMARS vehicle?	
Some MSD tasks in the computer were wrong or the illustration was not accurate.	1
(1) On the MSD portion, it was troublesome to keep the electrodes calibrated. Most of the time, it was easier to use a multimeter. Not being too knowledgeable on the vehicle, a slight pain on finding a start point. (2) Parts where you could use a multimeter you were not allowed to and sometimes it would take you around a problem the long way and then you would go to the problem (i.e., instrument gauges).	2
There were some steps that could possibly be taken out to make it quicker on troubleshooting.	1
63B had to come out and "assess" a generator gone badly when the operators already identified the problem. It would have saved plenty of time if the 63B went to Mow Way to pick up a part first, when they ended up doing exactly that in the end.	1(PLT Leader)
Q3: What (if any) are the significant HIMARS vehicle safety issues that you experienced?	
I know of none. I have none at this time.	2
A lot of fires and a lot of issues on melted air lines. The air hoses leading to the air tanks need to be protected by a metal plate or made of metal tubing.	2
Air hoses underneath the air tanks. During IOT, two vehicles went down because the fires melted or weakened the hoses so they burst. Fortunately, there was enough air pressure to move the HIMARS out of the fire before the brakes seized up. If enough pressure were lost, the vehicle would not have been able to move off the fire point and out of the fire.	1(PLT Leader)
Q4: What needs to be improved on the HIMARS launcher to make repairs better/easier?	
The belt tensioner for the generator was not very accessible. Would be better if it were spring loaded like on the 5-ton 900 series vehicles	1
(1) Air lines need to be protected from the underside of the vehicle. (2) Better air hoses on the air tanks would be the best things for what I have seen. (3) Spend more money on better air lines.	3

Q5: Were all the necessary tools or other maintenance equip provided to you so that you could properly complete repairs on the HIMARS vehicle and did everything function properly (IETM, tools, etc.)?	
The supporting unit was supposed to provide a tool truck but did not. So it took longer to get special tools (i.e., torque wrenches, large wrenches and so on).	1
(1) Yes (2) Yes all tools and maintenance needs were made available to make maintenance on vehicle easy and quick. (3) Yes everything was "up to snuff".	3
Q6: Please place an "X" on one of the following statements that best describes your ability to perform required HIMARS vehicle maintenance tasks.	
a. I would like more training	0
b. I have a general understanding of how to perform required HIMARS maintenance tasks and at times I require assistance.	2
c. I understand how to perform required HIMARS maintenance tasks and I do not require assistance to perform them.	2
d. I completely understand how to perform required HIMARS maintenance tasks. I can perform them without assistance and I can supervise or train others to perform them to (meet) standard.	0
Q7: In what areas do you need more training time in order to better prepare you or your section to perform required maintenance operations on the HIMARS vehicles?	
More time on electrical troubleshooting would have been more helpful.	1
(1) More troubleshooting procedures and more training on the HIMARS vehicle, if not the RSV. (2) On the HIMARS truck itself.	2
There was only one problem that we did not cover in training and that was the air hoses melting during live fire due to the burning bush.	1
Q8: List any additional comments and concerns that you have about performing maintenance on the HIMARS vehicles.	
Servicing the axles on the HIMARS; from what I am told, it takes 8 to 9 hours per axle. This is way too much time to spend on one vehicle for a simple service.	1
None/Nothing	2
As any new vehicle there will be new problems that arrive as they are introduced to the Army. Without further working on them, we will not know for sure.	1

Part 2: RSV/T Maintenance

In this part of appendix D, focused feedback from MOS 63 series Soldiers on maintaining the RSV/T is presented.

Questions and Answers	No. of Responses
Q1: What did you like the most about the troubleshooting procedures for the RSV/T?	
(1) That using the MSD can help greatly in troubleshooting. (2) The MSD makes trouble shooting easy and quick for most of the problems. Though during testing we had no major problems with these vehicles. (3) I liked the MSD; it takes you directly to the source of the problem and an NSN is readily available.	3
The layout of the vehicle is simple. It made work for the MSD easy.	1
Q2: What did you like least about the troubleshooting procedures for the RSV/T?	
That it's a new vehicle and don't know the "ins" and "outs" yet.	1
None	1
Unable to answer accurately due to no major problems during testing.	1
Too time consuming. If in battle you need to know a well-thought-out battle damage assessment and repair (BDAR)	1
Q3: What (if any) are the significant RSV/T safety issues that you experienced?	
(1) I know of none. (2) None.	3

Most of the tools in training tapes we don't have in our maintenance shop.	1
Q4: What needs to be improved on the RSV/T to make repairs better/easier?	
(1) I know of none. (2) None.	2
Wheel covers for the CTIS result in damage to valves and hoses; the crane is too technical for the average Soldier.	1
The crane is too technical for the basic Soldier and is too touchy and temperamental.	1
Q5: Were all the necessary tools or other maintenance equip provided to you so that you could properly complete RSV/T repairs and did everything function properly (IETM, tools, etc.)?	
No again. We had no tool truck so it took a lot longer to repair vehicles that took tools not found in the Gen Mechanics tool box.	1
(1) Yes. (2) Yes all necessary tools and equipment were available for us to use. (3) Yes, everything was available.	3
Q6: Please place an "X" on one of the following statements that best describes your ability to perform required RSV/T maintenance tasks.	
a. I would like more training.	0
b. I have a general understanding of how to perform required RSV/T maintenance tasks and at times I require assistance.	2
c. I understand how to perform required RSV/T maintenance tasks and I do not require assistance to perform them.	2
d. I completely understand how to perform required RSV/T maintenance tasks. I can perform them without assistance and I can supervise or train others to perform them to (meet) standard.	0
Q7: In what areas do you need more training time in order to better prepare you or your section to perform required maintenance operations on the RSV/T vehicles?	
I know of none. None	2
Overall general maintenance. Everyday care, which will come once introduced to the Army.	1
On the truck itself.	1
Q8: List any additional comments and concerns that you have about performing maintenance on the RSV/T vehicles.	
Just that air hoses are too exposed to fires caused by rocket exhaust grass fires.	1
Outstanding vehicle. A little trouble with crane operations.	1
(1) At this time there are none but as I work on them in future just normal experience will come the knowledge. (2) I have none at this time.	2

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Acronyms

AFATDS	Advanced Field Artillery Tactical Data System
AFOM	Army tactical missile family of munitions
AIT	advanced individual training
ALOC	admin logistics operations center
ARL	Army Research Laboratory
ATEC	Army Test and Evaluation Command
BC	battle command
BOC	battery operations center
CAFU	chemical and air
CCU	communications and control unit
COI	critical operational issue
CTIS	central tire inflation sytem
ECU	environmental conditioning unit
ESIT	Extended System Integration Test
FCP	fire control panel
FCS	fire control system
FDC	fire direction center
FMTU	family of medium tactical vehicles
FSTD	Fire Support Test Directorate
GDU	gunner’s display unit
GMLRS	Guided Multiple Launch Rocket System
HEMAT	heavy expandable mobility ammunition trailer
HEMTT	heavy expandable mobility tactical truck
HFE	Human factors Evaluation
HIMARS	High Mobility Artillery Rocket System
HRED	Human Research and Engineering Directorate
IETM	interactive electronic training manual
IOT	initial operational test
IOT&E	initial operational test and evaluation

IPDS	Imagery Processing and Dissemination System
LCFP	low cost fire control panel
LED	light-emitting diode
LFCS	launcher fire control system
LIDAS	launcher instrumentation data acquisition system
LPC	launch pod container
LLM	launcher loader module
LRU	line-replaceable unit
MANPRINT	Manpower and Personnel Integration
MCTD	MFOM Common Test Device
MFOM	Multiple Launch Rocket System Family of Munitions
MHC	material handling crane
MLRS	Multiple Launch Rocket System
MOP	measures of performance
MOPP	mission-oriented protective posture
MOS	military occupational specialty
MOS 13M	MLRS Crewman
MOS 13P	Fire Direction Specialist
MOS 27M	MLRS Repairman
MOS 63	Vehicle Maintenance
MSD-FR	maintenance support device-field ready
MSU	mass storage unit
NCO	noncommissioned officer
NVG	night vision goggle
OTP	outline test plan
PLT	platoon
PMCS	preventive maintenance checks and services
POA	pattern of analysis
RCU	remote control unit
RSV/T	resupply vehicle and trailer
SNVT	short-no-voltage-test
TIMOS	time in MOS

TIS	time in service
TPU	tactical processor unit
WSMR	White Sands Missile Range

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