Research Note 84-30

MULTIPLE LAUNCH ROCKET SYSTEM: A CASE STUDY OF MANPOWER, PERSONNEL AND TRAINING REQUIREMENTS DETERMINATION

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This report describes and analyzes the procedures used to determine Manpower, Personnel, and Training (MPT) requirements for the Multiple Launch Rocket System (MLRS) and related accomplishment of actual MPT events/documents to those called for in the Life Cycle System Management Model (LCSMM). It addresses concerns being raised about the adequacy and timeliness of the Army's MPT requirements determination procedures.

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FOREWORD

The Army is currently implementing a broadly based force modernization program featuring the introduction of a large number of sophisticated new materiel systems and simultaneous redesign of its force structure (Division 86) in an all-volunteer environment. This ambitious effort places heavy demands on the Army's manpower and training resources. Projected declines in the qualitative and quantitative manpower pool from which the Army must recruit its future soldiers will compound that problem over the next several years.

A necessary early step in coping with the Manpower, Personnel, and Training (MPT) resource problem is the production of an accurate and timely accounting of the number of people and skills needed, system by system and in the aggregate, to operate and maintain new equipment once fielded. To this end, the Army has developed an elaborate materiel acquisition process and a number of regulations and instructions which address the MPT issues to be considered during system development and acquisition. Nevertheless, a number of negative judgments, summarized below and generally supported by previous study findings, have been made about the Army's ability to determine MPT requirements for new systems.

- Tools and techniques for predicting manpower requirements and guidance for their application are both inadequate and unevenly applied.
- The process whereby MPT requirements are documented and transmitted is overly complex, slow, and fails to include direct early participation of Army personnel community representatives.

- o Materiel developers often fail to understand the impact that MPT requirements have on the ultimate cost and operational utility of a new piece of hardware once fielded; consequently insufficient funds and effort are devoted to MPT analysis and human factors engineering during early stages of system development.

Jointly sponsored by the Defense Systems Management College (DSMC) and the US Army Research Institute for the Behavioral and Social Sciences (ARI), this study effort by Information Spectrum, Inc. under contract MDA 903-81-C-0386 is one of several initiatives designed to respond to concerns being raised about the adequacy and timeliness of the Army's MPT requirements determination procedures. It supports ARI's intensive systems manning technology research and development program and DSMC's increased educational emphasis on performance of more effective man-machine tradeoffs during early stages of the materiel acquisition process.

This report is one of five resulting from ISI's research effort. Each of the first four was a case study that described and analyzed the procedures used to determine MPT requirements for a specific materiel system, and related accomplishment of actual MPT events/documents to those called for in the Life Cycle System Management Model (LCSMM). This fifth report analyzes findings from the four case studies, draws systemic conclusions, and makes recommendations for improving the MPT requirements determination process.

EXECUTIVE SUMMARY

BACKGROUND

Growing concern with the soldier-machine interface problem, the future manpower pool available to the Army, and the Army's ability to make accurate and timely determinations of the quantitative and qualitative Manpower, Personnel, and Training (MPT) requirements for newly developed systems provided the impetus for the study of several emerging weapon systems. This report examines the Multiple Launch Rocket System (MLRS), one of four systems selected for study. A comparative analysis report will examine the results of the four system case studies, identify systemic problems with the Army's MPT requirements determination procedures, and recommend solutions to identified deficiencies.

METHODS

The MLRS examination was divided into three major phases: literature review, data collection, and data processing and analysis. Official Department of Defense (DOD) and Department of the Army (DA) publications concerning the MPT effort within the system acquisition process were reviewed and earlier and on-going studies were also researched. Specific MLRS data was obtained from interviews with and draft and final MPT documentation prepared by materiel developers, combat developers, trainers, testers, manpower planners, personnel managers, and logisticians. Data was analyzed within the context of the MPT documents and events identified in the Life Cycle System Management Model (LCSMM), as modified by the MLRS acquisition strategy. Tools and techniques used to determine system MPT requirements were evaluated against those prescribed by the Army. The analysis paid

particular attention to how much emphasis was placed on MPT issues in early requirement and contractual documents.

MAJOR FINDINGS

The MLRS acquisition strategy, aimed at achieving an Initial Operational Capability (IOC) in 60 months and employing both competition and acceleration, left little time for meeting the logistic support requirements, including MPT. The MPT requirements determination process as defined by the LCSMM is workable under normal circumstances. However, it must be intensified early in an accelerated program; otherwise, the MPT effort will constantly lag behind other events and be driven by them.

The MLRS requirement documents emphasized development of a system that would minimize the logistic burden and the manpower requirements, and simplify training and skill requirements. However, the full benefit of these considerations has yet to be demonstrated at the general support and depot maintenance levels. Operation and organizational maintenance of the system may have been simplified at the expense of higher maintenance level requirements.

The Logistics Support Analysis (LSA) effort is not well understood by either the government or most contractors; consequently, the magnitude of effort involved is difficult to define in the Request for Proposal (RFP) and to properly estimate in contractors' bids.

The Army did a poor job of defining to the contractor the target audience. In fact, no effort was made to either "age the current force" or to estimate the available manpower pool at the time of the fielding of MLRS.

Human Factors Engineering (HFE) support for MLRS was exceptional. The Program Manager (PM) contracted with the Human Engineering Laboratory Detachment at the U.S. Army Missile Command (MICOM) for a full time dedicated human factors engineer. In addition, the contractor had a strong HFE program.

The many macro personnel management considerations involved in the MOS decision process, in addition to specific system related issues, argues for earlier personnel community involvement in the acquisition process. Involvement of the personnel community in the RFP formulation and the source selection evaluation processes is necessary if MPT and HFE considerations are to be addressed early-on and influence equipment design. Preparation and maintenance of a plan similar to the now defunct Military Personnel Center Initial Recruiting and Training (MIRAT) Plan would ensure more active participation by the personnel community in the process of determining new system requirements.

Questionable quantitative maintenance manpower requirements have been developed for MLRS because of the manipulation of LSA, Qualitative and Quantitative Personnel Requirements Information (QQPRI), and Manpower Authorization Criteria (MACRIT) data due either to misunderstanding of the process or lack of confidence in the data. The maintenance manhour determination process has been subjected to "factoring," manipulations of MACRIT formulas, and a generally undisciplined approach to determining quantitative requirements.

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SECTION I - INTRODUCTION

A. BACKGROUND

Materiel Systems Acquisition programs are the subject of continuing analyses, reviews, and evaluations. The scope and extent of these program appraisals are consistent with the high cost of materiel systems over a life cycle, their impact on operational capability and effectiveness, and their demand on current and future resources. Specific guidelines have been established for development and acquisition of major systems by the Departments of Defense (DOD) and the Army (DA). The process is detailed and involves many management levels.

Despite the detail and depth of documentation and directives governing the acquisition process, problems regarding establishment of manpower requirements and their true cost have been prevalent. Sufficient numbers of properly trained personnel are essential to operate, maintain, and support current and future materiel systems. The improvements in these systems offered by new technology, a corresponding requirement for more highly skilled personnel, the steady upward trend in operating and support costs, and the projected reduced availability of the recruitable population demand a close and early look at manpower requirements for materiel systems under development to measure both supportability and affordability.

A number of previous studies, some of which are cited below, have highlighted problems associated with the determination of

Manpower, Personnel, and Training (MPT) requirements for new systems.

1. In December 1978, the Logistics Management Institute concluded a study of manpower planning for new weapon systems for the Assistant Secretary of Defense, Manpower, Reserve Affairs, and Logistics (ASD, MRA&L), complemented by seven case studies. Two of these concerned Army systems, i.e., TACFIRE and Patriot.[1] Significant findings from that study included the following:

- Most estimates of manpower requirements made during acquisition programs are too low.
- Operating and support concepts are likely to vary throughout the acquisition process, causing fluctuations in the estimates of manpower requirements.
- There is greater uncertainty associated with maintenance manning than with any other element of new weapon system manpower requirements.
- Estimates of new system manpower requirements frequently reflect program goals rather than unbiased assessments of manpower needs.
- Manpower goals or constraints established for new systems have addressed only the aggregate manning of the using unit, not total manpower or skill level requirements.
- Controlling training requirements can be as important as constraining manning levels.
- Operational test and evaluation conducted prior to DSARC III does not normally test the intermediate level of maintenance support.

2. In August 1980, Generals Walter T. Kerwin and George S. Blanchard prepared a discussion paper for the Army Chief of Staff

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[1]Betaque, Norman E., Jr., et al, Manpower Planning for New Weapon Systems, WN ML 801-1 Through WN ML 801-9. Logistics Management Institute. July - December 1978.

concerning the soldier-machine interface (SMI) problem.[2] In that report, Generals Kerwin and Blanchard stated,

> "The Army has made some progress in dealing with this problem. Many efforts are underway. However, these efforts, while representing steps in the right direction, are fragmented, based on reactions rather than vision, and, to a large extent, individually initiated. In our opinion, these efforts will fall short in coping with the extent of the problem in time to have an impact in the near term. Significant improvement will not occur quickly unless efforts are integrated, the personnel and doctrine people become more actively involved early in the materiel development process, and the Army addresses man/machine interface in its broadest sense and begins to think tactical system develop ment in lieu of individual materiel development, individual people development and individual support development."

Specific observations presented in the report included:

- The Life Cycle System Management Model (LCSMM) must be disciplined concerning the manpower, personnel, training and logistics aspects of the process. Qualitative and Quantitative Personnel Requirements Information (QQPRI) and Basis of Issue Plans (BOIP) were singled out as examples.
- Careful consideration of MPT impacts must precede any variation in strategy which skips a phase of development for the purpose of achieving an early initial Operational Capability (IOC).
- Better utilization of and improvements in the QQPRI process are needed.
- MPT requirements must be better defined during concept evaluation.
- System development programs must recognize training constraints and employ sophisticated techniques to reduce training requirements.
- Human Factors Analysis and Engineering must become a mandated part of system development early in the cycle.

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[2]Blanchard, George S. & Kerwin, Walter T., Man/Machine Interface - A Growing Crisis, Army Top Problem Areas, Discussion Paper Number 2, August 1980.

- o PMs and TSMs must increase their emphasis on the MPT features of the Integrated Logistics Support (ILS) process.
- o The personnel community must become an active, rather than reactive, part of the acquisition process.

3. Some of the problems with the BOIP/QQPRI process identified by Generals Kerwin and Blanchard, were also discussed in a 7 January 1980 report by the Army Force Modernization Coordination Office (AFMCO).[3] In its examination, the BOIP/QQPRI Task Force reviewed the status of 76 new systems and found that of these 76, the BOIP/QQPRIs were late in 29 of the systems by an average of 19.5 months. Note: the task force considered current status of the primary item only, it did not consider associated equipment; Test, Measurement, and Diagnostic Equipment (TMDE); or training devices. Nor did the task force consider BOIP/QQPRI quality.

Regarding the impact of the late BOIP/QQPRI, the task force stated:

> "When the BOIP/QQPRI are not submitted on time, there is a high probability that the fielded system will be inadequately supported. At a low intensity of modernization there is some opportunity to offset late BOIP/QQPRI by shifting personnel and materiel resources to take advantage of other system delays and the general phase-in of equipment. However, the increased in tensity of modernization during the next four to five years will not allow this opportunity. In short, twenty-nine of the Army Modernization Information Memorandum (AMIM) systems to be fielded in the next three years may not be adequately supported in the field."

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[3]HQDA, Office of the Chief of Staff, BOIP/QQPRI Task Force Report, 9 January 1980.

The report goes on to say:

"There are many reasons for the number of late BOIP/QQPRI in the set of systems the task force examined. Part of the reason is a failure to adequately discipline the system. In many cases it is due to inadequate priorities being assigned to the extreme importance and value of the system with a consequent under resourcing of manpower at all levels. Above all, there exists no mechanism to centrally manage and police the preparation and submission of the BOIP/QQPRI."

4. A previous ISI study conducted for ARI,[4] identified and analyzed the MPT information required to be generated by the Army's LCSMM process. That study concluded that, if properly prepared in the sequence stipulated, MPT information should be adequate to meet LCSMM milestone goals. However, it also confirmed findings of other studies that the information generated in preparation for recent Army and Defense System Acquisition Review Council (ASARC/DSARC) reviews had been inadequate in some quality and timeliness of MPT planning and programming during the LCSMM process.

5. In January 1981, amid growing concern that its materiel systems are becoming too complex, HQDA directed U.S. Army Training and Doctrine Command (TRADOC) to lead an internal Army study to assess the impact of the SMI on total systems management and how the Army can better match men, skills, and machines.[5] The study was designed to either validate or recommend revision

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[4]Rhode, Alfred S., et al, Manpower, Personnel and Training Requirements for Materiel System Acquisition, ARI, February 1980.

[5]HQDA, Soldier-Machine Interface Requirements (Complexity) Study, January 1982.

to the existing materiel system acquisition procedures to insure that the Army pursues the best possible course to match men, skills, and machines during the next decade.

To accomplish the task, the study addressed in a very broad sense 30 different systems representative of most system types in various mission areas. Further, for each system, the study addressed all system-specific tasks associated with the immediate soldier-machine interface at operator; maintainer, and repairer (through GS) levels.

Since the objectives of that complexity study were similar to those of this effort, coordination was established with the complexity study team and information exchanged.

B. PURPOSE

This is one of four historical case studies dealing with Manpower, Personnel, and Training problems associated with the Army's acquisition of the following materiel systems.

- o AN/TYC-39 Message Switch & AN/TTC-39 Circuit Switch (TCC-39 Program)
- o Multiple Launch Rocket System (MLRS)
- o UH-60A Helicopter (BLACKHAWK)
- o AN/TPW-36 Mortar Locating Radar & AN/TPQ-37 Artillery Locating Radar (FIREFINDER)

Each case study examines the Army's ability to comply with its stated MPT requirements determination procedures during the development of specific systems, and assesses the timeliness and

quality of the MPT products. A fifth report, which accompanies these case studies, analyzes the four systems, identifying similarities and differences in the acquisition process and drawing comparisons where appropriate. It is stressed that the principal objective is to examine when and how well MPT requirements were developed and expressed, particularly during the early stages of system development.

C. APPROACH

1. System Selection

The systems selected for study represent a cross section of Army combat development mission areas, e.g., Fire Support (MLRS), Aviation (BLACKHAWK), Tactical Surveillance, Reconnaissance, and Target Acquisition (FIREFINDER), and Communications (AN/TTC-39 Program). Each of the systems selected has a high development priority and is well along in the acquisition process, thus permitting a more comprehensive examination of actual MPT events and documentation. Availability of US Army Materiel Development and Readiness Command (DARCOM) Project Managers (PM) and US Army Training and Doctrine Command (TRADOC) System Managers (TSM) to interact with study team members also influenced the choice of systems.

2. Scope

For each system case study, actual MPT events/documents and organizational elements responsible for their accomplishment are identified down to subordinate elements within DARCOM and the

subordinate proponent school level within TRADOC.

Occurrence of events are portrayed in time relative to the sequence called for in the Life Cycle Systems Management Model (LCSMM).[6] The May 1975 LCSMM was used as a baseline although some early acquisition stages in the systems examined began prior to that date. Tools and techniques used to generate MPT requirements are described and their value assessed. Qualitative and quantitative changes in MPT requirements are tracked, beginning with the initial establishment of system need and continuing through the latest completed event in the system's acquisition process. Reasons for such changes are also stated in those instances where data availability permitted such a determination to be made.

Where possible, the adequacy and timeliness of MPT information are assessed to determine whether ASARC; DSARC; Planning, Programming, and Budgeting System (PPBS); and fielding needs were met. If not, reasons for such deficiencies and their impact are stated.

The fifth report identifies and analyzes differences in when and how well MPT requirements were developed and expressed. The reasons for and impact, if any, of the identified differences are assessed to identify particularly effective/ineffective approaches to generation of MPT data; common problems and lessons learned are also highlighted. Recommendations for correction of identi-

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[6]HQDA, Pamphlet No. 11-25, Life Cycle System Management Model for Army Systems, May 1975.

fied deficiencies are made, taking into account significant efforts either recently completed or currently underway by the Department of Defense (DOD) and the Army to improve the MPT requirements determination process, e.g., Carlucci initiatives; changes in Army policies and procedures for processing QQPRI and BOIP (AR 70-2); and staffing a proposed new Military Standard for Weapon System and Equipment Support Analysis (MIL-STD-1388A).

The research effort was divided into three major phases: Literature Review; Data Collection; and Data Processing and Analysis.

3. Literature Review

The study effort began with a review of literature pertinent to the development and expression of MPT requirements for new materiel systems. It included an examination of policies and procedures promulgated by DOD; Headquarters, Department of the Army (HQDA); Headquarters, DARCOM; and Headquarters, TRADOC. Related study efforts and research reports such as those mentioned in paragraph A, supra, were also reviewed for background, ideas for data gathering and analysis methods, and to avoid unnecessary overlap and duplication of earlier efforts. Major policy and procedural document sources examined during this review are cited in Appendix A.

4. Data Collection

The evolution of MPT information for the FIREFINDER Program in response to materiel development policies and procedures,

including the LCSMM and the Integrated Logistics Support Management Model (ILSMM) processes, was tracked through each phase of the acquisition process. Data was gathered through examination of draft and final MPT documents and face-to-face interviews with Subject Matter Experts (SME) representing combat/materiel deve lopers, trainers, testers, manpower/personnel planners, and personnel managers. Data cutoff was 31 May 1982. Specific organizational elements contacted during the collection effort are identified in Appendix B. The major MPT source documents are listed in Appendix C.

5. Analysis

Information collected was cataloged and analyzed across acquisition milestones, measured against MPT data requirements in the LCSMM, and where appropriate, compared with like or similar systems; basic criteria for analysis were timeliness and adequacy of data relative to LCSMM and Army regulatory standards. The criteria were applied in examining the following major issues.

- o Tools, techniques, and standards used to compute and express MPT requirements and tradeoffs.
- o MPT requirements documentation and flow of information to decision makers.
- o The acquisition process itself, in terms of MPT requirements determination.

II. SYSTEM SUMMARY

A. REQUIREMENT

The Multiple Launch Rocket system (formerly General Support Rocket System (GSRS) was initiated in 1975 from the recognition of a need for a capability to deliver a large volume of fire in a very short time against critical, time-sensitive targets such as expected during surge conditions in Europe. Following the approval of a DARCOM/TRADOC Letter Agreement (LOA), a Special Study Group (SSG) was formed at the US Army Field Artillery School to define the MLRS characteristics and conduct a concept definition study to include a Cost and Operational Effectiveness Analysis (COEA). The SSG analyzed various rocket system candidates, in combination with a base artillery system to meet the European requirement. The approved Best Technical Approach (BTA) provided for MLRS to be an add-on to the existing field artillery systems.

B. ACQUISITION STRATEGY

The acquisition strategy adopted for MLRS varies significantly from the events described in the LCSMM. The initial strategy planned for MLRS, as described in the SSG report of November 1976 and presented at DSARC I in January 1977, provided for the normal LCSMM process that would progress through the required Milestones II, III, and IIIa. However, a special ASARC held in April 1977, in response to Secretary of Defense guidance to study ways to accelerate the program, examined program alternatives and selected one that essentially eliminated the Full Scale Engineering Development Phase and the Milestone II requirement.

This strategy, which was briefed to representatives of the House and Senate Armed Services and Appropriation Committees to insure agreement with congressional views and approved by OSD, provided for a competitive Demonstration and Validation Phase terminating with an ASARC/DSARC III (Milestone III), to be followed by a Maturation/Initial Production Phase. This latter phase allowed for design maturation concurrently with commencement of initial production and was expected to end in early 1983. Full scale production would commence following ASARC IIIa approval. Figure II-1 shows the approved MLRS acquisition strategy.

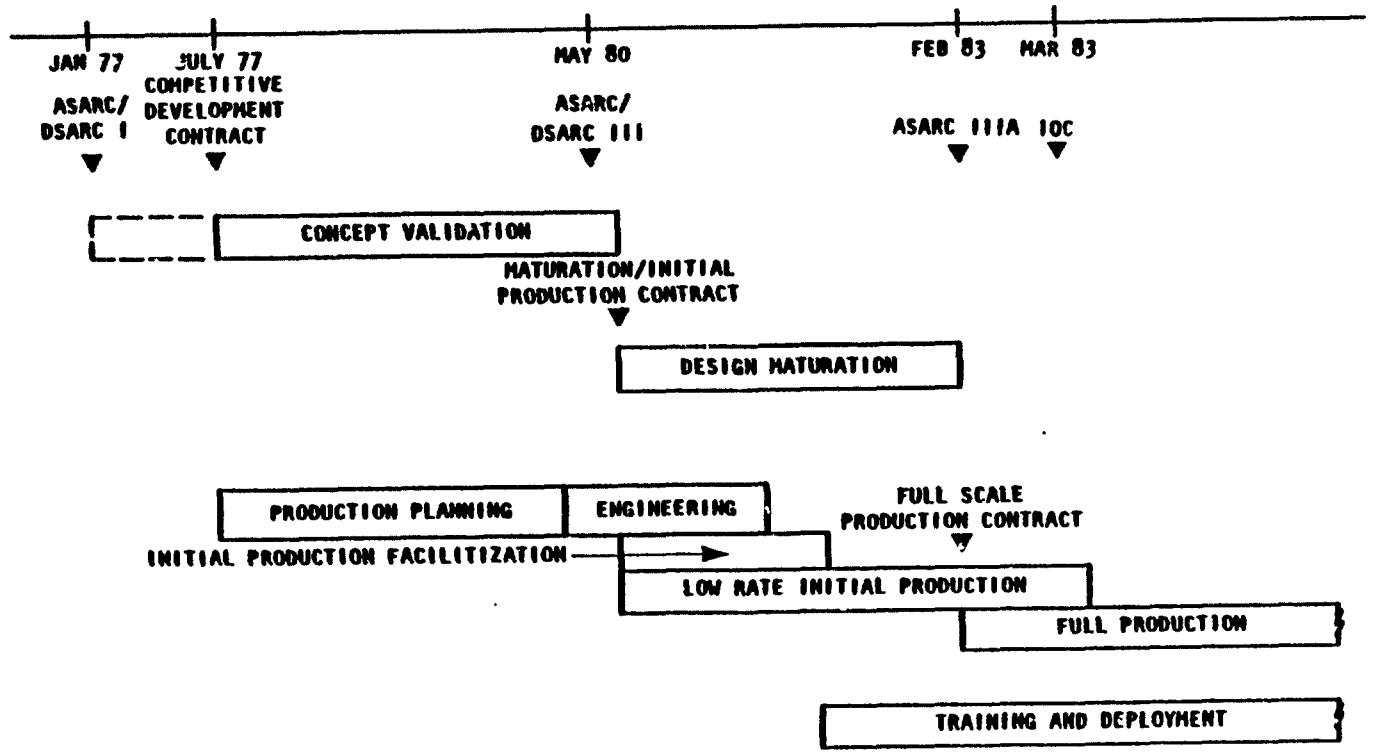
The MLRS acquisition strategy was also characterized by the use of competition during the Demonstration and Validation Phase which covered the period September 1977 to April 1980 (32 months). Two contractors developed and fabricated prototype systems that were evaluated by a DT/OT I in late 1979 and early 1980. A major consideration in the scoring was ammunition cost effectiveness. This criteria combined system accuracy, warhead effectiveness, unit costs, and operational capabilities.

How each of these two elements of the MLRS acquisition strategy, program acceleration and competition, impacted on the MPT requirements determination process is identified and analyzed in Sections III, Discussion and IV, Analysis.

A chronology of completed and planned acquisition milestones is presented in Figure II-2.

C. SYSTEM DESCRIPTION

The MLRS carrier is a derivative of the Infantry Fighting



APPROVED MLRS STRATEGY

FIGURE II-1

MLRS
SYSTEM ACQUISITION MILESTONES

• DARCOM/TRADOC LOA	SEP 75
• SPECIAL STUDY GROUP	DEC 75-NOV 76
• PROJECT MANAGER (ACTG) AT MICOM	JAN 76
• CONTRACT CONCEPT DEFINITION STUDIES	MAR-JUN 76
• PROJECT OFFICE (PROV) AT MICOM	JUL 76
• ASARC/DSARC I	DEC 76/JAN 77
• SPECIAL ASARC	APR 77
• VALIDATION PHASE RFP RELEASED	APR 77
• TSM ESTABLISHED AT FT SILL	JUN 77
• COMPETITIVE VALIDATION PHASE	SEP 77-APR 80
• MLRS ETABLISHED AS INTERNATIONAL PROGRAM	JUL 79
• MATURATION PHASE RFP RELEASED	AUG 79
• DT/OT I COMPLETED	FEB 80
• ROC	FEB 80
• ASARC/DSARC III	APR/MAY 80
• MATURATION/INITIAL PRODUCTION PHASE	JUN 80-FEB 83
• FDTE	JUN-SEP 82
• OT III	OCT 82-JAN 83
• ASARC IIIa	FEB 83
• IOC	MAR 83

FIGURE II-2

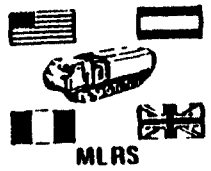
Vehicle currently being produced by the FMC Corporation. In the MLRS configuration the carrier is equipped with a Launcher Loader Module (LLM) containing two disposable Launch Pod/Containers (LP/C). Each LP/C holds six rockets and serves as a dual purpose launch and storage container. The rockets contain a warhead with a dispersing system for its six hundred plus sub-munitions that is activated by an automatically set fuse. The carrier also has an on-board fire control system, an azimuth and position determining system, and loading/unloading booms. The MLRS configured carrier vehicle is referred to as a Self-Propelled Launcher Loader (SPLL). It is operated by a three man crew which can conduct fire missions from the manrated SPLL cab. Figure II-3 shows the carrier and the MLRS components.

Rocket resupply will be provided by a new family of 10-ton trucks and trailers, the Heavy Expanded Mobility Tactical Truck (HEMTT) and the Heavy Expanded Mobility Ammunition Trailer (HEMAT). Eighteen sets of these vehicles will be organic to the MLRS Firing Battery. The HEMTT has its own crane to facilitate loading and unloading of the LP/Cs.

Other supporting equipment includes:

1. The Platoon Leader's Digital Message Device (PLDMD) which will provide a digital link between the platoon leader, the battery, and the three widely dispersed SPLLs in the platoon.

2. The Field Artillery Meteorological Acquisition System (FAMAS) is a new meterological set that will automate the entire data collection, computation, and distribution process. FAMAS is needed for adequate support of the MLRS spatial and time requirements for meteorological data.



MLRS-FORERUNNER OF THE FUTURE FIELD ARTILLERY

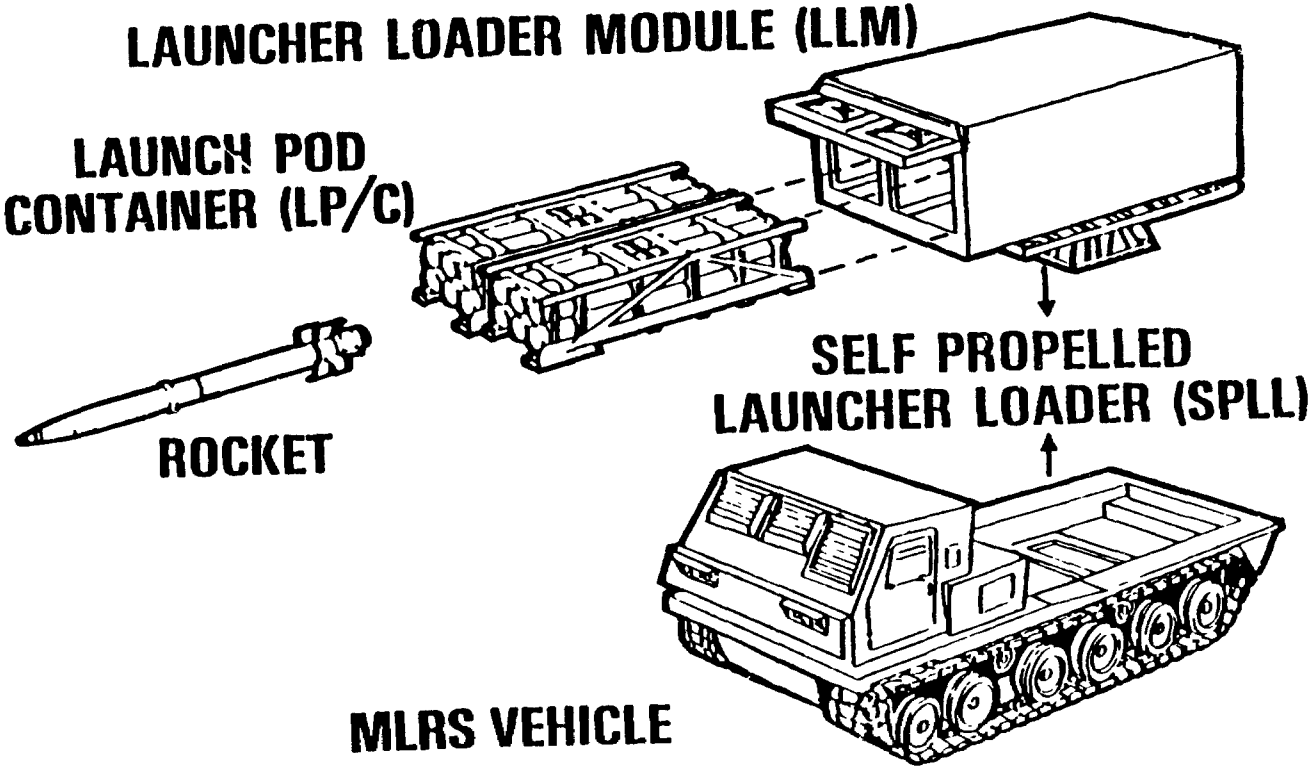


FIGURE II-3

3. The Electronic Quality Assurance Test Equipment (EQUATE), designed to be used for test and fault isolation at the general and depot suppport levels.

4. The Battery Computer System (BCS) which will provide tactical target data to MLRS fire units and pass on other data such as meterological messages. The MLRS fire direction system uses the BCS battery computer unit with specialized MLRS software.

5. TACFIRE is a digital data link system that may be provided to MLRS battalions. It will link with the BCS, FAMAS, other artillery units, and target acquisition systems.

6. FIREFINDER is a new target locating radar system consisting of two radars, the AN/TPQ-36 Mortar Locating Radar and the AN/TPQ-37 Artillery Locating Radar. These counterbattery and countermortar radars are expected to be fielded before the MLRS IOC and will be a significant target acquisition asset for MLRS.

7. Training devices have been developed for use at the US Army Field Artillery Center & School. They include a Fire Control Panel (FCP) Trainer, a training rocket, and an LP/C Trainer. The latter two training devices will also be issued to each MLRS unit.

D. ORGANZATIONAL AND OPERATIONAL CONCEPT

The Organizational and Operational (O&O) concept will be more fully discussed in ensuing sections of this report. However, because it is important that the reader have an early understanding of the current MLRS O&O concept, a brief description is included at this point.

1. Organization Concept. MLRS units will be organized into relatively self-sufficient firing batteries with three platoons

of three SPLLs each. One battery will be assigned to each heavy (Armor/Mechanized) and light (Infantry) division under the Division 86 concept. Batteries will be organic to the composite (8"/MLRS) battalion in the heavy divisions. In the light division, the MLRS battery will be a separate battery within the Division Artillery. MLRS batteries will not be organic to airborne or air assault divisions or separate brigades.

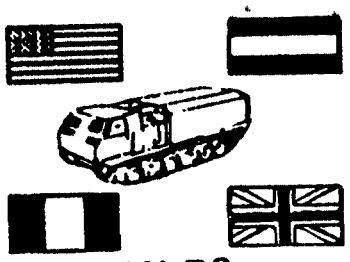
The Corps MLRS unit will be organized as a 27-launcher battalion consisting of three MLRS batteries and a Headquarters and Headquarters and Service Battery (HHS).

All MLRS firing batteries are identical in organization, regardless of their parent organization. Figures II-4 and II-5 show the MLRS Firing Battery, the MLRS Battalion, and the Composite Battalion Organizations.

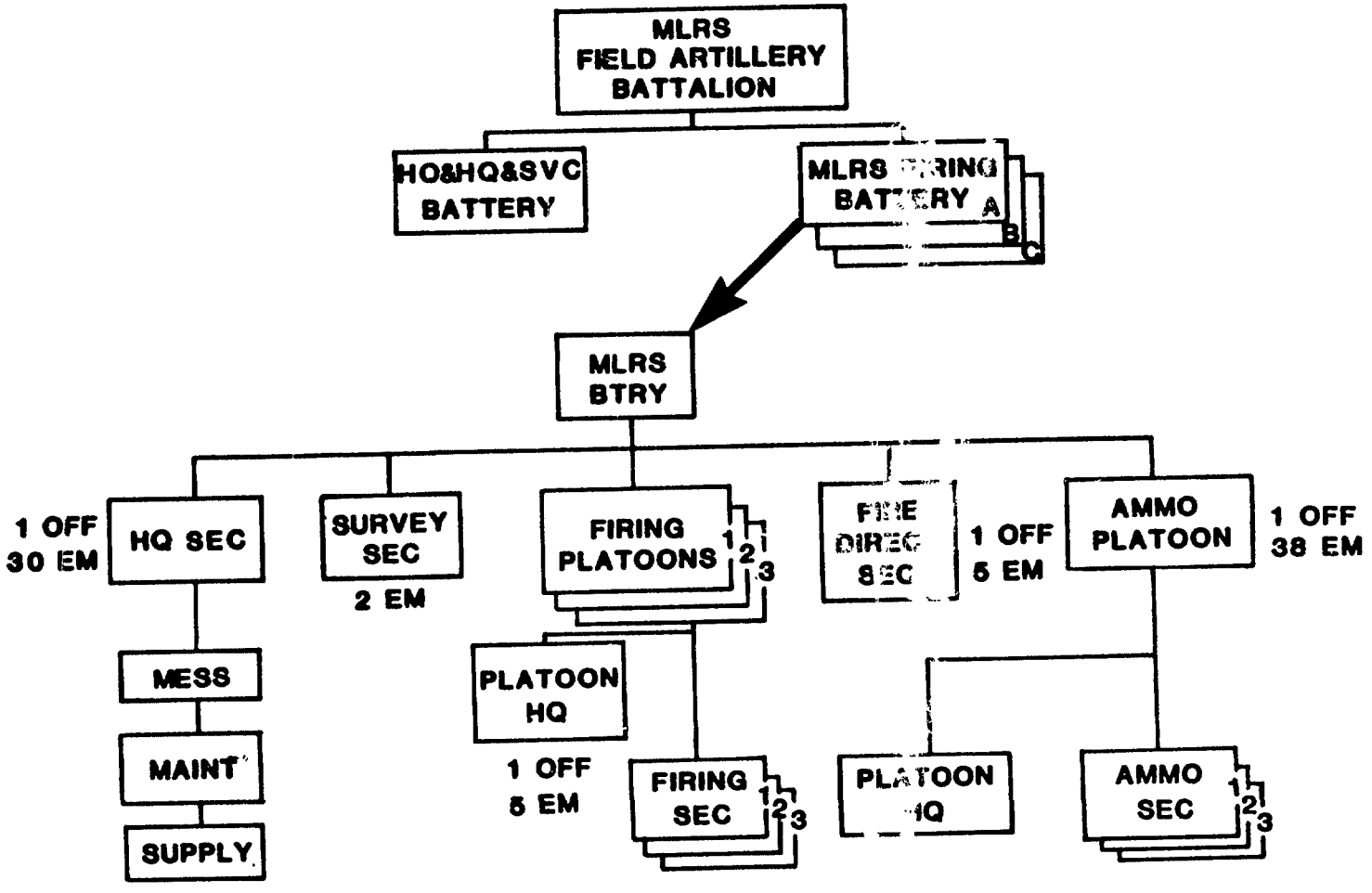
2. Operational Concept. MLRS operations are characterized by rapid emplacement, target engagement, and immediate displacement to a reload point and subsequently to a concealed position to await a fire mission (shoot-and-scoot tactics). Each SPLL has the on-board capability of receiving a fire mission, determining SPLL location, computing technical firing data, orienting on the target, and firing up to 12 free flight rockets per mission.

MLRS units will normally be employed in individual platoon areas, controlled and supported from a battery position. The three SPLLs in each platoon will be further dispersed within the platoon area.

Command, Control, and Communications (C^3) and ammunition resupply are particularly important considerations in the MLRS operational concept and have personnel and training implications



MLRS ORGANIZATION
(AS OF 31 MAY 1982)



PERSONNEL SUMMARY

MLRS BN	28 OFF
	414 EM
HH&S BTRY	10 OFF
	63 EM
MLRS BTRY	6 OFF
	117 EM

MAJOR EQUIPMENT

9-SPLL
18-10T RSV W/TRLR
4-M577
1-BCS(FDS)
3-DMD

FIGURE II-

Composite Battalion

(2 X 8 - DIV 86)

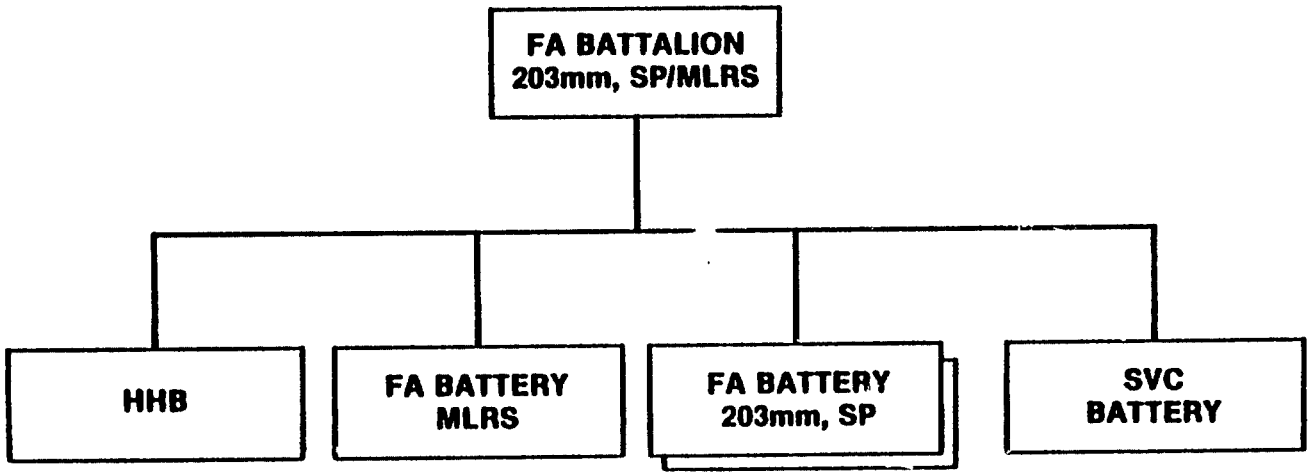


FIGURE II-5

that will be discussed later. Figure II-6 summarizes the MLRS description.

E. MAINTENANCE AND SUPPORT CONCEPTS

1. MLRS will be integrated into the existing maintenance and supply concepts and organizations. The maintenance concept for the MLRS is based upon maximum utilization of the established four levels of maintenance. The MLRS rocket will be a "wooden" round. No maintenance, other than normal routine surveillance, will be required in the field for the LP/C and rockets.

a. Operator maintenance functions will include the performance of checks, adjustments, preventative maintenance, and minor repair functions. The operator will be able to monitor system performance by the self-check and system monitoring capability of the Built-In-Test Equipment (BITE). Organizational maintenance and supply will be performed by field artillery battery or battalion personnel, and will include the removal and replacement of selected defective pluck-out-plug-in major modules/assemblies using BITE system servicing, and other minor repair beyond the capability of the operator. Organizational maintenance personnel will perform adjustments and alignments not performed by the operator. Defective assemblies will be evacuated to the direct support unit/contact teams for exchange.

b. Direct support functions will include both maintenance and supply. Direct support maintenance unit personnel will:

(1) Be capable of performing all of the maintenance functions authorized for the organizational maintenance

MLRS
SYSTEM DESCRIPTION

MAJOR COMPONENTS

- Self Propelled Launcher Loader(SPLL)
  - Carrier-FMC Corporation
  - Launcher Loader Module-Vought
  - Launch POD/Container-Vought
- Resupply Vehicle and Trailer

ORGANIZATION

- Add-on to Field Artillery Force
- 1 MLRS Firing Battery with 9 SPLLs&18 RSVs in Division GS Battalion/Separate Battery in Light Division
- 3 MLRS Firing Batteries in the MLRS BN
- 1 MLRS BN in Each Corps

OPERATION

- Autonomous MLRS Battery
- Shoot and Scoot Tactics

FIGURE II-6

level and repair and replacement of parts/units as authorized in the maintenane allocation charts.

(2) Be able to fault-isolate system assemblies and cables not identified by BITE.

(3) Handle removal and replacement actions through mobile forward area contact teams. No MLRS peculiar test sets have been developed for the contact teams.

(4) Evacuate unserviceable assemblies to the general support unit for repair.

(5) Maintain a direct exchange facility for MLRS assemblies.

c. General support maintenance unit personnel will:

(1) Provide backup for direct support maintenance units.

(2) Have the capability to repair assemblies evacuated from the direct support maintenance unit.

(3) Using automatic test equipment, repair electronic assemblies by removal and replacement of printed circuit boards.

d. Depot maintenance unit personnel will:

(1) Overhaul repairable systems, end items, assemblies, and subassemblies, including those items beyond the capability of the general support unit.

(2) Repair printed circuit boards evacuated from general support.

e. The Army's decision to develop EQUATE will require interim contractor support for the MLRS electronics until EQUATE is fielded.

2. Transportation, storage, and handling of the loaded launch pod/container shall be in consonance with existing conventional ammunition procedures. Additional support units are required in the theater of operations to support the MLRS ammunition requirements. At the organizational level, resupply vehicles and trailers, each capable of carrying four LP/Cs are required for adequate support.

3. The manpower, personnel, and training implications associated with the maintenance and support concepts are identified and analyzed in Sections III, Discussion and Section IV, Analysis.

III DISCUSSION

A. INTRODUCTION

This section is based on an examination of policy and procedure documentation, subject matter expert interviews and specific system MPT data. The discussion and analysis sections have been organized chronologically to show progressive steps and changes in information as the MLRS Program proceeded through the various phases of the acquisition process. Use is made of figures, tables, and summaries to provide the reader with a better understanding of the inter-relationships of events and the data flowing from them.

When analyzing the events that occurred in the acquisition of a particular system and comparing these events to the requirements of the LCSMM, the following quote from DA PAM 11-25 should be kept in mind.

> "The LCSMM depicts the process by which Army materiel systems are initiated, validated, developed, deployed, and supported. However, it is not a strict requirement to be followed in all cases by materiel/combat developers. It is possible for many of the LCSMM events and, in some cases, entire phases to be bypassed by the responsible command or agency. Only events deemed pertinent and necessary for the development of the particular system are accomplished."

The MLRS project is a good example of one that did not rigidly adhere to the LCSMM event schedule.

B. CONCEPTUAL PHASE

1. Introduction. In this phase the technical, military, and economic bases for proposed systems are established and concept formulation initiated through pertinent studies.

Critical issues and logistical support problems and actions are identified for investigation and resolution in subsequent phases to minimize future development risks. The conceptual phase is a highly interactive process with activities performed simultaneously and/or sequentially. No specific period of time in months or years is prescribed for the phase because its length is determined by the characteristics and status of the operational and technical factors making up the proposed programs, the urgency of meeting the predicted operational threat, and environmental and resource constraints.[7]

Figure III-1 illustrates the MPT related LCSMM events appropriate to the MLRS Conceptual Phase. For major systems such as MLRS that require DSARC approval, the phase ends with Event 14, DSARC I/DCP I approval and SECDEF authority to proceed to the Advanced Development (Validation) Phase. Since publication of DA Pamphlet No. 11-25 in May 1975, the upfront requirements have become more formalized. A MILESTONE 0 was added and an approved Mission Element Need Statement (MENS) was established as the authority to proceed into the Conceptual Phase for new system acquisitions. Recent changes in the process substituted a Justification for Major System New Starts (JMSNS) for the MENS, and required it to be submitted not later than the Program Objective Memorandum (POM) submission in which funding for the system is to be included. Neither of these changes applied to the MLRS project.

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[7] DA Pamphlet No. 11-25, Life Cycle Systems Management Model for Army Systems, HQDA May 1975.

CONCEPT PHASE

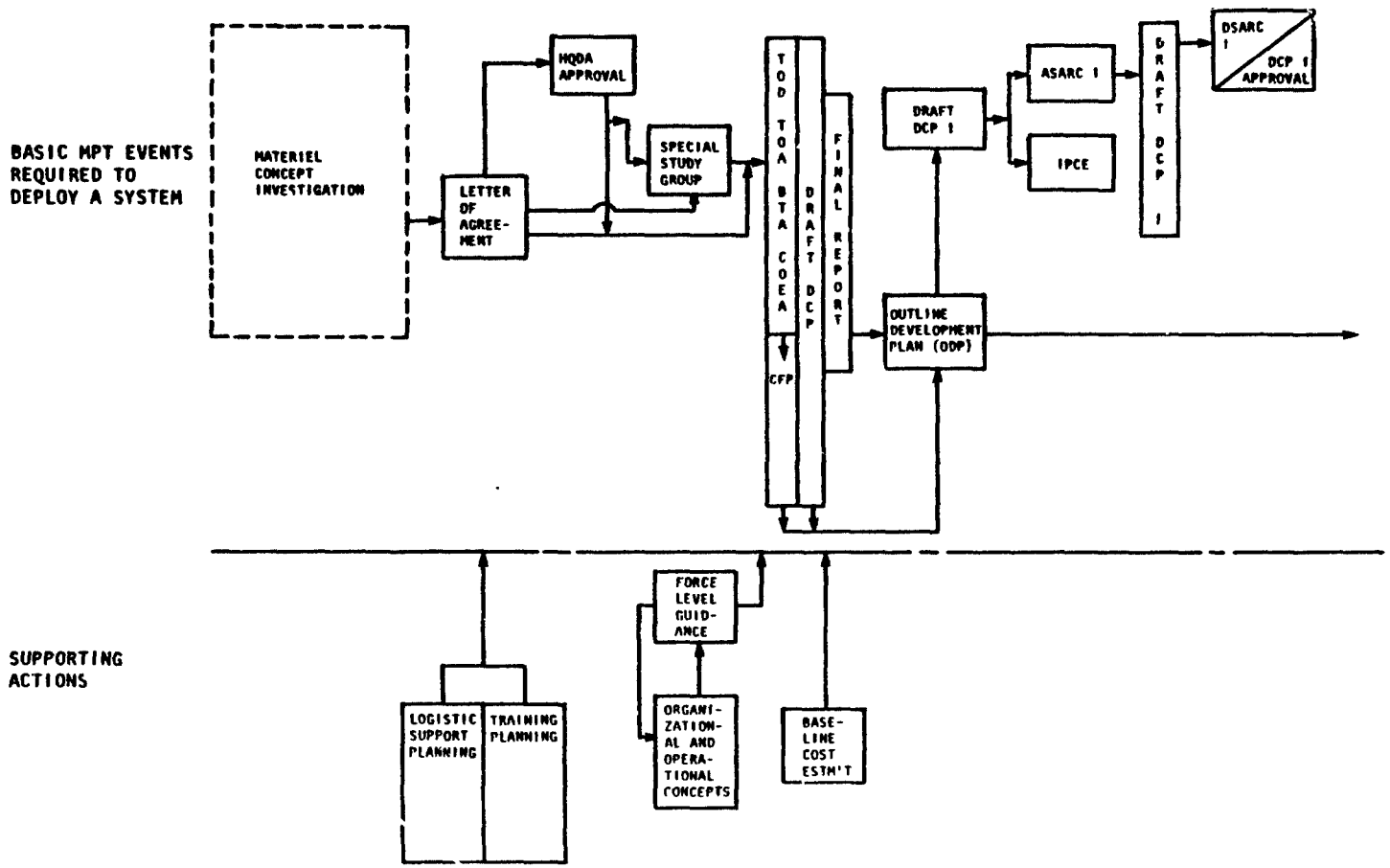

FIGURE III-1

The Conceptual Phase MPT related LCSMM events examined for this study were:

- o Letter of Agreement (LOA)
- o Special Study Group (SSG)
- o Force Level Guidance
- o Organizational and Operational (O&O) Concepts
- o Baseline Cost Estimates (BCE)
- o Decision Coordinating Paper (DCP)
- o ASARC/DSARC I
- o Request for Proposals (RFP) - Validation Phase

2. Discussion. The materiel concept investigations that led to the MLRS requirement were begun in 1971. Although the system was initially referred to as the General Support Rocket System (GSRS), its name was changed to the Multiple Launch Rocket System (MLRS) in 1979. Throughout this study, it will be referred to as MLRS. The need for a rapid fire, area saturation weapon system was identified in a study of the 1980-1990 battlefield. In February 1974, TRADOC established a Joint Working Group (JWG) to assess the use of a multiple launch rocket system for counterfire and suppression of enemy air defense. The JWG conducted preliminary technical and cost assessments of such a system. To expedite the decision on whether to develop a rocket system, the Army conducted a design and evaluation study of future artillery capabilities. This study, Task Force Battleking, was completed in December 1974. It concluded that artillery improvements were needed. One of the weapons which promised to make a major improvement of the artillery system was

the MLRS. The Battleking study formed the basis for the Letter of Agreement (LOA) between TRADOC and DARCOM.

a. Letter of Agreement. The Letter of Agreement for MLRS was prepared jointly by DARCOM and TRADOC and signed in April 1975. It was approved by HQDA in September 1975. The LOA reflected concerns regarding MLRS manpower and training requirements and the logistic impact of ammunition transportation, handling, and resupply. Among the characteristics identified by the LOA for investigation were:

- o RAM - emphasize simplicity and reliability.
- o Human Factors - minimize crew size and training requirements.
- o Logistics - emphasize bulk handling of pre-assembled rounds, possibly from a launch from container configuration.
- o Operational Effectiveness - design simplicity.
- o Operational and Organzational Concepts - to be developed.
- o DT/OT I - identification of critical issues to be a joint DARCOM/TRADOC effort.

b. The Special Study Group (SSG) was established in December 1975 by TRADOC as directed by HQDA. The MLRS SSG report was approved by TRADOC in November 1976. It included the:

- o Tradeoff Determination (TOD)
- o Tradeoff Analysis (TOA)
- o Determination of the Best Technical Approach (BTA)
- o Cost and Operational Effectiveness Analysis (COEA)
- o Outline Development Plan (ODP)
- o Draft Decision Coordinating Paper (DCP)

The SSG concluded that the manpower requirement for an 8" SP Howitzer Battalion and an MLRS Battalion were essentially the

same but that the MLRS unit could attack 2-3 times as many targets in the same time span. MLRS was also judged to be the more survivable unit. Operating and support costs were estimated to be similar based on a planned strength of 26 MLRS firing batteries.

Following its analyses, the SSG selected a BTA that was consistent with the LOA. The BTA features provided for minimizing manpower, training, and operator skill requirements. Further, it provided for survivability, mobility, responsiveness, and a large on-launch firepower capability. The provisions for a man-rated cab, from which the crew could fire, implied a maximum crew size of three.

Figure III-2 summarizes the MPT issues presented in the SSG report.

During the time that the SSG was preparing its report, the US Army Missile Command (MICOM) sponsored a four-month effort by five contractors to assist in determination of a BTA. The resulting reports were a major input to the SSG.

c. Force Level Guidance. There is no evidence that formal force level guidance, as described in the LCSMM, was provided to DARCOM or TRADOC.

d. ASARC/DSARC I. The ASARC I met in December 1976 and the DSARC I in January 1977. Both councils approved project go-ahead. The SECDEF also directed that the Army study ways to accelerate the project. A special ASARC in April 1977 recommended an accelerated MLRS program that was subsequently approved by representatives of the DSARC principals.

e. An acting Project Manager was selected in January 1976 and the MLRS Project Office (Provisional) established in July 1976.

MLRS
MPT ISSUES IN SSG REPORT

- MAN-RATED CAB
- HIGH RATE OF FIRE/LAUNCHER
- FUNCTION W/O STABILIZING JACKS
- FUNCTION W/O LOW LEVEL WIND MEASUREMENTS
- MAKE EFFECTIVE USE OF SHOOT AND SCOOT TACTICS
- AUTOMATIC FIRE CONTROL AND REMOTE FUZE SETTING
- EXPENDABLE LAUNCH POD/CONTAINER
- ON BOARD RELOADER
- WOODEN ROUND CONCEPT
- BUILT IN TEST EQUIPMENT
- TOTAL TRAINING PACKAGE AT OT I
- EARLY IDENTIFICATION OF TASK AND SKILL REQUIREMENTS

FIGURE III-2

C. DEMONSTRATION AND VALIDATION PHASE

1. Introduction. Following DSARC I, and in accordance with SECDEF guidance to determine how the MLRS project could be accelerated, the Army held a special ASARC in April 1977 to define an accelerated program leading to Initial Operating Capability (IOC) in 60 months. The resulting SECDEF approved acquisition strategy provided for a 29-month competitive Demonstration and Validation Phase which would conclude with an ASARC/DSARC III and authority to proceed into a 31-month Maturation and Initial Production Phase. The Maturation and Initial Production Phase would conclude with an ASARC/DSARC IIIa and IOC in the last quarter CY82 timeframe. Thus, the MLRS project would combine the Demonstration and Validation Phase and nearly all of the Full Scale Development Phase into a 29-month period, omitting the ASARC/DSARC II (Milestone II) in the process.

2. Discussion. The combined Validation and Full Scale Development Phase, to be completed in 29 months,[8/] involved the completion of many actions. As described by the LCSMM, the requirements for the two phases included:

> Validation - This phase consists of those steps required to verify preliminary design and engineering, accomplish necessary planning, analyze trade-off proposals, resolve or minimize logistics problems identified during the conceptual phase, prepare a formal requirements document and validate a concept for full-scale development. Advanced development prototypes should be used and tested (DT/OT I) to provide data to estimate the prospective system's military utility, cost, environmental im-

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8/ Actually took 32 months because of design changes when MLRS became a multinational program

pact, safety, human engineering, operational effectiveness, and suitability.[9] (This phase consists of LCSMM events 15 thru 42.)

Full-Scale Development - During this phase, the system, including all items necessary for its support, is fully developed and engineered, fabricated, tested (DT/OT II), and a decision made whether it is suitable to enter the inventory. Concurrently, nonmateriel aspects required to deploy an integrated system are developed, refined, and finalized. An essential activity of the Full-Scale Development Phase is that of adequate test and evaluation conducted by the Army and contractors. Support problems that need to be solved may be uncovered in the Full-Scale Development Phase, even though risks have been adequately addressed during the Conceptual and Validation Phases. These problems will be addressed considering trade-offs between stated operational requirements, cost, and operational readiness data.[10] (This phase consists of LCSMM events 43 thru 71.)

Figure III-3 shows the LCSMM events 15-71. Those not appropriate to the accelerated MLRS project have been omitted.

The Demonstration/Validation Phase MPT related events/documents examined for this study include:

- o Contractual Documents
- o Required Operational Capability
- o Organizational and Operational Concept
- o Logistic Support Analysis
- o QQPRI/BOIP/MOS Decisions
- o TOE
- o Training
- o Human Factors Engineering/Safety
- o Government Test, Evaluation, and Analysis

a. Contractual Documents. The RFP was issued in April 1977. The request specified a 29-month effort for the design,

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[9] LCSMM, page 2.

[10] LCSMM, page 2.

DEMONSTRATION/VALIDATION PHASE

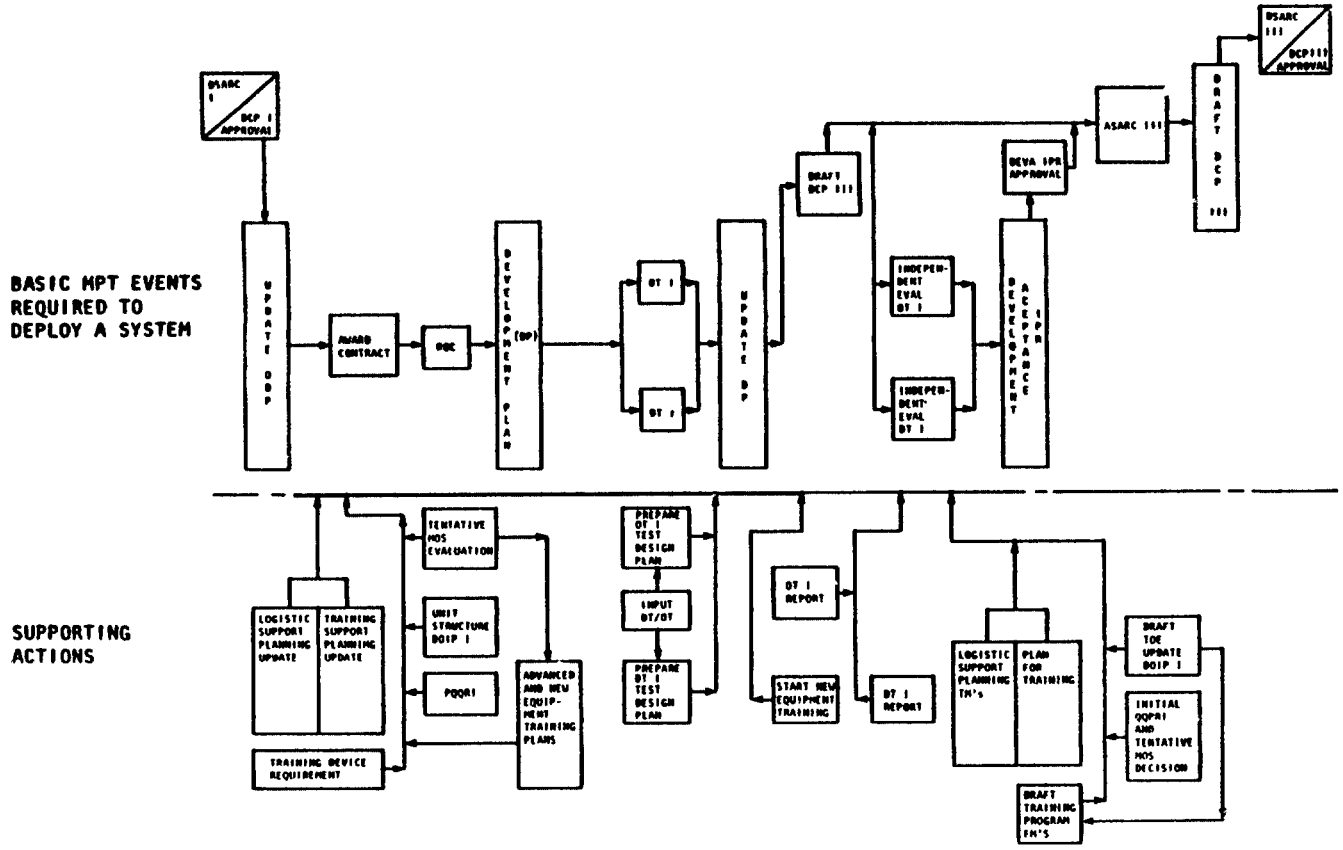


FIGURE III-3

fabrication, documentation, and test and evaluation of the MLRS concept; that is, "a simple to operate, economically maintained rugged and reliable rocket system." MPT and HF issues in the RFP are summarized in Figure III-4.

The evaluation criteria used for source selection are shown in Figure III-5. The areas of cost and system performance and engineering design were given the greatest weights. HF considerations were included in the engineering design factor, but ranked ninth of nine consideration. Operational factors were less important than the first two factors. Included in the operational factor were Logistic/RAM, Training, and Operational and Organizational Concepts.

The Source Selection Board considered that both the Boeing Company and the Vought Corporation proposals were responsive to the RFP. Because Vought went on to win the competition, its proposal was the only one examined for this study. Figure IV-6 lists several of the MPT issues presented in the Vought proposal. These issues reflect Vought's well developed concept for the rocket system based on their earlier studies.

b. Requirements Documents. The MLRS ROC was approved by HQDA on 8 February 1980, shortly before the ASARC III. Earlier Validation/Demonstration Phase events that required ROC guidance had to be satisfied with draft versions. These events included planning for DT/OT I, maintenance support, training, and manpower assessments and preparation of the BOIP and QQPRI.

MPT issues that were included in the HQDA approved ROC are:

MLRS
MPT AND HFE ISSUES IN VALIDATION PHASE RFP

- SYSTEM CHARACTERISTICS
  - Simple to Operate
  - Economically Maintained
  - Rugged and Reliable
  - Survivable – Reaction Times That Allowed for Shoot and Scoot Tactics
- REQUIRED PLANS FOR
  - LSA
  - HFE and HF Test Program
  - System Safety
  - Reliability
  - Maintainability
  - NET

FIGURE III-4

MLRS VALIDATION PHASE EVALUATION CRITERIA

- Cost } of high weight and equal
- Technical }
- Operational-less important than cost or tech
- Management-not weighted, go-no-go

HFE Included as 9th Issue of Nine Under Engineering Design Factors of Technical Area

LOGISTIC/RAM/TRAINING/ O&O Concept Included in Operational Area

FIGURE III-5

MLRS VALIDATION PHASE CONTRACTOR'S PROPOSAL

- ADVOCATED SYSTEM PECULIAR MOS STRUCTURE
- ADVOCATED MOS REQUIRING LEAST TRAINING
- PROPOSED FULL TIME HFE AND SAFETY EFFORT
- STRONG MANAGEMENT CONTROLS TO INSURE R AND M INTERFACE WITH LSA
- PROPOSED ORGANIZATIONAL AND OPERATIONAL CONCEPT
- LSA PLANNED TO MINIMIZE MANPOWER
- TRAINING INTEGRATED WITH ILS EFFORT

FIGURE III-6

- Organizational Concept
  MLRS Firing Battery with three platoons of three SPLLS each
  MLRS Battalion with three MLRS Firing Batteries and a Headquarters and Headquarters and Service Battery (HHS)
  Composite Rocket/Howitzer Battalion with one MLRS Firing Battery and three 8" Howitzer Firing Batteries

- Maintenance Concept - Standard four level concept but with Forward Area Direct Support (DS) Contact Teams and EQUATE at General Support (GS). Depot level maintenance concept was not developed.

- Training (TRADOC Responsibilities included):
  - provide DARCOM with information on the target user population
  - identify unusual training requirements
  - prepare Skill Performance Aids (SPA) package to include Technical Manuals (TM) and training materials

- Training Device Requirements
  - Launch POD/Container
  - Fire Control Panel
  - Launcher Loader Module (tentative)
  - Field Trainer Console/Data Link (tentative)
  - Limited Performance Training Rocket (tentative)
  - One-quarter cutaway of a full scale rocket (tentative)
  - Need for additional training requirements to be investigated

- Individual and Collective Training Plan to be prepared by the Field Artillery School to include: MOS, Skill Levels, Tasks, and materiel developer training for service school staffs and faculties.

- TMs and training materiel developed by DARCOM to be made available to the Field Artillery School in time to allow preparation of a training support package for tests prior to ASARC III.

- Draft SPAs and TRADOC training materiels developed to support OT/II

- OT player personnel be representative of the user population and be trained with DARCOM/TRADOC training materials -- this was a critical issue for testing.

- Manpower/Force Structure Assessment was based on Total Army Analysis (TAA) - 86 and was to be reviewed by the ongoing DIVISION 86 study. Based on the TAA, the MLRS impact is:

MLRS Organizations[11/]	2,804
Support Personnel	2,466
Additions to Composite BNs	84
Total	5,354

- o TAA-86 accommodated the MLRS addition by trading off two 155mm Howitzer Battalions. Also, additional ammunition and transport units would be required because of the introduction of MLRS, but the requirement was not quantified. The U.S. Army Logistic Center study, MLRS Logistic Force Assessment, Dec. 1979, addressed the issue.

c. Organizational and Operational Concepts. The earliest O&O concepts appeared in the LOA and the SSG Report. These concepts emphasized shoot and scoot tactics, survivability, and mobility and an initial organizational concept but, for all practical purposes, left the details to be developed at a later date. An O&O concept was also prepared by the Field Artillery School in August 1979 in support of and tailored to the specific conditions of OT I.

The early O&O concept contributed to force structure decisions, determination of personnel requirements and training requirements, TOE development, system design, and the maintenance and support concept.

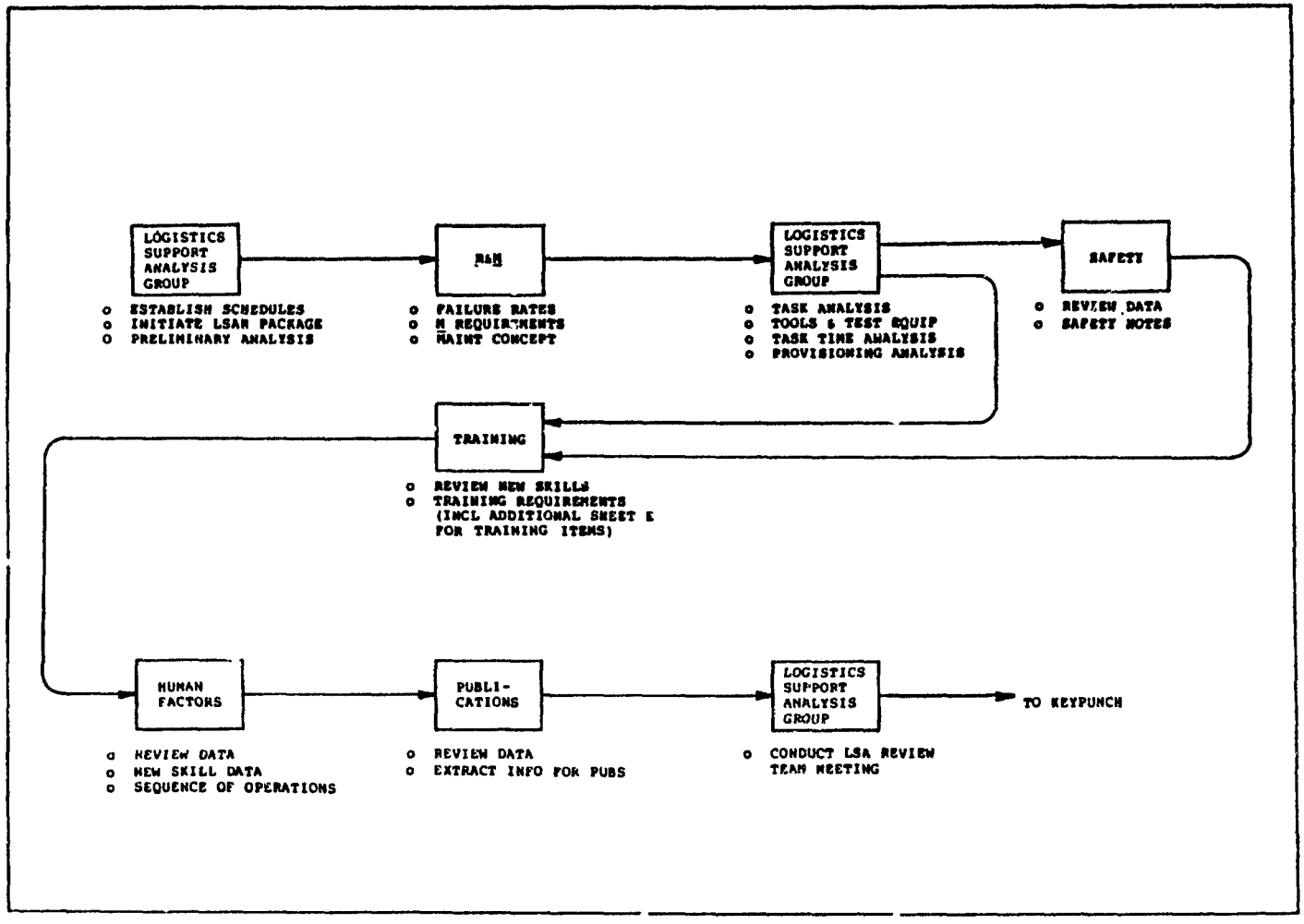
d. Logistic Support Analysis (LSA). The Vought LSA program covered contractor-furnished equipment (CFE) which imposed logistic and operational requirements and for which the government did not have an established maintenance capability. Maintenance capability includes training equipment, technical publications, support equipment, trained personnel, supply support and facilities.

11/ Organizations - three MLRS BN (426 personnel each), fourteen MLRS Firing Batteries (109 personnel each).

The LSA candidates, identified in the Vought Final Logistics Support Plan, 9 January 1978, included, in addition to CFE, several items of Government Furnished Equipment (GFE). Submission of LSA data to the government commenced in March 1978 and continued until the end of the Validation Phase at which time the LSA effort on approximately 105 items was complete. However, these 105 candidates represented only a third of the number eventually identified during the following acquisition stage. Early LSA were based on standards, estimates, and engineering judgments, with actual data being substituted as it became available. The Vought LSA level of effort, including the lead man, totaled 7. One man was dedicated to the Army provided Logistics Operating Cost Analysis Model 5 (LOCAM-5). LOCAM-5 was used to identify logistic cost in design trade-offs studies, to identify the logistic cost risk in selecting maintenance repair levels, and to support repair versus discard decisions.

Figure III-7 shows the LSAR Data Flow as described in the Vought Corp. LSA Plan. The data flow illustrates Vought's conviction that it is necessary to look at training, reliability, maintainability, human factors, safety, etc. as parts of the ILS effort and to establish controls and corporate relationships that ensure they interface with the LSA effort. In order to calculate the Direct Productive Annual Maintenance Manhour (DPAMMH) requirements a mission scenario had to be selected and utilization rates for each LSA candidate determined. Not having been provided the LSA Worksheet A, Vought used previous experience, comparable data provided on the Lance System, and a TRADOC mission scenario to determine equipment operating hours. The

LSAR DATA FLOW
VOUGHT CORPORATION



scenario, which was made up using a combination of 88% Peacetime and 12% Wartime for a total of 1988 operating hours per year. Utilization factors are the relationship of specific equipment utilization hours to the mission operating hours. Utilization hours are determined by equipment functional time in the load/fire cycle and the operational travel time. The utilization factor is developed from a sample combat day and operating times for the specific item of equipment during the various events of that day. For example, the electrical system has a factor of 1.0, whereas the hoist used in loading and unloading the LP/Cs has a factor of 0.13. Vought's factors were approved by the Army for use in the maintainability and LSA efforts.

During the Validation Phase several events caused redirection/correction of the LSA effort. These events and actions included:

- o design changes
- o equipment changes
- o MOS changes
- o maintenance concept changes

It is significant to remember that the Validation Phase was competitive and that Boeing was also conducting an LSA effort for its proposed system. Thus, two sets of data were being provided to the Army, one for each contractor's system.

e. QQPRI/BOIP/MOS Decisions.

(1) General. The QQPRI and BOIP are iterative documents that provide manpower and training planners the earliest and most current information concerning the numbers and qualifications of personnel required to operate, support, and maintain a materiel

system under development. For the majority of acquisition programs, input to both documents comes from a variety of organizational sources within the materiel development (DARCOM) and combat development (TRADOC) communities. A substantial amount of basic data in both documents is derived from Logistic Support Analysis (LSA). The materiel developer, e.g., MICOM in the case of MLRS, initiates both the BOIP and QQPRI processes by preparing BOIP Feeder Data (BOIPFD). A BOIPFD is prepared for each principal and associated item of equipment, to include Test, Measurement, and Diagnostic Equipment (TMDE) required to support the new system. The materiel developer concurrently prepares a proposed QQPRI which lists skills, tasks, and knowledge required to operate and support the new item (and its support, components, and test equipment) and estimates of time required to maintain it. Both the BOIPFD and proposed QQPRI are forwarded by the materiel developer through DARCOM channels to TRADOC. The materiel developer's proposed QQPRI is refined by TRADOC by adding the training, support and doctrinal implications of the new system. Using data from both the QQPRI and BOIPFD along with the O&O concept, a TRADOC proponent school, e.g., US Army Field Artillery School in the case of MLRS, develops the BOIP. The BOIP is a planning document which predicts quantitative requirements for a system.

Following TRADOC's refinement of the QQPRI and development of the BOIP, both documents are staffed at the Soldier Support Center-National Capital Region (SSC-NCR) and HQDA to determine if the system falls within manpower constraints, reflects the appropriate Military Occupational Specialty/Additional Skill

Identifier (MOS/ASI), meets Standard of Grade Authorization (SGA), has a feasible grade structure, and can be supported by Army recruiting and training capabilities. As the system proceeds through the development process, QQPRI and BOIP must be updated to reflect the latest outputs from the LSA, and other processes which feed the DOIP and QQPRI.

(2) Validation Phase QQPRIs

MICOM submitted a Provisional QQPRI (PQQPRI) in May 1978. Because this was only shortly after the start of the contractor's LSA effort, the data was based on the results of studies, MACRIT (AR 570-2), and engineering estimates. Direct Productive Annual Maintenance Manhours were presented for Organizational, DS, and GS levels of maintenance for the SPLL and a 5-ton Resupply Vehicle. The number of direct operators and their MOS and titles was also presented with narratives of individual duties of tasks and suggested MOS from which personnel can be obtained.

A second QQPRI was submitted on 1 May 1979, as a Final QQPRI (FQQPRI). Actually, two were submitted, one based on the Boeing data (System A) and one based on Vought data (System B). Both included the SPLL and the Resupply Vehicle (RSV). The RSV requirement had been established as a 10-ton truck with a 10-ton trailer. Vought DPAMMH values for the SPLL were based on the LSA data available at the time which ranged from 90% completion at the Organizational level to 65% at the GS level. These QQPRI presented the same type of information as the earlier version but also included information on training for test and evaluation and training literature availability.

A third QQPRI, an Amended FQQPRI (AFQQPRI) was submitted on 11 March 1980. This QQPRI contained incomplete data

for the SPLL, LP/C, Battery Computer Unit, RSV and Trailer, and eight other associated items of equipment and was a combination of Systems A and B.

(3) MOS Determination for MLRS Personnel Operator

(a) Operators

Initially the Field Artillery School favored the use of MOS 13B (Cannon Crewman) for the MLRS Crewman. This preference was based on NCO availability, rotation base, recruiting prospects, and other factors. Vought Corp. favored the use of the 15D MOS (Lance Crewman). The FA School later reconsidered and decided that MOS 13B was already responsible for too many systems. The March 1980 AFQQPRI recommended a new MOS 15X for the crewmen and 15D for the MLRS Section Chief.12/ MOS 15X would merge with MOS 15D at the E6 level.

Changing from MOS 13B to the 15X/15D MOSs for the MLRS Section Chief and crew made it necessary to also change the MLRS Fire Direction Specialist MOS from 13E to 15J. This change was reflected in the March 1980 AFQQPRI.

Initially, there was consideration for using MOS 64C (Motor Transport Operator) for the MLRS battery resupply vehicles. However, this was changed because of a Field Artillery School/ MILPERCEN decision early in 1980 based on the school's desire to have RSV operators MLRS qualified. Accordingly, the AFQQPRI identified MOS 15X for the RSV drivers and assistant drivers, as well as the MLRS crewmen.

The first QQPRI had the MLRS crewman performing organizational maintenance. The training implications of qualifying all

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12/ Before the March 1980 submission was approved by HQDA some 8 months later, the MOS 13M MLRS Crewmen decision was made.

crewman as organizational maintainers forced the decision to train selected personnel only and identify them with an additional skill identifier (ASI). This decision was reflected in the 1979 QQPRIs and was made even more appropriate when the RSV operator's MOS was changed to the MLRS crewman MOS which significantly increased the number of personnel to be trained as crewmen.

(b) Organizational Maintenance

The first two QQPRI provided for a Communication-Electronic Equipment Mechanic (31B later 31V), a wheeled vehicle mechanic (63B), a track vehicle mechanic (63C), and an automotive repairer (63H). Initially, the MLRS Mechanic was to be a crewman (MOS 13B); however, as described above, the next iteration recommended MOS 13B W/ASI. This latter decision was changed in March 1980 to MOS 15XP1. In decisions related to associated equipment, MOS 63T had been established as the track vehicle organizational mechanic, and MOS 63S as the RSV mechanic. The latter two MOS were added to AR 611-201 in September 1980. Unchanged were MOS 31V, 63B, and 44B.

(c) DS/GS Maintenance MOS

As more items of equipment were identified by BOIPFD and included in the MLRS QQPRI, the list of DS/GS MOS requirements expanded. The first two QQPRIs presented requirements for seven DS/GS maintenance personnel. However, by March 1980 when the AFQQPRI was submitted, the number of items of equipment had expanded to twelve (from two in earlier QQPRI) and DS/GS MOS requirements had increased to nine. All of these MOSs were currently listed in AR 611-201. MLRS peculiar skills would be developed by the addition of MLRS information into the curric-

ulum of existing MOS producing resident training courses at the respective proponent schools.

The U.S. Army Ordnance Center and School, Aberdeen Proving Ground, MD, was critical of the AFQQPRI, noting in its 19 May 1980 letter to HQTRADOC that: (1) it was incomplete and did not contain sufficient information on which to base support maintenance requirements; (2) no DPAMMH for some maintenance significant equipment was presented; and (3) inadequate or incorrect data for those few items of equipment which do have DPAMMH. The school recommended that until such time when adequate information is available to properly analyze and develop the maintenance support requirement, the AFQQPRI be changed to an Amended Provisional QQPRI (APQQPRI). Similar comments regarding the incompleteness of the AFQQPRI were received from elements of the DA staff. The AFQQPRI was approved without change by HQDA in November 1980, eight months after its submission by MICOM.

(4) Use of DPAMMH Data

DPAMMH predictions were made for each item of equipment by MOS and skill level. For example, organizational maintenance for the SPLL was predicted in each QQPRI as shown in Table III-1 which illustrates the erratic nature of the data. Using the DPAMMH data, the basis of issue from the BOIP, and the delivery schedule (which first appeared in the May 1979 QQPRI, covered only FY 82 deliveries and did not appear again in the March 1980 QQPRI), planners are expected to determine maintenance personnel requirements and prepare TOEs, training requirements, recruiting schedules, and other MPT requirements. For instance, using the MACRIT (AR 570-2) formula, DPAMMH per end item are converted to unit maintenance manpower requirements. The formula requires the QQPRI predicted DPAMMH, the density of equipment in the unit,

indirect productive time factors from the AR, and the available annual productive maintenance manhours-also from the AR.

TABLE III-1

ORGANIZATIONAL DPAMMH

SPLL	MOS	MAY 78	MAY 79	MAR 80
	13B10*	--	4.7857	5.4139
	13B20	40	2.7773	1.0800
	13B10XX	--	--	18.6493
	13B20XX	--	9.5378	2.2953
	13B30	--	--	TBD
	31B20	0.55	(31V)0.55	--
	44B10	0.24	--	0.0065
	63C10	132.19	--	(63T)132.9829
	63H10	24.65	--	--
	63S10/20	--	--	TBD
RSV				
	63B10	177.7**	117.7	TBD

* Changed from 13B to 15X in March 1980 QQPRI.

** Taken from IFV, XM2 FQQPRI.

Using the March 1980 QQPRI DPAMMH, organization maintenance manpower requirements for a nine SPLL MLRS firing battery were calculated to be 0.13 personnel. Fractional results were also obtained for other organizational and DS/GS MOS.

f. TOE/TDA. No MLRS TOEs or TDAs were developed during this phase. However, as manpower requirements and organizational requirements were identified by BOIP/QQPRI/and other documents they were accumulated on Unit Reference Sheets (URS). The URS are required where new organizations are involved. They are used to support operational concepts and doctrine studies and provide information that will be used in the development of TOE. Increasing need for the data on URS has led to the establishment of Automated Unit Reference Sheets (AURS). Proponents of TOE prepare the AURS, e.g., Field Artillery School in the case of MLRS units and update them as new information becomes available. Prior to Milestone III the TRADOC proponent produces a Draft Plan TOE from the AURS. After HQTRADOC staffing the Draft Plan TOE is submitted to HQDA as a Plan TOE. During the MLRS Validation Phase, there were neither Draft Plan nor Plan TOEs--all of the MLRS data remained in the AURS. MACOMS were asked to work from the AURS.

In addition to establishing new organizations, the introduction of MLRS into the Army creates a requirement for the changing of many DS/GS Unit TOEs. These actions are the responsibility of the Center or School having proponency for the DS/GS unit TOE. Centers or Schools also have the responsibility to change their own Tables of Distribution and Allowances (TDA) according to the training requirements created by the new system.

g. Training. The Individual and Collective Training Plan (ICTP), 29 January 1980, produced by the Field Artillery School sums up the training planning accomplished during the Validation Phase. Other training actions included contractor conducted training (Boeing and Vought) for their respective systems. The contractors presented operator and maintenance training during 1979 for the TRADOC instructors and OTEA test personnel. The OT-I player personnel were trained by the TRADOC instructors as part of OT-I.

Earlier in the period, MILPERCEN had published the MILPERCEN Initial Recruiting and Training Plan (MIRAT), June 1978. The MIRAT was an internal plan designed for use by the personnel community to identify the qualitative and quantitative personnel requirements, as well as critical milestone dates which had to be met to ensure successful fielding of the system. Assumptions made to support development of the MLRS MIRAT Plan included:

- MLRS will be organized as composite batteries to existing 8-inch Field Artillery Battalions. This will require that 26 MLRS batteries be organized and activated.
- Qualifications of soldiers selected for training on MLRS will be the same as those required for cannon artillery system.
- CMF 13 will provide the basic operator authorization for MLRS.
- MOS 34G and 45C will provide the necessary loader/ launcher DS/GS maintenance support.
- A large ammunition platoon is required to support the high volume of firepower.
- Each MLRS battery will be authorized 6 SPLLs with each SPLL operated by a three-man crew.
- Development of planning documents such as the BOIP and TOE will be reviewed for grade structure feasibility within the MOS, the subfield, and/or CMF. A feasible grade structure is one that has within it a sufficient

trainee base and documented E3 and E4 requirements to self-renew its own career field.

- The following courses of instruction will train MLRS:
  - Cannon Crewman, 13B10-30, add on 80 hours, identify with new ASI.
  - Cannon Fire Direction Specialist, 13E10-30, add on 40 hours.
  - Fire Control Computer Repairman, 34G10, add on instruction.
  - Artillery Repairman, 45L10, add on instruction.

The MIRAT assumed an MLRS Firing Battery with three platoons of two SPLLs each, a fire direction center, and a battery headquarters. Battery strength was projected to be 5 Officers and 64 Enlisted Personnel. Augmentations to the 8-inch FA Battalions required by the addition of the MLRS Battery totaled 1 Officer and 43 Enlisted Personnel. The bulk of the augmentation (1 Officer and 32 Enlisted) were for the ammunition section in the Service Battery. The remaining augmentation (11 Enlisted Personnel) were to be assigned to the Headquarters Battery in the Mess, Supply, Administration, Medical, Communications, and Survey Sections.

The MIRAT concluded that:

- Utilization of MOS 13B provides a good sustaining base to support the system. Award of ASI will provide MLRS trained personnel that are available and easily identifiable for assignment to a MLRS unit.
- It is critical that TRADOC identify the training requirements early to ensure timely input for funding for schools, training material, and personnel.
- Currently no action has been initiated to identify personnel tradeoffs to support the increase of spaces associated with MLRS.
- Sufficient lead times for recruiting will ensure lower grade (E3-E4) fill for MLRS requirements, but NCO spaces will have to be filled by reclassification from another MOS in the force structure. MOS that will be used for this purpose must be identified as soon as possible.

- With the MLRS batteries as new units to the inventory, there will be an increased demand for DS/GS maintenance support for wheel and track vehicles.
- The planning process used in developing the MIRAT Plan has been useful in requiring the personnel, training, and acquisition communities to take a look at the personnel implications of MLRS.

Starting in February 1978, New Equipment Training Plans (NETP) were prepared semi-annually by MICOM. The NETP includes the schedule of new equipment training courses for the transfer of knowledge from the materiel developer to the tester, trainer, user, and maintainer personnel. The NETP becomes a part of the Development Plan.

The ICTP, prepared by the Field Artillery School, served to outline the milestones, requirements, and strategies for developing a training system for MLRS at the Field Artillery School. Similar training plans were developed by the Ordnance School (for MOS 34G, 45L, and 63 series) by the Armor School (for MOS 63T-Tracked Vehicle Mechanic), and by the Transportation School (for MOS 64C) to cover their areas of training responsibility for the system (Later USAFAS would integrate and coordinate all of the plans into a TRADOC MLRS ICTP).

The January 1980 ICTP noted the Field Artillery School favoring of MOS 15D for MLRS Operator/Crewman because of the compatibility of MLRS skills with Lance and because there were already five cannon systems in the 13B MOS. The ICTP also noted that the RSV operator, MOS 64C, would be trained by the US Army Transportation School. Another assumption made in the ICTP was that USAFAS would conduct new unit battery and battalion cadre training courses at Fort Sill. The cadre would then receive and train the remainder of the unit at their CONUS home stations in

the case of CONUS units, or in the case of OCONUS units, either at Fort Sill or in the overseas command. The ICTP also assumed that MLRS would be fielded in separate artillery battalions consisting of three missile batteries and one Headquarters and Headquarters Battery. It speculated that the firing battery would probably include nine firing sections in three platoons of three sections each and one ammunition platoon of thirty-seven people and eighteen 10-ton RSVs.

Each contractor, Boeing and Vought, provided an operator's manual and a -23 manual for organizational and limited DS maintenance. They also developed lesson plans, draft extension training materials, and technical manuals for small group trials in 1979. Revisions were subjected to further trial and evaluated in OT-I in early 1980.

Three training devices were envisioned.

(1) The fire control panel (FCP) trainer was to be a classroom trainer incorporating 12 operator panels and 2 instructors' consoles. The operator panels were to be identical to the fire control panel inside the SPLL cab. It would eliminate the space constraints of the SPLL cab and create a better learning/training environment. One of the main advantages of the FCP over the AET (Actual Equipment Trainer) was that it would process programmed data to introduce into the training various situations the students might see during live fire missions. The FCP trainer would also provide feedback and evaluation information to the instructor and students as to how well they were receiving the training/instruction and what steps should be followed to improve it.

(2) The Launch Pod/Container (LP/C) trainer was to be designed to look like the actual LP/C, similar in size and weight, but having no live rockets. Instead it would have a series of electrical circuits giving the operator proper indications as to the operational condition of each simulated rocket in the LP/C trainer. The instructor would have the capability of interjecting simulated faults into the LP/C trainer. The LP/C trainer would provide for constructive training in the areas of loading/off-loading, misfires, and hang-fires.

(3) Launcher Loader Module (LLM). The LLM trainer was to be the actual LLM from a SPLL. The trainer would be used to teach/train the skills necessary to operate the loading/off-loading of LP/C's. However, the use of one unit/system of the SPLL eliminates the use of another at the same time, thus limiting the effectiveness of training. The dismounting of the LLM from the SPLL would enhance training greatly.

The FCP, LLM, and LP/C trainers would be used at the United States Army Field Artillery School in an institutional environment to train MLRS crew members and other related personnel on a year round basis in basic and advanced operational skills. The LP/C trainer would also be used in the field where the basis of issue would be two per SPLL. It was envisioned that they would be used in conjunction with tactical vehicles to practice dry fire missions and to practice the procedures. Organizational, DS and GS maintenance training devices would be developed, if necessary, during the maturation phase.

Training Aids and Instructional Media Requirements are to be determined by USAFAS and the Ordnance School, based on the Skill Performance Aids material provided by the contractors.

h. Human Factors Engineering/Safety

The MLRS project office funded HFE support by the HEL Detachment, MICOM at a one man-year level of effort throughout the Validation Phase. The HEL engineer worked closely with the contractor HFE personnel, the project office, the test and evaluation commands, the TSM, the Field Artillery School, and the Medical R&D Command. He was involved in the SSG effort; participated in the MLRS Test Integration Working Group (TIWG), design reviews, RFP preparation, source selection evaluation, and test planning; and prepared the HFE analysis for the ASARC/DSARC III.

The HFE/Safety effort at the Vought Corp. was a two-man effort with peak work load assistance during tests, reviews, and other HFE activities. The major thrust of the HFE effort was directed toward meeting the reaction (mission cycle) times. The HFE became the watchdog over reaction times and the achievement of operational simplicity and all of the tasks involved which in turn influenced system design. The HFE also interpreted MIL SPECs for the engineers, reviewed designs against specifications, (including sub-contractor's design), provided HFE advice and data to equipment designers, and worked closely with the maintainability engineer to ensure the consideration of human factors.

The safety effort included a fault tree type of analysis intended to ensure a system design where no single event could cause a catastropic reaction. This analysis was in accordance with the CDRL although the Army did not specify exactly the events to analyze. A safety statement was kept current and provided during tests. Safety considerations were coordinated with the publications developer on a continuing basis.

The government user personnel description specified MOS 13B for the MLRS crewman but provided little other information. Vought personnel understood what a 13B (Cannon Crewman) was because several former field artilleryman, including the HFE, were on the MLRS project staff. Because of this and the corporate experience with the Lance project, Vought argued for MOS 15D (Lance crewmember) for the MLRS. A government study conducted during OT-I concluded that either the 13B or 15D were appropriate as MLRS crewmembers.13/

Vought also argued against the Army's tentative decision to use the MOS 45G (FA Systems Repairer) and 34G (Field Artillery Computer Repairer) for direct support. The contractor recommended a system dedicated MOS for direct support of the MLRS by contact team as specified in the ROC.

Prior to the ASARC/DSARC III, a HFE Analysis was prepared. Figure III-8 summarizes the analysis which examined human performance, soldier equipment interface, health hazards, personnel skills, workload, and training. It should be noted that the HFE Analysis did not have complete DT/OT-I data at the time of its preparation because the events were more simultaneous than sequential.

i. Government Testing and Evaluation

1) Operational Testing

The U.S. Army Operational Test and Evaluation Agency (OTEA) conducted an OT-I during the period January-February 1980 in preparation for the ASARC/DSARC II.

13/ Cost and Training Effectiveness Analysis TEA 3-80, U.S. Army TRADOC Systems Analysis Activity, June 1980.

MLRS
HUMAN FACTORS ENGINEERING ANALYSIS

- PREPARED FEB 1980
  - BY: HEL DET/MICOM
    U.S. Army Medical R&D Command
  - FOR: ASARC III
- DATA BASE VOIDS (Due to Project Acceleration)
  - Fina Contractor Reports for Validation Phase
  - OT I eports
  - DT I Reports
  - TRADOC Tests and Evaluations
- CRITICAL HFE CONCERNS AND PROBLEMS
  - Noise Level
  - Filter Scrubbing Capability
  - Filter Desorption
  - * Heater/Defroster System
  - * Ventilation Discharge
  - * Cab Positive Pressure
- PRIMARY CONCLUSIONS AND RECOMMENDATIONS
  - Both Contractors Systems Well Designed from HE Viewpoint (GFE Excluded)
  - System Operation Simple
  - System Maintenance Simple
  - Training Requirements Minimal
  - Reaction Times Met
  - No Reason to Alter Acquistion Schedule

* JUNE 1982-STILL A PROBLEM(GFE)

FIGURE III-8

Because the MLRS project was accelerated and omitted Milestone II (including OT-II) the plan for OT-I visualized an expanded OT-I which would combine the goals of OT-I and OI-II as defined in Army Regulation 70-10, "Test and Evaluation During Development and Acquisition of Materiel," 29 August 1975.

OT-I is defined in the AR as:

> A test of the hardware configuration of a system or its components to provide an indication of military utility and worth to the user. The test estimates the potential of new items or systems; the relative merits of competing prototypes; and the adequacy of the concepts for employment, supportability and organization; and doctrine, and training requirements.

OT-I supports the decisions to (not to) enter Full Scale Development.

OT-II is defined in the AR as:

> A test of engineering development prototype equipment prior to an initial production decision. Test goals are to estimate the item or systems military utility, operational effectiveness, and operational suitability in as realistic an operational environment as possible. The test is characterized by testing done by organizational units, the use of controlled field exercises, and the assessment of pretest troop training.

The MLRS OT-I objective, a combination of the OT-I and the OT-II objectives, was:

> Provide data and analysis on the operational effectiveness and suitability of MLRS to the ASARC/DSARC III on which to base a decision to enter low rate production.

The MLRS OT-I test objectives where based on operational issues and test criteria provided by TRADOC and the ROC (draft). These objectives were:

> Objective 1. To provide information on the mission performance effectiveness of the MLRS.

Objective 2. To provide information on the system survivability of GSRS in tactical operations.

Objective 3. To provide information on the reliability, availability, and maintainability (RAM) of the system.

Objective 4. To provide insights on human factors, safety, training, doctrine, organization, and tactics of the GSRS.

Objective 5. To provide insights on the logistical support concept of the GSRS and the GSRS compatibility with other field artillery systems.

The OT began in Jan 80; two candidate GSRS sytems were operationally tested at two sites, in three phases, covering a six-week period. Phase I was at Ft. Sill; it consisted of three weeks devoted to training of the launcher sections and execution of a pilot test. Six individuals (two crews), were trained on each candidate system. There was no cross training of crews. Phase II, also at Ft. Sill, consisted of a two-week, dry fire and maneuver exercise in which both candidate sections performed operational tasks such as emplacement, displacement, preparation for firing, ammunition preparation, simulated firing, section maintenance, and resupply operations in a series of realistic extended field tactical exercises. Tactical play included representation of a tactical communications network, intercept and jamming. Portions of this phase used the same rockets that were fired in Phase III. Phase II culminated with an air move to White Sands Missile Range (WSMR) where Phase III was conducted. Operational air transportability loading and unloading was evaluated within this move. Phase III was a combined live-fire DT/OT of one week during which 12 rockets were fired from each of the candidate systems by the OT sections.

OT-I had several limitations that affected the thorough evaluation of many MPT related issues. Test limitations included:

- o Short test duration and only one prototype SPLL from each contractor reduced the quantity of RAM data available for evaluation.
- o Surrogate ammunition resupply vehicles became inoperative and limited the data on which to evaluate the units resupply capability and procedures.
- o Two Lance self-propelled launchers had to be used with each protype SPLL to simulate a platoon of three SPLLs.
- o Interface equipment not available for test (e.g. BCS, PLDMD, RSV, etc.) limited capability to address the compatibility and the command and control issues.
- o Organizational level components which normally would have been replaced, were repaired by contractor personnel which degraded the ability to evaluate the logistic burden placed on supply and maintenance activities.
- o All maintenance above the organizational level was performed by contractor personnel which portrayed unrealistic maintenance times.

OTEA's summary of OT-I observed the test was adequate for a <u>partial evaluation</u> of:

- o firing cycle
- o system accuracy
- o operational safety problems
- o survivability
- o transportability

and, that the test was adequate to <u>provide insights</u> into:

- o operational reliability and maintainability
- o ammunition logistical support
- o comparability with other FA systems
- o tactics, doctrine, and organizations
- o training
- o human factors and safety

OTEA observed that the OT-I was more a validation of MLRS than the operational test usually accomplished prior to a production decision.

In the area of personnel selection and training, OTEA observed that there were no unique personnel requirements and that any soldier in Career Management Field (CFM) 13 with entry level scores of 90 or higher in the Operator and Food (OF) or Field Artillery (FA) areas could be trained to operate and maintain the MLRS at the organizational level.

The two contractors selected different MOSs for MLRS crewman. Boeing selected MOS 13B, Cannon Crewman and Vought selected MOS 15D, LANCE Crewmember. Vought's selection was based on its Lance experience and the Lance/MLRS similarities. Test personnel were selected from field artillery units at Fort Sill and trained from 7-17 January, 1980 using contractor provided TMs and Extension Training Materials. These contractor produced training materials were judged to have satisfactorily provided the essential information for proper operation of the individual fire unit.

OTEA also judged that a crew of three was adequate for sustained operation of an MLRS fire unit (SPLL) and that the "shoot and scoot" concept was feasible.

Overall, OTEA concluded that:

- Individual MLRS unit can deliver effective fire.
- Average soldier in CMF 13 can operate MLRS.
- R&M demonstrated indicate that goals <u>can</u> be achieved (Availability was not a requirement).

- o Testing to accomplish (assess) battery level effectiveness, interoperability, supportability, availability of MLRS must be accomplished before fielding.
- o Organizational issues should be addressed by FDTE.

2. The Executive Summary of an independent evaluation of MLRS by the U.S. Army Materiel Systems Analysis Activity (AMSAA) was also available to the ASARC/DSARC III. The analysis considered data from developmental and operational testing as well as the results of other government and contractor tests during the Validation/Demonstration Phase.

From its analysis of the available data, AMSAA ascertained the status of the MLRS relative to the requirements and goals for the fielded system. The ROC (draft) was the basis for determining the issues and criteria for evaluation. AMSAA views the ROC as a contract between the PM and HQDA.

Among critical issues of concern to AMSAA were:

- o Has MLRS demonstrated the potential of achieving acceptable RAM requirements.
- o What is the survivability of MLRS.
- o What impact will MLRS have on the support systems.

In addition, AMSAA evaluated several other issues, including:

- o Safety
- o Human Factors
- o Mobility and Transportation
- o Communications Interface

AMSAA's analysis was handicapped by data deficiencies due to the acceleration of the MLRS project. Tests normally conducted in advanced development or engineering development were deferred to the next testing phase, therefore, limiting the available data.

The results of the AMSAA evaluation include:

- o RAM - MLRS demonstrated the capability to achieve the ROC requirements. MLRS seems to be satisfactorily designed for ease of maintenance, with a few minor exceptions.
- o Survivability - MLRS can meet the displacement times and "shoot and scoot" tactics are feasible.
- o Supportability - Organic maintenance and support personnel are suitable if projected TOE is fully staffed and SPLL built-in-test and automatic test equipments are available. The DS/GS maintenance personnel requirements could not be validated. AMSAA concluded that the performance of MLRS may be constrained by the ammunition resupply capability of logistic units external to the MLRS organization.
- o Human Factors/Safety - identified a number of correctable HF engineering and safety problems or concerns. Determined that hearing protection is required for MLRS crewmembers. Restated a number of safety precautions that had been identified by MICOM and the U.S. Army Test and Evaluation Command.

With some reservations, AMSAA agreed that the risks were acceptable and it supported the production decision.

D. MATURATION/INITIAL PRODUCTION PHASE

1. Introduction. Following DSARC III, the MLRS project entered the Maturation/Initial Production (M/IP) Phase. This phase is an extension of the Validation Phase activities leading to full-scale production and deployment. The maturation effort includes continued design update, hardware fabrication, and completion of engineering and environmental testing initiated in

the Validation Phase. The production effort provides hardware for the Production Qualification Test (PQT) and DT/OT III. Deliveries of production units began in early 1982. The phase, expected to be a 31 month effort, will end in early 1983 following ASARC IIIa approval to enter full-scale production.

2. Discussion. Figure III-9 shows the events identified by the LCSMM for this phase of the MLRS project. The events and documents examined for this study include:

- o Contractual documents
- o Requirements documents
- o Organizational and Operational Concepts
- o LSA Effort
- o QQPRI/BOIP/MOS DECISIONS
- o TOE/TDA
- o Training
- o Human Factors Engineering and Safety
- o Test and Evaluation
- o Manpower

a. Contractual Documents. The Request for Proposal was released 15 August 1979 with receipt of proposals in response to this RFP from the two competing Validation Phase contractors scheduled for 16 November 1979. On 29 April 1980, following the source selection process and the ASARC III, a contract was awarded to Vought Corporation for the Maturation Phase R&D. In June 1980, two additional contracts were awarded to Vought for Initial Production Facilities and for Low Rate Production (rockets and SPLLS). The source selection evaluation criteria were divided into nine areas, relatively weighted as follows:

MATURATION/INITIAL PRODUCTION PHASE

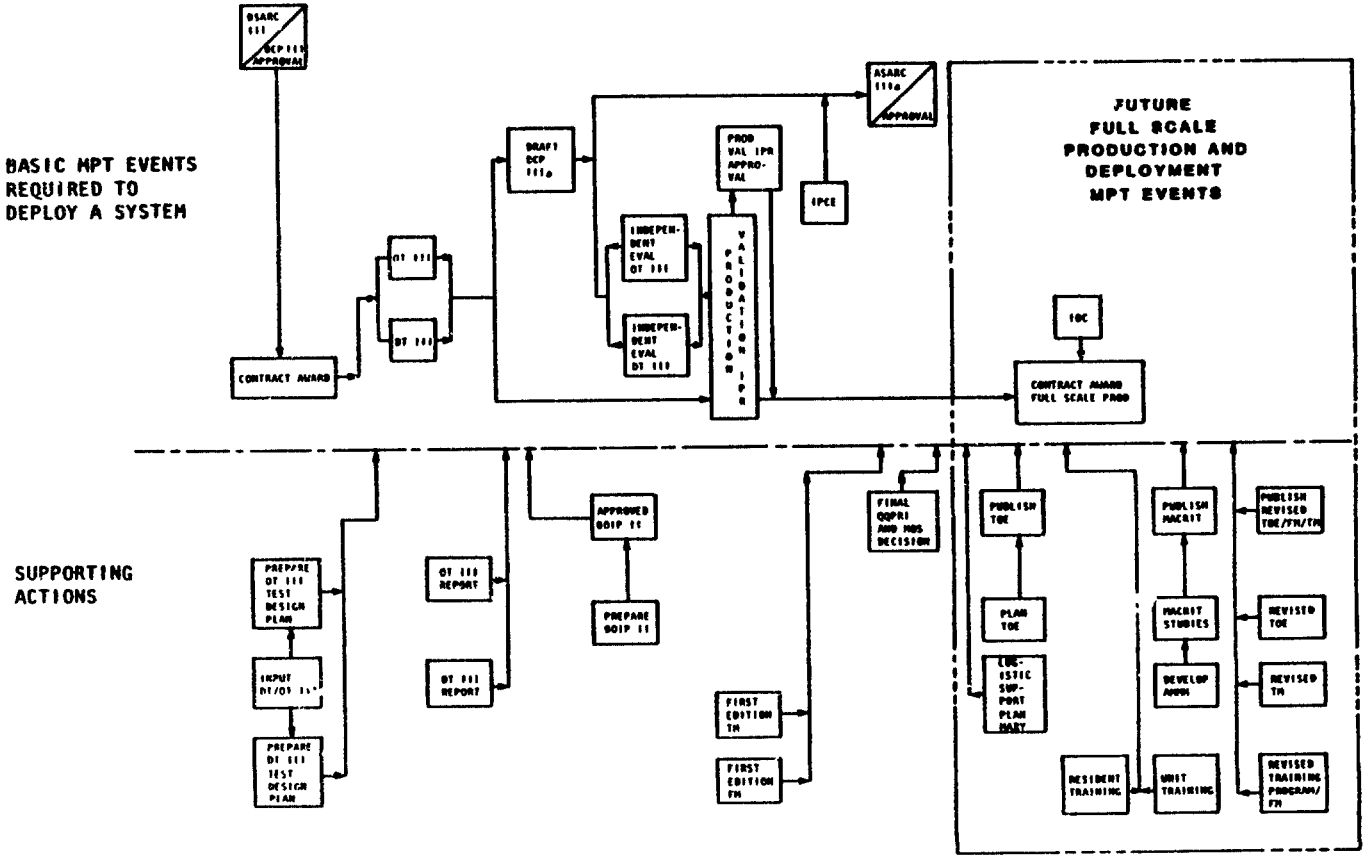

FIGURE III-9

- o Criterion 1 - Ammunition Cost Effectiveness
- o Criterion 2 - Maturation Phase Proposal
- o Criterion 3 - Low Rate Production Proposal

Criterion 1 was vastly more important than either of the remaining criteria. Criteria 2 and 3 were of the same weight and considerably more important than the remaining criteria which were:

- o Criterion 4 - Mission Cycle Times
- o Criterion 5 - Operational Utility

Criteria 4 and 5 were of the same weight and more important than 6.

- o Criterion 6 - Initial Production

Criterion 6 was slightly more important than 7.

- o Criterion 7 - Validation Phase Contractual Performance
- o Criterion 8 - RAM

Criterion 8 was of less importance than the previous criterion and was slightly more important than criterion 9.

- o Criterion 9 - Conformance to the System Specification

Important MPT requirements were contained in the Operational Factor of Criterion #2, Maturation Phase Proposals. These requirements included appropriateness of training programs to meet the development completion objectives, human engineering considerations, appropriateness of ILS program to meet fielding requirements, and the appropriateness of the RAM programs to meet development completion objectives.

Other criteria involving MPT issues were #4, Mission Cycle Times; #5, Operational Utility; and #8, RAM Characteristics Assessments.

The Source Selection Plan (SSP) for MLRS established the evaluation methodology and scoring for each of the criterion and associated factors. For instance, in Criterion 5 - Operational Utlity, the Human Engineering factor elements to be scored included human performance requirements associated with meeting mission cycle times (to include noise, toxics, blast, and heat effects), maintenance requirements, and transportability requirements. Physical characteristics consisted of vehicle cab design, and HFE associated with the SPLL and LP/C. MIL-STD-1472B served as the baseline for the HFE assessments.

The Operator Skill and Training Requirements Factor of Criterion 5, addressed the issue of whether unusual new qualifications are required for operation and maintenance of the MLRS. Also, the operator and maintenance training effectiveness was examined. Specifically, the examination was to identify any critical tasks which were not addressed in OT-I; the proficiency level attached to each critical individual or collective task evaluated; and manuals. For evaluation purposes, the factor was subdivided into four elements; fire control system operation, system fault isolation and replacement of modules, launcher loading, and misfire/hangfire procedures.

Contractual requirements concerning MPT issues are described in the ensuing discussions of training, HFE/Safety, LSA Effort, and QQPRI.

b. Requirements Documents. The ROC for MLRS was approved by HQDA in February 1980 and has remained unchanged since then. The details of the MLRS ROC were discussed in paragraph IV.C2b. ROCs for the resupply vehicle and trailer (HEMTT and HEMAT) were

approved by HQDA in early 1981. The USA Transportation School is the TRADOC proponent for these items and the PM-Heavy Expanded Truck (HET) at the U.S. Army Tank-Automotive Command has development responsibility. The ROCs were coordinated with the PM-MLRS and the TSM-MLRS to ensure that the truck and trailer meet the MLRS requirements.

c. Organizational and Operational Concepts. The brief O&O narratives in the LOA and the Validation Phase RFP were expanded in the OT-I O&O Concept. However, this latter concept was tailored to the requirements and circumstances of OT-I. In December 1980, the Field Artillery School began preparation of an O&O Concept for OT-III. Several divisions within the Combat Developments Directorate collaborated to produce and staff the first thorough MLRS O&O Concept. The draft concept, dated June 1981, served as a guide for the preparation of the draft Field Manual 6-60, Multiple Launch Rocket System (MLRS). The draft FM is intended to be used as doctrine for employment of the MLRS until the HQDA approved FM 6-60 is published in 1983.

The 1981 O&O Concept also supported the FDTE scheduled for mid-1982, preparation of the Training Course Outline for Staff Planners (prepared by Vought in Mid-1981), and preparation of Army resident training plans, and caused a re-evaluation of the MLRS Firing Battery and Battalion organizations that resulted in personnel increases in the battery draft TOE. (Discussed in paragraph 5c.2e.)

d. Logistic Support Analysis. The LSA process initiated during the Validation Phase has been expanded in depth and scope during the M/IP Phase. Under the Vought concept the analysis of

LSAR data gathered throughout the MLRS program serves as a focal point of the ILS program and acts as the interface between hardware design, maintenance and personnel requirements, training and publications preparation, and provisioning activities. Vought feels that one common LSAR precludes duplication of effort among the various support and design activities.

The delivery of LSAR data commenced in June 1980 and is expected to continue until March 1983, the end of the M/IP phase contract. In its Logistics Support Analysis Plan, dated 10 June 1980, Vought described how the LSA program would be controlled within the corporation, how the LSA candidate list would be generated and how and at what levels the government/contractor interface should take place. Figure IV-7, LSA Data Flow, presented in the Validation Phase discussion, also applies to the LSA effort in this phase.

The LSA condidate list includes all reparable CFE assemblies under the current maintenance philosophy, peculiar special tools, training devices, and test equipment. The LSA candidate list consisted of approximately 150 items at the time the plan was prepared. The Human Factors Engineering Program provides data to the LSA program on the operator and maintenance tasks to insure that they can be humanly performed. Safety Factors Analysis provide hazard data to the LSA effort for consideration in system engineering, support equipment engineering, provisioning, and warning notices in publications.

By April 1982, two years after the start of the LSA effort, the number of LSA candidates had expanded to approximately 250, and the effort was estimated to be 80% completed. By March 1983, Vought expects the LSA effort to be over 90% completed. Because

the LSA process is iterative and continually being affected by changes, it rarely reaches 100% completion. Not only do the number of candidates change, but the effort is also affected by maintenance concept changes, equipment redesign, and MOS and training program changes.

e. QQPRI/BOIP/MOS Decisions.

(1) The AFQQPRI submitted in March 1980 by MICOM and approved in November 1980 by HQDA was the last one submitted during the Validation Phase. The first Maturation Phase QQPRI was submitted on 8 May 1981, also as an AFQQPRI. This submission was an expedited action, following the selection of a single contractor's system for maturation and initial production, in order to meet fielding date requirements. Although MLRS fielding was only 22 months away, this QQPRI was incomplete because of insufficient testing and LSA data. The AFQQPRI reported on fourteen items of equipment. It also integrated the separate trainer QQPRI previously approved by HQDA on 17 December 1980 and reflected the MOS decision announced by ODCSPER, HQDA which established the MOS 13M and 13M10S8 (MLRS crewmember and organizational maintainer) and revised LANCE System MOS 15J and 15D to include provisions for MLRS duties as Fire Direction Specialist and MLRS Sergeant respectively.

Many of the DPAMMH entries presented in the AFQQPRI were described as being "best technical engineering estimates". The QQPRI also pointed out that the MOS Decision for DS/GS maintenance on the LP/C trainer was being studied for revision. Further, the QQPRI stated that additional MLRS support items are being developed for all levels of maintenance and would be included in the next QQPRI revision.

In addition to being incomplete, the LSA generated DPAMMH in earlier QQPRIs were too low to establish either the manpower requirements or spares requirements considered to be necessary to support the fielded MLRS. Figure III-10 presents the contractor reported LSA DPAMMH. Because of this problem, the practice of factoring contractor provided LSA data prior to its being entered in the QQPRI was initiated. The LSA data that is eventually used to determine the requirements for MOS 13M10S8 (MLRS Mechanic) Artillery Repairer, as well as several other MOSs, has been multiplied by a factor of approximately 15. This approach was initially developed at the U.S. Army Logistic Center (LOGC) based on a study of maintenance requirements for several similar systems and the use of regression analysis. The "k" of approximately 15 is a compromise between MICOM and the Logistic Center based on engineering judgements.

The Project Office rationale for factoring LSA data is that the contractor reliability estimates (from which DPAMMH are calculated) are derived from "inherent" reliability and do not consider such "real" factors as :

- o neglect
- o damage
- o training deficiencies
- o personnel shortages
- o excessive trouble-shooting

The regression analysis (where the system weight is the independent variable) provides the "k" factor that permits the conversion of contractor "inherent" data to "real" data.

MLRS
MAINTENANCE MANPOWER REQUIREMENTS PER MLRS FIRING BATTERY

(Number of Personnel)

MOS	USING LSA DATA		
	MAY 78	MAY 79	MAR 80
13M1OS8	0.20	0.05	0.13
63T	0.79	-	0.67
45L(DS)[1/]	0.47	0.11	0.29
63S[2/]	1.18	1.18	-

1/ CHANGED IN 1981 TO MOS 27M

2/ NOT LSA DATA

FIGURE III-10

Incomplete LSA data is first adjusted to 100% completion before the analysis is made. The entire process has been agreed to by the Materiel Readiness Support Activity (MRSA), Logistic Center, MICOM, Soldier Support Center - National Capital Region (SSC-NCR), and the MLRS Project Office. It was started in 1981 and becomes apparent in the AFQQPRI submitted in May of that year; the factored data is shown in Figure III-11.

The DPAMMH data for the MLRS carrier (GFE) is provided by the PM Fighting Vehicle Systems (FVS). The data orginates from the LSA effort at FMC. Compared to MACRIT data for similar tracked vehicles, the carrier DPAMMH data seems low by a factor of approximately 0.4. The FMC Corporation LSA data is not factored.

The DPAMMH for the HEMTT and HEMAT are provided to the PM MLRS by the PM HET. Because of the status of these equipments, e.g. non-developmental items, ROCs only just approved, and no LSA requirement, the PM HET used MACRIT data for similar size trucks and trailers. The MACRIT data is not factored.

The impact of factoring DPAMMH data and of using apparently incorrect data on the manpower requirements determination process is discussed in the TOE paragraph that follows this discussion.

An immediate result of the abrupt change in DPAMMH for MOS 13M10S8, MOS 45L, and other MOSs was to raise the previously simmering issue of DS for the MLRS SPLL. MOS 45L (Artillery Repairer) is a U.S. Army Ordnance Center and School (USAOC&S) responsibility. As the LSA data increased, task analyses began identifying the requirement for a number of MOS to provide DS/GS support for MLRS. No one existing MOS could do the job. In addition, the electrical-mechanical-hydraulic interface problems

MLRS
MAINTENANCE MANPOWER REQUIREMENTS PER MLRS FIRING BATTERY FACTORED

(Number of Personnel)

MOS	USING LSA DATA			USING FACTORED LSA DATA
	MAY 78	MAY 79	MAR 80	MAY 81
13M1OS8	0.20	0.05	0.13	2.11
63T [1]	0.79	-	0.67	0.84 [4]
45L(DS) [2]	0.47	0.11	0.29	5.82
63S [3]	1.18	1.18	-	3.28

[1] FMC LSA DATA-NOT FACTORED

[2] CHANGED IN 1981 TO MOS 27M

[3] MACRIT DATA-NOT FACTORED

[4] 1.89 IF M577s ARE IN INCLUDED

FIGURE III-11

became apparent and the proponent schools identified problems with adding to the existing MOS training. The previous QQPRI (March 1980) had stated the DPAMMH requirement for MOS 45L as 45.3 hours per SPLL. The next QQPRI (May 1981) states the DPAMMH for MOS 45L as 530.0 hours per SPLL. The nearly twelve-fold increase prompted a meeting to be called by the U.S. Army Logistic Center, Fort Lee, VA. Attendees included most agencies involved in QQPRI preparation, MOS decisions, and training applications. (MRSA, MICOM, LOGC, PM-MLRS, USAFAS, TSM-MLRS, SSC-NCR, USA SIGNAL SCHOOL, USA OC&S, VOUGHT CORP, and MMCS).

Initially there was strong disagreement among the participants, particularly the Ordnance Center and School (MOS 45L proponent) and the USA Logistic Center over the DS contact team concept, the need for a dedicated system repairer versus conventional maintenance concepts, and the impact on MOS 45L of absorbing the MLRS maintenance requirement. After the perceived duties of the system repairer were defined and explained and it was made clear that the concept did not include C-E equipment, an unanimous decision was reached to proceed with the system repairer concept.14/ The product of the conference was another AFQQPRI in which all concurred. After the conference, MICOM put the AFQQPRI into final form and forwarded it to MRSA for normal distribution.

This third AFQQPRI was dated 13 July 1981. Except for a few small DPAMMH changes and the addition of one more item of

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14/ MFR, Maintenance Division, MICOM, Subj: Summary of MLRS QQPRI Finalization Conference 22-23 June 1981, 24 June 1981.

associated equipment, the primary purpose of the 13 July AFQQPRI was to report the MOS 27M MLRS System Repairer concept decision.

Before the 13 July 1981 AFQQPRI was staffed through to HQDA approval, a fourth AFQQPRI was submitted by MICOM in September 1981. This version of the QQPRI was required because of equipment name changes, deletion of MOS 35C (System Operator/Repairer), and the addition of six more items of tools and test equipment. There were no meaningful DPAMMH changes and the same footnotes carried in the May 1981 AFQQPRI regarding "best engineering estimate" still applied.

As of April 1982, another AFQQPRI (the fifth) was being prepared based on the identification of additional items of equipment. At that time HQTRADOC was waiting for the BOIPFD to be forward from DARCOM (EARA). Also, there seemed to be no question that further amendments would be needed based on known requirements for items of associated equipment not yet reported by BOIPFD and QQPRI.

Figure III-12 summarizes the M/IP Phase QQPRIs.

(2) MOS Decisions. By Letter of Notification (LON) E-16-5, dated 28 November 1980, HQDA DCSPER announced the following approved revisions to CMF 13:

- New MOS 13M -- MLRS Crewmember
- Revised MOS 15D -- to include provision for supervision of MLRS crewmembers in grades E6 and E7
- Revised MOS 15J -- to include provision for operation/intelligence functions associated with MLRS
- Established ASI S8 for MOS 13M -- to provide identification of personnel and positions associated with organizational maintenance of MLRS.

MLRS
MATURATION/INITIAL PRODUCTION
PHASE QQPRI

DATE	ITEMS	DPAMMH	MONTHS TO IOC
MAY 1981	14	• FACTORED VOUGHT LSA DATA • INCOMPLETE • MANY ENTRIES DESRIBED AS "BEST TECHNICAL ENGINEERING ESTIMATE"	22
JUL 1981	15	• IMPLEMENTED MOS27 DECISION • NO DPAMMH CHANGES	20
SEP 1981	21	• NO MEANINGFUL CHANGES FROM MAY 1981 QQPRI • STILL "BEST TECHNICAL ENGINEERING ESTIMATES"	18
APR 1982		• FIFTH AFQQPRI IN PREPARATION	11

ADDITIONAL QQPRIs WILL BE NECESSARY

FIGURE III-12

By letter, subject, "Women in MLRS Units", dated 12 January 1981, HQDA DCSPER closed MOS 13M to women and closed all MLRS units to women.

By LON E-18-7, dated 4 December 1981, HQDA DSCPER, announced the establishment of MOS 27M as the MLRS System Repairer.

By another LON, DSCPER also announced the decision that MOS 35E would be the EQUATE system operator and maintainer. Although not an MLRS specific MOS, the new MOS 35E does support MLRS at GS levels.

Figure III-13 summarizes the M/IP Phase MOS decisions.

f. Tables of Organization and Equipment (TOE). The series of changes in MOS, skill levels, DPAMMH, maintenance concepts, and items of equipment each impact on the TOE preparations. As MOS, skill levels, maintenance concepts and equipment lists change, changes must be made in the TOE. Changes in the DPAMMH data may cause changes in the quality as well as the quantity of personnel required to support the system.

The Army has a simple formula for converting the DPAMMH to maintenance manpower requirements for each MOS, skill level, and level of maintenance. The formula, presented in AR 570-2, provides for the conversion of DPAMMH to manpower requirements as shown in Figure III-14. An indirect productive time factor of 1.4 is used by the Army although a lower number can be used if justified by the using command (MICOM uses 1.36). Equipment density is determined from the BOIP, e.g. nine SPLLs per firing battery. Available annual productive maintenance manhours, based on the type of unit, are also obtained from AR 570-2. Computation results for specific MOS are discussed below.

MLRS
MATURATION/INITIAL PRODUCTION
PHASE MOS DECISIONS

DATE	ACTION	MONTHS TO IOC
NOV 1980	LON E-16-5 ESTABLISHED MOS 13M MOS 13M W/ASI S8 MOS 15D MOS 15J	28
JUL 1981	LON E-17-16 ESTABLISHED MOS 35E	21
DEC 1981	LON E-18-7 ESTABLISHED MOS 27M	15

FIGURE III-13

CONVERSION OF DPAMMH TO MANPOWER REQUIREMENTS (AR 570-2)

$$A = \frac{B \times C \times D}{E}$$

WHERE:

A = NUMBER OF PERSONNEL REQUIRED

B = DPAMMH PER SYSTEM

C = INDIRECT PRODUCTIVE TIME FACTOR

D = EQUIPMENT DENSITY

E = AVAILABLE ANNUAL PRODUCTIVE MAINTENANCE MANHOURS

FIGURE III-14

(1) MOS 27 MLRS

The decison to establish MOS 27M MLRS System Repairer required a realignment of DPAMMH previously charged to other MOS. The U.S. Army Missile and Munitions Center and School (MMCS) as the proponent for the new MOS, was responsible for the determination of the quantity and quality of MOS 27M personnel necessary for DS/GS support of MLRS. Figure III-15 presents the MOS 27M (DS) requirements as determined by the MMCS. In their calculations, MMCS used the MICOM Indirect Productive Time Factor of 1.36, used 0.5 of the allowed available APMMH from AR 570-2, and included DS responsibility for the division float along with the nine SPLLs in the MLRS battery. The justification for factoring the available APMMH was based on an analysis of the MLRS operational concept, the maintenance concept, the wide dispersion of MLRS platoons, and the estimated travel time for the DS repairers. AR 570-2 allows factoring but provides no guidance relevant to the determination of an appropriate factor. Input data for the computation were:

(2) MOS 13M10S8 (MLRS Mechanic-Organizational)

Using the factored DPAMMH, the U.S. Army Field Artillery School has calculated a requirement for two (2) personnel per MLRS firing battery as shown in Figure III-16.

(3) MOS 63T (MTV, IFV, CFV Mechanic - Organizational)

Using the QQPRI DPAMMH (which is approximately 40% of the MACRIT value) and the same factors as used for MOS 13M10S8, a requirement for one (1) MOS 63T per MLRS firing battery has been identified. Because the battery also has four M577s that MOS

MLRS
MOS 27M (DS) REQUIREMENTS

- DPAMMH/SPLL(DS) (INCLUDES 2 LP/C TRAINERS PER SPLL) 578
- INDIRECT PRODUCTIVE FACTOR 1.36
- AVAILABLE APMMH 2700×0.5 = 1350
- NUMBER SPLLs/BATTERY 10*

COMPUTATION

$$\frac{578 \times 1.36 \times 10}{1350} = 5.82 = 6 \text{ Personnel}$$

\+ 1 Supervisor

TOTAL 7 27M(DS) Required Per MLRS Battery

*INCLUDES DIVISION FLOAT

FIGURE III-15

MLRS
MOS 13M10S8-ORGANIZATIONAL MECHANIC REQUIREMENT

• DPAMMH/SPLL (INCLUDE 2 LP/C TRAINERS/SPLL)	417
• INDIRECT PRODUCTIVE FACTOR	1.4
• AVAILABLE APMMH (CAT.I)	2500
• NUMBER OF SPLL/BTRY	9

COMPUTATIONS

$$\frac{417 \times 1.4 \times 9}{2500} = 2.11$$

2 MOS 13M10S8/MLRS BATTERY

FIGURE III-16

63T must maintain, there is a requirement for a second MOS 63T. Therefore, based on the QQPRI (SPLL) and MACRIT (M577) the requirement for two (2) MOS 63Ts were identified as shown in Figure III-17.

(4) MOS 63S (Heavy Wheeled Vehicle Mechanic - Organizational)

Three (3) MOS 63S are required for vehicle maintenance in each MLRS firing battery. Calculations are based on data provided by PM-HET (MACRIT) and the same factors used for the other organizational mechanics as shown in Figure III-18.

(5) Comparison of calculated versus authorized requirements.

Figure III-19 summarizes the computed maintenance manpower requirements for the above described MOSs and the quantity of each MOS authorized in the HQDA approved November 1981 TOEs.

Although the Calculations indicated a requirement for two (2) MOS 13M10S8 Mechanics Organizational, the TOE 06-398J100, FA Battery, MLRS (Div 86) authorizes only one (1) MOS 1310S8. The explanation given is that several 13Ms in each battery will be trained for organizational maintenance but that, because of manpower limitations, only one MLRS mechanic could be authorized in the TOE for the MLRS battery maintenance section.

In the case of MOS 63T, TOW Vehicle/Infantry Fighting Vehicle/Cavalry Fighting Vehicle System Mechanic, three MOS 63T spaces are authorized by the TOE. Manpower computations identified, including consideration of the four M577s in the battery, a requirement for two positions. The explanation for the third position is that it is an attempt to strengthen the MLRS firing battery autonomy and reduce the need to rely on the battalion maintenance section.

MLRS
MOS 63T-TRACK MECHANIC
REQUIREMENT

• DPAMMH/SPLL (LSA)	168
DPAMMH/M577 (MACRIT)	464
• INDIRECT PRODUCTIVE FACTOR	1.4
• AVAILABLE APMMH (CAT.I)	2500
• NUMBER OF SPLL/BTRY	9
NUMBER OF M577/BTRY	4

COMPUTATIONS

$$\frac{168 \times 1.4 \times 9 + 464 \times 1.4 \times 4}{2500} = 1.89$$

2 MOS 63T/MLRS BATTERY

FIGURE III-17

MLRS
63S-HEAVY WHEELED VEHICLE MECHANIC REQUIREMENT

• DPAMMH/HEMTT	200
DPAMMH/HEMAT	114
DPAMMH/RECOVERY VEHICLE	214
• INDIRECT PRODUCTIVE FACTOR	1.4
• AVAILABLE APMMH (CAT.I)	2500
• NUMBER OF HEMTT/BTRY	18
NUMBER OF HEMATT/BTRY	18
NUMBER OF REC.VEH./BTRY	1

COMPUTATIONS

$$\frac{200\times1.4\times18+114\times1.4\times18+214\times1.4\times1}{2500} = 3.28$$

3 MOS 63S/MLRS BATTERY

FIGURE III-18

MLRS
MAINTENANCE MANPOWER REQUIREMENTS PER MLRS FIRING BATTERY FACTORED/TOE

(Number of Personnel)

MOS	USING LSA DATA			USING FACTORED LSA DATA	MLRS BATTERY TOE
	MAY 78	MAY 79	MAR 80	MAY 81	NOV 81
13M1OS8	0.20	0.05	0.13	2.11	1
63T [1/]	0.79	-	0.67	0.84 [3/]	3
27M (DS)	0.47	0.11	0.29	5.82	7
63S [2/]	1.18	1.18	-	3.28	4

1/ FMC LSA DATA-NOT FACTORED

2/ MACRIT DATA-NOT FACTORED

3/ 1.89 IF M577s ARE INCLUDED

FIGURE III-19

MLRS has consistently been compared to the 8" Howitzer Battalion and Battery organizations. Early predictions of MLRS unit organization and strengths, such as those reported by the SSG, were patterned after the 8" units. During the Validation Phase, the MLRS Battery was predicted to have a strength of 6 Officers and 103 Enlisted (Total 109) and the MLRS Battalion was predicted to have a total strength of 426 Officers and Enlisted. These figures were included in the MLRS ROC.

Following OT-I and, particularly after the preparation of the O&O concept in early 1981, major changes were identified for the MLRS Battalion and Battery organizations. Based on the principle of achieving the maximum degree of self sufficiency for the MLRS Firing Battery, its strength was increased and the Battalion HHS Battery strength decreased. The result was an increase in the MLRS Firing Battery to 6 Officers and 121 Enlisted (Total 127). The HHS Battery was decreased to 10 Officers and 63 Enlisted (Total 73). The three firing battery battalion strength became 28 Officers, 426 Enlisted (Total 454).

These revised TOEs for the MLRS Firing Battery and the 8" and MLRS Composite Battalion were approved by HQDA in November 1981. The MLRS HHS Battery is still in AURS form.

The approved MLRS firing battery TOE was changed in March 1982 to accommodate the Division 86 Study manpower requirements, i.e. reduced by four spaces. The spaces selected by the USAFAS for deletion were three drivers, MOS 13M10 and one cook, MOS 94B10. This change reduced the MLRS Battalion strength by 12 Enlisted (from 426 to 414) and total strength from 454 to 442, where it presently stands.

g. Training. The New Equipment Training Plan for the MLRS provides for the use of contractor personnel to train US Army Instructor and Key Personnel (I&KP) on the system and its peculiar equipment, using MLRS equipment and contractor prepared training materials. Subsequent to I&KP training, the capability to train US Army personnel individually and as units will be established at the US Army Field Artillery Center and School. Since the MLRS does not replace an existing weapon system, training will be conducted for each battery as it is equipped with the MLRS. OCONUS units will receive individual and collective unit training in block form as an organized MLRS unit and on tactical equipment diverted to the training base. Each OCONUS unit, when trained as a unit, will be deployed to the respective Theater of Operation where it will be issued its own TOE tactical MLRS equipment. Individual training for replacement personnel will begin in FY83 at the USAFCS.

By September 1981, after the final MOS decisions, training device decisions, and TRADOC school proponency issues were settled, the training responsibilities for MLRS were established as follows:

- o TRADOC school responsibilities
  - oo US Army Field Artillery School, Ft. Sill, OK: Operators and Organization Maintenance (13M, 15D, and 15J) for MLRS, PLDMD and FDS.
  - oo US Army Ordnance Center and School, Aberdeen Proving Ground, MD: Support Maintenance Personnel (63G, 63S, 63W) for vehicles.
  - oo The US Army Southeastern Signal School, Ft. Gordon, GA: Operator, organization, and support maintenance personnel (35E) for AN/USM-410 (ATE).

- oo The US Army Armor Center & School, at Ft. Knox, KY, will train the Organization Maintenance Repairman (63T) on the carrier vehicle.

- oo The US Army Missile Munition Center and School at Redstone Arsenal, Alabama, will train support maintenance personnel (27M) for the MLRS repairer and MOS 55B and 55X ammunition handlers MOS 55D (EOD) will receive MLRS peculiar training at the US Naval Explosive Ordnance Disposal School, Indian Head, Maryland.

- oo The USAFAC&S will provide the mobile training team and be responsible for development of the individual and collective training plan for the MLRS.

- o Training Devices. Only two training devices are planned for the MLRS.15/ All other training will be conducted using tactical equipment issued to the training base or the tactical units. These two training devices are the training Launch Pod/Container (LP/C) and the Fire Control Panel (FCP) trainer. In addition to classroom use, two training Launch Pod/Containers will be issued with each SPLL to the tactical unit as an item of TOE equpment for training. The Fire Control Panel trainer will be utilized as classroom trainers at the USAFAS only.

- o New Equipment Training Team (NETT). A NETT team will be deployed to support the first CONUS and OCONUS units at the appropriate locations to train maintenance support personnel. All other personnel needed to operate and support MLRS will be trained by TRADOC schools or the contractor prior to the initial fielding. Future NET requirements for MLRS at each gaining command will be determined on a case by case basis.

The Field Artillery School updated the Individual and Collective Training Plan (ICTP) in January 1981. Although it was up-to-date with respect to earlier MOS and training decisions, it was overtaken by the MOS 27M MLRS System Repairer decision later in the year.

15/ A requirement for a MLRS Maintenance Trainer for MOS 27M at MMCS is currently in the planning stage. A practice rocket is under development, but is not considered a training device.

The training program was based on fourteen Divisional batteries and four Corps battalions with three firing batteries each for a total of 26 MLRS firing batteries.

Included in the Plan were provisions for meeting the USAFACS collective training responsibility which came about due to MACOMs refusal to accept untrained units. The USAFAC&S MLRS training battery will be attached to the USAFCS. The battery consists of five officers, two warrant officers, and 51 enlisted personnel. The Proposed TDA for the battery was a part of the ICTP. As of early 1981, the requirement to fund and provide resources for the battery still existed.

The schedule predicted by the ICTP has slipped several months. But, by May 1982, the FDTE/OT-III/IOC Battery had been formed at Fort Sill and preparations for the FDTE completed.

An attempt was made in 1980 to update the MILPERCEN Initial Recruiting and Training (MIRAT) Plan but it never progressed beyond the draft stage. After the Soldier Support Center-National Capitol Region (SSC-NCR) was established on 1 November 1980, MILPERCEN initiated the MLRS Personnel Plan. This Plan was intended to be an in-house document describing for the personnel community, what has, will, or should be done. The first MLRS Personnel Plan was published by MILPERCEN in August 1982.

Following the MOS 13M and 27M decisions, Individual Training Plan Proposals (ITPP) were prepared by the proponent schools, USAFACS and USAMMCS, respectively. The ITPP is designed to provide a total look at the training requirements for a specific MOS, whereas the ICTP is system oriented.

h. Human Factors Engineering/Safety. The HFE/Safety efforts initiated in the Validation Phase are being continued

during the Maturation/Initial Production Phase. The HF Engineer from the HEL Detachment, MICOM is still being funded by the MRLS project office. At the Vought Corporation, the individual who handled HFE during the previous phase is still on the MLRS team but now working in the maintainability area. The individual who handled Safety during the Validation Phase now has both HFE and Safety responsibilities on a full time basis.

The Vought MLRS Human Factors Program Plan, 13 February 1981, is a continuation of the Validation Phase program. The HFE program objective remains to ensure, through analysis, design, test and evaluation, that the human in the system can perform safely, accurately and without undue workload to meet the requirements of the operational MLRS. The program is scoped to encompass all soldier - MLRS interfaces under application of the proposed operating and maintenance procedures and sequences in all intended modes of operation. The program has been implemented in accordance with MIL-H-46855B. The Vought HFE Test Plan, 17 December 1981, describes how tests will be conducted to obtain MLRS human factors data.

The HEL Detachment engineer participated in the preparation of the RFP for the Maturation Phase. He has also participated in or will participate in the Source Selection Evaluation, all design reviews, and preparation of plans for and conduct of HF tests and OT-III and other tests such as PTD/MD. In addition, he has monitored the progress of corrective actions on deficiencies discovered during the Validation Phase, coordinating with the Medical R&D Command as necessary. He conducted the HFE Analysis for ASARC III and plans to conduct a second analysis for ASARC IIIa, if required.

The HFE effort also involves engineers from the MLRS Project Office and personnel from the Field Artillery School, and particularly the TSM's office. Test Design Plans were reviewed with Vought, TECOM, AMSAA, and OTEA.

i. Government Test and Evaluation. The Validation Phase concluded with OT-I in January and February 1980. The next operational test (OT-III) was scheduled for the period October 1982 - January 1983 in order to support the ASARC IIIa decision. Prior to OT-III, the Field Artillery Board at Fort Sill, OK, and the TRADOC Systems Analysis Activity (TRASANA) were scheduled to conduct Force Development Testing and Experimentation during the period June - September 1982. This period also serves as collective training for the MRLS firing battery that was formed at Fort Sill earlier in the year. The same personnel will be the test players in OT-III and will then become the first IOC battery in March 1983.

The purpose of FDTE is to test the organization, tactics, doctrine, and training of the proposed MLRS firing battery. Operational testing will be conducted by OTEA using the same personnel involved in FDTE. OT-III will evaluate operational characteristics of all end items and associated equipment. Safety, reliability, and maintainability will also be assessed. Tests will be conducted for all equipments not fully tested or qualified in the Validation Phase as well as those developed during the Maturation Phase.

Several waivers have been granted. One concerns the GS electronics support portion of the System Support Package for OT-III. Because of the non-availability of EQUATE for OT-III and the in-

complete development of Test Program Sets (TPS), the contractor will provide GS electronics support. A second waiver concerns the HEMTT and HEMAT. The PM-HET will provide HEMTTs and HEMATs that have been conditionally released to the MLRS program. The conditional release means commercial manuals only, contractor training only, and contractor maintenance support. Finally, the FMC carrier maintainers (63T and 63H) will have received contractor training only.

Environmental Qualification Tests have been conducted to demonstrate performance and reliability of the design in simulated and actual operational environments. Man-machine performance at the required environmental levels was a particularly important HFE concern.

Operator and maintainer tasks were verified during the Physical Teardown and Maintenance Evaluation (PTE). Draft technical manuals were used during PTE.

j. Manpower. Major Army restructuring studies (Division 86) have made it impossible to follow an audit trail of the manpower impact caused by the introduction of MLRS to the Field Artillery force. The Army has managed at the macro level -- identifying all requirements and assets and making tradoffs that are not identifiable to a specific system.

However, several facts have emerged during examination of MLRS documentation. One, the Field Artillery in 1980 planned to tradeoff two 155mm Howitzer Battalions in order to field MLRS. In 1981, the tradeoff requirement had been reduced to one 155mm

Battalion. Secondly, the Army Force Modernization Coordination Office reported in the 1980 Army Modernization Information Memorandum (AMIM 80) that in addition to the inactivation of two 155mm Howitzer Battalions there would be a requirement to activate as many as twelve maintenance, support, ammunition, and truck companies and detachments in FORSCOM and USAREUR.

The AMIM 81 reported the plan to inactivate only one 155mm Howitzer Battalion, and deleted four of the twelve units reported in AMIM 80 for activation. The AMIM 81 also listed the DS/GS units affected by MRLS but did not specify the impact by MOS (quality and quantity). New system DS/GS requirements are often fractional spaces that must be accommodated by existing spaces, or in conjunction with other requirements for the same MOS, justify a demand for additional spaces.

Manpower requirements are derived from the MLRS organizations, the DS/GS requirements, support requirements (particularly those related to ammunition resupply), and training staff and facility requirements.

In the later case, an unexpected training requirement surfaced in 1980 when the MACOMs refused to accept MLRS units that had not already received unit training. Therefore, a requirement for eight weeks of battery level training was placed on the Field Artillery School. Fifty-eight personnel are required to meet the battery level training requirement. These personnel were taken from FORSCOM assets and will become the last MLRS battery deployed to a FORSCOM unit.

Finally, the MLRS imposed workload on EQUATE, and therefore MOS 35E, is currently an unknown as are the workload impacts of

having the MLRS System Repairer (MOS 27M) assigned to one maintenance unit and having EQUATE operator and maintainer (MOS 35C), with which MOS 27M must interface, assigned to another unit.

IV. ANALYSIS

A. INTRODUCTION

The MLRS project embarked on an ambitious and optimistic schedule. Based on the urgency of the requirement and the low technical risk associated with its development, the MLRS project was scheduled to proceed from Milestone I to Milestone IIIa and IOC in 60 months. It was a schedule that would challenge the Army's ability to meet the logistics support requirements necessary to support the fielding of a new system.

Sixty months is considered to be about the minimum period in which a new system's logistic support requirements can be met. But the MLRS project acquisition strategy added complicating factors. First, the Validation Phase was competitive, thus the project was nearly one-half completed before one contractor's system had been selected for design maturation and initial production. Secondly, the MLRS project skipped Milestone II and nearly all of the Milestone II related events which included many early MPT requirements. The impact was increased because the decision to select the accelerated program alternative came after the ASARC/DSARC III, e.g. as the Maturation Phase was beginning and IOC was less than 3 years away. And thirdly, the MLRS project was dependent on several other decisions and development programs. These included: 1) the carrier vehicle was a derivative of the Infantry Fighting Vehicle, under development by the PM-FVS. The MLRS contractor had to design his system to interface with the GFE carrier and the MLRS project was subject to the FVS project problems, delays, and design changes; 2) The Army's decision regarding the HEMTT and HEMAT did not occur until after

the start of the Maturation Phase. The RSV and trailer, particularly the HEMTT, must be designed to interface with the SPLL for the time critical loading operation. In addition, FDTE and OT-III require the use of the HEMTT and HEMAT to effectively test the resupply function, operator training, equipment performance, and personnel requirements; and 3) The Army's decision to develop EQUATE caused a major redirection of the MLRS automatic test program which, in turn, had MPT impacts.

In accordance with the requirements of the LOA, SSG Report, and the ROC, MLRS has been designed to be simple to operate, simple to train for, and capable of a high rate of fire power per launcher. The Vought Corporation refers to MLRS as "the Soldier's System," stressing that "a combat team with minimum training can shoot the 12 rocket salvo, scoot, reload, occupy a firing point, and fire again." This is probably true; in fact, during OT-I the MLRS was successfully operated through the firing cycle by one man.

However, as simple as it is to operate and maintain at the organizational level, the degree of simplicity of maintenance training and functioning at the DS/GS and Depot Levels remains a question. Maintenance at these levels has not been tested because the contractor performed the maintenance in OT-I and will for GS in OT-III because of the non-availability of EQUATE. In fact, the Direct Support Contact Team operational concept has not been established to everyone's satisfaction and the big issue, the concept of operation for EQUATE, is a subject of considerable concern to the logistic community.

It is also true that MLRS will be fielded (if the IOC date is met) without:

- o a completed LSA effort
- o time to react to the results of FDTE and OT-III
- o time to adjust training requirements
- o EQUATE
- o an adequate RAM evaluation

Because there is a period of many months between the IOC battery and the next fielding, the MLRS project will have time to adjust from the events occurring just prior to IOC and from early IOC batery experience.

B. CONCEPTUAL PHASE

1. The LOA reflected the Army's concern for reducing manpower requirements in terms of crew size, maintenance and training requirements, and ammunition handling requirements. It also recognized the potential logistical impact of ammunition resupply for MLRS but placed the subject in the "unknown to be resolved" category.

2. The SSG selected a Best Technical Approach (BTA) that was consistent with the LOA requirement. The BTA features provided for minimizing manpower, training, and operator skill requirements. Further, the concept provided for survivability, mobility, responsiveness, and a large on-launch firepower capability. The provision for a man-rated cab, from which the crew could fire the rockets, implied a maximum crew size of three (3).

3. The SSG also recognized the importance of RAM by setting preliminary RAM goals in its report. In addition, the SSG recommended a maintenance concept that included use of BITE and a "wooden" round. Both could lead to reduced operator and

organization maintenance and skill requirements. Early emphasis was also placed on the training requirement and early involvement by the Field Artillery School. The SSG recommended that the RFP for advanced development require that the contractor deliver, prior to DT/OT-I, a complete task inventory, task analysis, and training strategy. It further specified that OT-I should evaluate the total training package and that it should be a major consideration in the source selection proceeding.

4. The LOA and the SSG Report were consistent. Each placed emphasis on the manpower, personnel, and training issues. Clearly, manpower requirements for the new system were to be kept as low as possible by striving for a minimum crew size, simple operational tasks, minimum training requirements, bulk handling of preassembled wooden rounds, and operational reaction times that strengthened system survivability through the employment of shoot and scoot tactics. The thrust of both documents was directed toward developing a simple solution that would minimize the logistic burden and the manpower requirements and simplify both the training and skill requirements as well as placing emphasis on system effectiveness in order to reduce the number of systems required to meet the operational need.

5. Although formal force level guidance was apparently not provided by HQDA, it is evident that there was motivation to control the manpower requirements for operation, maintenance, and support of the new system. The SSG report referred to on-going studies that were intended to provide spaces to increase the division maneuver force firepower. These studies were to provide

a final determination of space allocations for MLRS prior to DSARC II.15/

6. Early selection of a Project Manager and the establishment of the MLRS Project Management Office at MICOM were helpful in getting the project through the fast moving events leading to Milestone I and the schedule and strategy changes that occurred early in 1977.

7. Following the ASARC/DSARC I, HQTRADOC in accordance with the requirements of AR 1000-1, appointed a TRADOC Systems Manager (TSM). Prior to his selection, the MLRS actions were handled by the Combat Developments Directorate, Field Artillery Center and School, Fort Sill, OK.

8. The following four tables summarize the MPT actions/events that occurred during the Conceptual Phase. These tables will be repeated at the conclusion of the analysis of each subsequent acquisition phase. Because they will accumulate data through all phases, they will provide an easy to follow track of the development of MPT issues, decisions, and events.

Table IV-1a	QQPRI/BOIP/TOE/MOS Decisions
Table IV-1b	O&O Concept/Force Structure
Table IV-1c	Test and Evaluation
Table IV-1d	Training

15/ MLRS skipped DSARC II, proceeding directly to DSARC III early in 1980 at which time there were still force structures uncertainties.

TABLE IV-1a

QQPRI/BOIP/AURS/TOE/MOS DECISIONS

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
BOIPFD	No Action		
QQPRI	No Action		
SPLL	---		
RSV	---		
Training Devices	---		
LSAR	No Action		
Scope of Effort	---		
DPAMMH	---		
AURS/TOE	SSG identified organizational options		
MLRS BTRY	6-9 Launchers/ Btry		
MLRS BN	SSG proposed MLRS Btry and Rkt/How Bn		
RKT/HOW BN			
MOS Decisions	None		
Operator	SSG speculated use of CMF 13 for		
Organizational	Operator and Org. Maintainer		
DS/GS			
Other			

TABLE IV-1b

REQUIREMENTS, FORCE STRUCTURE, CONCEPTS

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
REQUIREMENTS DOCUMENTS	LOA - 1975		
FORCE STRUCTURE			
Status	Replace or Add-On Not Determined. Manpower from FA Assets		
MLRS Personnel	Not Stated		
Support Personnel	Not Stated		
Training Personnel	Not Stated		
CONCEPTS			
O&O	In LOA & SSG Report		
Tactics	Dispersed, Shoot and Scoot Tactics, General Support		
Launcher Type	Tracked		
Launchers/Unit	6/Btry		
Launcher Crew Size	3 Implied		
RSV/Firing Btry	Unknown		
Maintenance	Standard Four Level Maintenance Concept. Use BITE, modules, wooden rounds.		
Support	Standard		

TABLE IV-1c

TEST, EVALUATION, AND ANALYSES

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
T&E PLANNING	Considered in the LOA & SSG Report		
TIWG	No action		
TEMP	No Action		
DT/OT	Planned DT/OT-I thru III		
Test Design Plan	Planning requirements specified in SSG Report		
Test	None		
Report	None		
Independent Evaluation	None		
FDTE	None		
ANALYSIS			
HFE	None		
MAP	None		
COEA	SSG Prepared for Milestone I		
CTEA	None		

TABLE IV-1d

TRAINING

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
PLANNING	Guidance in LOA and SSG Report		
TRAINING DEVICES	No Action		
TRAINING	No Action - But Requirement Specified in SSG Report.		
PUBLICATIONS			
TMs	---		
FMs	---		
Soldiers Manuals	---		
Job Book	---		
ARTEP	---		
SQT	---		

C. DEMONSTRATION AND VALIDATION PHASE

1. Contractual Documents.

The RFP and the Source Selection Criteria were not fully consistent with the intent of the LOA and SSG Report. The RFP was heavily cost and technically oriented, with less emphasis on the factors considered important for MPT requirements determination. The human factors engineering considerations were well covered in the RFP, but logistics considerations received less attention except in the area of ammunition handling. The MLRS project office treated MLRS as a material handling problem and designed the system to avoid the manpower intensive ammunition handling requirement associated with tube artillery. Logistic support requirements were lessened by shipping, storing, and firing of rockets from the LP/Cs.

The Integrated Logistic and Training Support Division, MLRS Project Office was not established until August 1977. Although this date closely coincided with the start of the Validation Phase Contract, it was long after the RFP and source selection process planning and execution took place. In addition, the logisticians were not well represented at source selection.

The source selection criteria were heavily weighted toward cost (Design to Unit Production Cost) and technical factors. Factors important to the MPT requirements determination process were generally included in the third, and lowest weight area --

Operations. Included in the Operational Factor were logistics, RAM, training, and operational and organizational concepts. The low emphasis placed on RAM was a reflection of the project management office confidence in the contractor's ability to meet RAM goals. However, the lack of emphasis on the other MPT related issues was not consistent with the program acceleration schedule. The MLRS program had 60 months to proceed from Milestone I to Milestone IIIa and IOC. The schedule would challenge the Army's ability to meet the logistic support requirements necessary to field MLRS.

Vought's proposal presented a strong human factors and safety program and a strong ILS program with well structured integration of training, RAM, and logistics. Vought personnel, however, had several complaints with the Army's RFP which are summarized below.

- The target audience description was not adequate. The RFP referred the contractors to Career Management Field (CMF) 13, Field Artillery as described in AR 611-201. Contractors were instructed to select the system operator and organizational maintainer from MOS contained in CMF 13. This was insufficient guidance for contractor personnel involved in task analysis, skill level determination, manual preparation, and training planning. In addition, the data in AR 611-201 reflects the current manpower situation, not the target audience at the time of MLRS fielding, five-plus years away.

- Because the RFP made no provision for hardware dedicated to logistics (training) requirements, contractors had to use the test hardware as it was available. The accelerated schedule provided little time for hardware availability delays and a contractor in a competitive project will not fund for a training prototype unless it is called for in the contract.

- The magnitude of the LSA effort was not clear. Few people understood the LSA process and the effort involved. Neither the Army (to include the Source Selection Evaluation Board) nor the contractors anticipated the intensity of the LSA effort required to meet the Milestone III requirements. It is difficult to properly bid an LSA effort that is not well defined in the RFP. It is equally difficult to evaluate the bid.

- The impact of project acceleration on the LSA effort was not realized by the contractor or the Army until LSA planning had revealed the problems with the LSA program schedule and interfacing milestones during the Validation Phase.

- The RSV requirement was not well defined. One reason was that the Army had not yet selected a vehicle for MLRS resupply. However, because of the RSV/SPLL interface problem during reloading operations and the high priority on mission cycle times, such RSV characteristics as height and location of the on-board crane were needed early on for SPLL design and task analysis.

- Human factors engineering data and specifications were judged by Vought personnel to be lacking in definition. Human endurance data, for instance, is not covered in the HFE references. The general observation on HFE documents was that they provided only fair guidance.[14/]

2. Requirements Documents

The ROC forms a "contract" between the material developer and HQDA. The MLRS ROC was not approved by HQDA until February 1980, the end of the Validation Phase. It was available in draft for as guidance for OT-I preparation, training planning, and preparation of O+O Concepts. Once approved by HQDA it became the authority for proceeding with training device development. Training device requirements (TDR) were a relatively new requirement (established in 1979). Because the approved ROC authorized two

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14/ A recent GAO report made a similar observation. PSAD-81-17, Effectiveness of U.S. Forces Can Be Increased Through Improved Weapon System Design, January 29, 1981.

training devices, the Launch Pod/Container Trainer and the Fire Control Panel Trainer, the TDR preparation effort was discontinued and the ROC used as authority to develop the training devices.

3. Organizational and Operational Concepts

There never was an adequate O&O Concept for MLRS during the Validation Phase. The concepts presented in the LOA, SSG Report, and ROC were incomplete. The O&O Concept prepared for OT-I, while containing evidence of considerable thought on MLRS operations, was tailored to reflect the limited material available for OT-I.

4. Logistic Support Analysis

Although Vought established a strong, well integrated LSA program, the effort was delayed initially because of the requirement to obtain Army approval of the LSA Program Plan. Although the time between contract award (September 1977) and the first LSA submission (June 1978) was not entirely lost (for example, the MLRS Logistics Working Group was formed in September 1977 and the LSA effort began in March 1978), it was a significant part of the 32 month Validation Phase.

The LSA effort was subjected to several changes by both the Army materiel developer and user. These changes in design, MOS, maintenance concept, and equipment all served to either increase the effort or require work to be repeated.

The MLRS Project Office did not provide LSA Worksheet A to the contractors. Worksheet A (Operations and Maintenance Requirements) provides operational hour data which is one of the inputs necessary for the computation of DPAMMH. As an alternative Vought used a TRADOC mission scenario to determine

operating hours. In the case of utilization rates, which is another input to the DAPMMH determination process, previous experience and data from the LANCE system, enabled Vought to predict utilization rates for each LSA candidate.

Finally, the Army was faced with LSAR input from two competing contractors. Some decisions and plans could not be firmed-up until one contractor's system was selected. Involved were such MPT issues as training, MOS selection, tasks, skill levels, number of personnel, and publications. When the system selection was made, there were less than three years remaining before IOC.

5. QQPRI/BOIP/MOS DECISIONS

By the end of the Validation Phase, three QQPRIs and twelve BOIPFD had been submitted by MICOM. The QQPRIs had been routinely submitted in the prescribed sequence -- Provisional-Final-Amended Final. Consideration apparently was not given to the fact that the Validation Phase was competitive and that until a contractor was selected, the system design was uncertain. In addition, the AFQQPRI had several serious deficiencies:

- o Incomplete list of equipment
- o Incomplete DPAMMH data
- o Inaccurate DPAMMH data
- o Decisions were still pending regarding organizational and DS/GS maintainer MOSs

Under the circumstances, the QQPRI should have continued as provisional during the Validation Phase. However, provisions for dealing with the requirements of competitive and/or accelerated programs are not provided by the regulations governing BOIP and QQPRI (including the new AR 70-2, July 1982).

There are a number of comments to be made regarding the QQPRI/BOIP process. Because they are not unique to the Validation Phase, they will be presented in Paragraph D.5. below.

There was considerable turbulence with respect to the MLRS operator and maintainer MOS decisions. This turbulence was due to such factors as:

- o Data on which to make a decision was either not available, inaccurate, or incomplete. Examples: DPAMMH, task analysis, maintenance concept decisions.
- o The organizational and operational concept had not been throughly thought out early on.
- o There were school proponency issues
- o Test and evaulation results were not available
- o There were many other factors that had to be considered by the personnel community before an MOS decision could be made. Because the personnel community came on the scene late, earlier plans had to be changed to accommodate such factors as:
    - oo Career Management Field structure
    - oo MOS saturation
    - oo Training requirements
    - oo Recruiting prospects
    - oo Rotation base
    - oo NCO availability
    - oo Ability to manage ASIs
    - oo Women in the Army

At the end of the Validation Phase two tentative MOS decisions for MLRS had been made. The first decision, in 1979, established MOS 13B as the MLRS operator and the second decision changed MOS 13B to MOS 15X. Other MOSs were changed during the

Validation Phase, some due to MOS decisions concerning equipments to be used by MLRS (the HEMAT, HEMTT, and IFV carrier), some necessary because of the MLRS tentative decisions (such as the change from 13E to 15J for the fire direction specialist made necessary by the operator change 13B to 15X), and some based on considerations such as the field artillery wanting the RSV driver and assistant driver to be MLRS qualified (15X rather than 64C) and the selection of an additional skill identifier for organizational maintenance personnel.

In summary, the amended final QQPRI submitted in March 1980 was not adequate for the purposes intended. Maintenance personnel requirements could not be accurately determined and therefore, MOS decisions were made difficult, if not impossible. Recruiting, training, and TOE preparations also suffered from the lack of useful and adequate data.

6. Tables of Organization and Equipment

The automation of the unit reference sheets (AURS) allowed for the accumulation of the QQPRI/BOIP data in preparation for TOE development. Because MLRS would require activation of new units, decisions had to be made concerning their organization. Initially their organization was patterned after the 8" Howitzer units. Later the organizational and operational concepts established the basis for organizing the MLRS units. SPLL crewmember and ammunition resupply personnel requirements were easily determined, however other operating personnel requirements were not as easily defined because of the lack of experience with similar type units, test data and O&O concept details. Quantitative and qualitative maintenance personnel requirements were not determinable from the data provided by the March 1980 AFQQPRI.

At the end of the Validation Phase, MLRS had only AURS from which the commands were asked to plan and prepare for MLRS fielding.

7. Training

The MILPERCEN Initial Recruiting and Training (MIRAT) plan of June 1978 was an early effort to involve the personnel community in the MLRS development. In fact, a conclusion of the MIRAT was that it had served a useful purpose in requiring the personnel, training, and acquisition communities to take a look at the personnel implications of MLRS. Because it was not revised during the remainder of the Validation Phase, it soon became outdated--overtaken by program events.

The Individual and Collective Training Plan prepared by the USAFAC&S late in 1979 portrayed the training plans as of the date of its preparation. It also, was quickly overtaken by events. In addition, an examination of the MIRAT and ICTP assumptions disclosed a significant variance in some areas including MOSs, organization of MLRS units, training considerations, and TRADOC school responsibilities.

8. Human Factors Engineering/Safety

The HFE/Safety effort for MLRS was well supported by the Project Office and the contractor. Government and contractor human factors engineers were involved in all necessary aspects of the MLRS Validation Phase. The HFE Analysis, prepared for ASARC/DSARC III, identified HFE/Safety issues. Corrective actions have been carefully monitored since the issues were identified.

9. Government Test and Evaluation

The Operational Test-I, administered by the Army Operational Test and Evaluation Agency, did not provide the range and detail

of information normally required to support an ASARC/DSARC III. But, because of the confidence in the system, the belief that the risk was low, and the urgency of the need, MLRS was approved for advancement to the Maturation/Initial Production Phase. The MPT community gained little from the test other than confidence that MLRS was indeed simple to train for and operate and to perform organizational maintenance. Insights were also gained regarding safety, human factors, organization, and tactics. Little hard data was obtained because of the lack of supporting equipment for the test and the fact that the contractor conducted most maintenance. The OTEA report concluded with a recommendation that OT-III address OT-I shortcomings and that an FDTE be conducted prior to OT-III to evaluate organizational issues.

The Independent Evaluation Report (IER) of DT-I conducted by AMSAA concluded, with reservations, that MLRS risks were acceptable and the production decison was supported. The IER was handicapped by data deficiencies, the fact that the contractor performed maintenance at the DS/GS levels, and the lack of sufficient equipments for the development of RAM data or the testing of operational procedures. Nevertheless, recognizing the unique schedule for MLRS, the low risk, and the urgency of its need, AMSAA made its recommendations without having the amount of supporting data normally expected at Milestone III.

The MLRS success with Milestone III, in spite of the lack of adequate test and evaluation data, can be partially attributed to early establishment of two Test Integration Working Groups (TIWG) to integrate test requirements and data requirements, and to ensure the understanding by all participants of the unique

requirements of the MLRS test program. The TIWG members were informed that there was a short and firm schedule, due to the competitive Validation Phase requirements, and that there may be deviations from the standard testing procedures because of the planned acceleration of the MLRS program. The close and early coordination among all involved in the test and evaluation activity was achieved by the MLRS Project Office.

In addition to those personnel directly involved in test and evaluation, the decision-makers also had to be oriented to the situation and the fact that all of the questions customarily asked at the ASARC/DSARC III could not be answered. They had to weigh the urgency of the need against the potential remaining risks in the system development process.

The MLRS Project Office took the initiative to adapt the test program to the acquisition strategy. The regulations governing Test and Evaluation do not make provisions for dealing with programs that deviate from the normal testing sequence. Similarly, the LCSMM fails to provide guidance for the conduct of test and evaluation when the program is accelerated.

Tables IV-2a thru IV-2d summarize the Demonstration/Validation Phase data and the Conceptual Phase data discussed earlier.

D. MATURATION/INITIAL PRODUCTION PHASE

1. Contractural Documents

The Maturation Phase RFP and Source Selection Plan continued the trend established with the Validation Phase. The emphasis was on cost effectiveness - an important factor that involved many characteristics of the system, some having a bearing on MPT requirements. However, at this point in this acquisition cycle,

TABLE IV-2a

QQPRI/BOIP/AURS/TOE/MOS DECISIONS

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
BOIPFD	No Action	12 submitted	
QQPRI	No Action	3 submitted	
SPLL	---	Boeing and Vought Prototypes	
RSV	---	5-ton truck-change to 10-ton truck w/trlr and on-board crane	
Training Devices	---	FCP and LP/C Approved with ROC	
LSAR	No Action	Contract Requirement Initiated. ILSMT Established Sep 1977	
Scope of Effort	---	SPLL and RSV - 105 LSA Candidates nearly completed	
DPAMMH	---	Not Useful	
AURS/TOE	SSG identified organizational options	AURS initiated - no TOEs	
MLRS BTRY	6-9 Launchers/ Btry	Three platoons, three launchers each	
MLRS BN	SSG proposed MLRS Btry and Rkt/How Bn	Three Firing Batteries and HQ & HQ & SVC Btry	
RKT/HOW BN		One MLRS Btry, Three 8" HOW Btry	
MOS Decisions	None	Tentative	
Operator	SSG speculated use of CMF 13 for	13B, then changed to 15X	
Organizational	Operator and Org. Maintainer	13B, then changed to 15X, then 15XP1	
DS/GS		Total of seven MOSs identified	
Other		MLRS Opns/Intell Sp 13E to 15J	

TABLE IV-2b

REQUIREMENTS, FORCE STRUCTURE, CONCEPTS

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
REQUIREMENTS DOCUMENTS	LOA - 1975	MLRS ROC Feb 1980	
FORCE STRUCTURE			
Status	Replace or Add-On Not Determined. Manpower from FA Assets	Add-On. Trade Off 2-155mm How Bn. Field 26 MLRS Btrys then changed to 3-4 Bn and 14 Btry	
MLRS Personnel	Not Stated	ROC-2804; MAP III-3476 MLRS Btry 109-127 (O&EM)	
Support Personnel	Not Stated	ROC-2466; MAP III-3012	
Training Personnel	Not Stated	To be determined	
CONCEPTS			
O&O	In LOA & SSG Report	Prepared for OT-I & in ROC	
Tactics	Dispersed, Shoot and Scoot Tactics, General Support	No Change - Concept Verified by OT-I	
Launcher Type	Tracked	No Change	
Launchers/Unit	6/Btry	9/Btry, 27/Bn	
Launcher Crew Size	3 Implied	3 - Verified by OT-I	
RSV/Firing Btry	Unknown	15-18 5-Ton trucks changed to 10-ton trucks. Specific vehicle not selected	
Maintenance	Standard Four Level Maintenance Concept. Use BITE, modules, wooden rounds.	No Change Equate Selected as ATE	
Support	Standard	USALOGC Analysis	

TABLE IV-2c

TEST, EVALUATION, AND ANALYSES

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
T&E PLANNING	Considered in the LOA & SSG Report	TRADOC issues identified	
TIWG	No action	Established Oct 76	
TEMP	No Action	Prepared 79, Published Jan 80	
DT/OT	Planned DT/OT-I thru III	Combined DT/OT-I & II	
Test Design Plan	Planning requirements specified in SSG Report	DT-I, June 1979 OT-I, Aug 1979	
Test	None	DT I TECOM 1979 OT I OTEA 1980	
Report	None	DT I TECOM, May 1980 OT I OTEA, Apr 1980	
Independent Evaluation	None	OT I OTEA, Apr 1980 DT I AMSAA, Apr 1980	
FDTE	None	Recommended by OTEA and USAFAC&S	
ANALYSIS			
HFE	None	Prepared by HEL Detachment MICOM for DSARC III	
MAP	None	Prepared by USAFAC&S for ASARC III	
COEA	SSG Prepared for Milestone I	Prepared by USAFAC&S for ASARC III Feb 1980	
CTEA	None	TRASANA prepared for ASARC III Feb 1980	

TABLE IV-2d

TRAINING

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
PLANNING	Guidance in LOA and SSG Report	MIRAT, Jun 1978 ICTP, Jan 1980 NETP Initiated 1978	
TRAINING DEVICES	No Action	FCP and LP/C Trainers Identified in ROC. TDRs Not Submitted	
TRAINING	No Action - But Requirement Specified in SSG Report.	Test Personnel, Instructors, & OT-I Players Trained by Contractor and/or TRADOC.	
PUBLICATIONS		LSAR Generated Tasks.	
TMs	---	Contractor Drafts for OT-I	
FMs	---	Input from O&O Concepts	
Soldiers Manuals	---	Vought Provides Task Analysis Info Sheet	
Job Book	---	Produced from Soldier's Manual	
ARTEP	---	---	
SQT	---	Produced from SM and TRADOC Common Tasks Manual	

TABLE IV-2d

TRAINING

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
PLANNING	Guidance in LOA and SSG Report	MIRAT, Jun 1978 ICTP, Jan 1980 NETP Initiated 1978	
TRAINING DEVICES	No Action	FCP and LP/C Trainers Identified in ROC. TDRs Not Submitted	
TRAINING	No Action - But Requirement Specified in SSG Report.	Test Personnel, Instructors, & OT-I Players Trained by Contractor and/or TRADOC.	
PUBLICATIONS		LSAR Generated Tasks.	
TMs	---	Contractor Drafts for OT-I	
FMs	---	Input from O&O Concepts	
Soldiers Manuals	---	Vought Provides Task Analysis Info Sheet	
Job Book	---	Produced from Soldier's Manual	
ARTEP	---	---	
SQT	---	Produced from SM and TRADOC Common Tasks Manual	

MLRS was challenging the Army to provide the logistical support necessary for its fielding in less than three years. The RFP and the Source Selection Plan did not adequately reflect the challenge.

2. Requirements Documents

The MLRS ROC served as a contract between the PM and HQDA. AMSAA used the ROC as the basis of its independent evaluation. A ROC for the trailer and a JSOR for the RSV properly reflected their MLRS interface requirements. It is not clear, however, if the developer (DARCOM-TACOM) had been provided the projected user population information by TRADOC or if the anthropometric and reading grade level requirements stated in the HEMAT ROC were coordinated with the Field Artillery CMF 13 requirements.

3. Organizational and Operational Concept

The Field Artillery Schools' effort to produce an O&O Concept, which was started in December 1980, was late. The O&O Concept serves to guide many MPT plans, and events, and is a source document for training and operations publications. A significant change in the MLRS Firing Battery strength resulted from the examinations and analysis necessary to prepare the O&O Concept. Earlier concentration on the concepts for the organization and operation of MLRS units could have prevented some of the planning iterations and made the MPT requirements process easier. Program acceleration, coupled with a competitive Validation Phase, caught the Field Artillery School short -- as it did others in the acquisition community.

4. Logistic Support Analysis

Following the selection of the Vought system and receipt of

the authority to proceed into the Maturation/Initial Production Phase, logistic support considerations became critical. In addition, both Vought and the Army were faced with the problem of more design changes than they had anticipated and the addition of many more LSA Candidates. Program changes, such as those concerning maintenance concepts, MOS decisions, and levels of maintenance served to increase the LSA effort. This had an adverse impact on the schedules for manual development, determination of maintenance manpower requirements, training task analysis, and nearly all MPT related areas.

5. QQPRI/BOIP/MOS Decisions

The first QQPRI submitted in the Maturation Phase was an expedited action in recognition of the time constraint. It was submitted in May 1981 when fielding was less than 2 years off. Not only was it late, it was also incomplete. It did, however, contribute to the solution of one problem -- the low DPAMMH reported in the earlier QQPRI.

Because of the factoring of the Vought LSA data, the DPAMMH reported in the May 1981 QQPRI could be translated into maintenance manpower requirements that seem more reasonable.

As of 31 March 1982, the Vought LSA determined DPAMMHs were still considerd low and the factoring continued. Low DPAMMH are not unusual (most projects suffer from the same problem) but it is more serious because of lack of "catch-up" time due to the acceleration of the MLRS program.

Factoring LSA data is not unprecedented, although the use of a single factor and its application across all disciplines--mechanical, electrical, electronic, hydraulic - is questionable.

The U.S. Navy experience with the F/A-18 aircraft revealed that contractor LSA data, in order to be a useful predictor of maintenance requirements and maintenance manpower requirements, had to be factored.[15/] However, the factors varied considerably among the aircraft subsystems and the analysis that developed the factors included consideration of the impact of technological advances on maintainability and reliability, the extent to which BITE and ATE are used, maintenance concepts, and contractor design controllable tasks versus U.S. Navy controllable tasks.

Army Regulation 71-2, effective July 1982, has corrected some of the QQPRI/BOIP deficiencies. It supersedes earlier editions of AR 71-2 and Chapter 3 of AR 611-1 and has made the following changes:

- o QQPRI/BOIP/ROC will be staffed as a package.
- o It provides one regulation addressing both the QQPRI and the BOIP.
- o It makes provisions for the numbering of the tentative and the final QQPRI and BOIP.
- o It offers better definitions for several terms that had caused trouble in the past.
- o It established provisions for automation of both the QQPRI and the BOIP.

The problems identified by this study that are related to the above issues will not be discussed further because they are recognized and steps have been taken to correct them.

The new AR, however, left many problems unsolved, some even

15/ Information Spectrum, Inc., Report No. V-8075-04, Evaluation of Procedures For Estimating Mature F/A-18 MMH/FH, February 16, 1981.

not addressed. These unsolved problems include:

- o Source of all DPAMMH data is not identified and audit trail for factoring is not clear.
- o Inconsistencies often exist between QQPRI and BOIP.
- o No feedback on comments and recommendations and they do not appear in subsequent submissions.
- o No specific guidance as to when to start the process.
- o MACOMs often have their own guidelines.
- o Process is confusing, misunderstood, and those preparing or reviewing the documents do not understand their use.
- o DPAMMH predictions ranged from values to the nearest man-hour to values to the nearest ten-thousandth of a man-hour. There is no guidance relative to how DPAMMH should be stated.
- o Personnel people do not look at the QQPRI/BOIP until they are about six months into the review process, e.g. when the SSC-NCR receives the documents.
- o The QQPRI/BOIP staffing process is lengthy (up to nine months) and involves many commands, staffs, and activities. In spite of the many reviews, the documents continue to be in error.
- o The community must cope with a confusing array of maintenance man-hour definitions and must also understand which data they are using and its source.
- o AR 570-2 has not been revised since Change 10, September 1978. The basic document was published in 1969. According to a TRADOC source, personnel turnover has prevented the revision of AR 570-2. Apparently, its revision has not received a high priority.
- o AR 570-2 is suspect in some areas which appear to be inflated and the data can not be replicated.

6. Tables of Organization and Equipment

The TOEs for MLRS were late being approved by HQDA. There were two reasons, one, the Division 86 Study which was ongoing and two, the late MPT decisions within the MLRS program. Early in 1982, the approved MLRS Battery TOE was changed because of Division 86 Study manpower requirements. The USAFAC&S could have

avoided the late O&O concept examination that caused a re-evaluation of the organization of MLRS units in 1981. This examination should, and could, have been done earlier.

The TOEs may change again as a result of the findings of the on-going FDTE. In addition, OT-III, scheduled for late 1982 and early 1983, will give TRADOC another opportunity to look at the MLRS TOE before IOC. However, there will not be enough time to react before the IOC date.

The process for determining the quantity of maintainers in the MLRS Firing Battery and in the DS/GS units is prescribed in AR 570-2. This report has shown how the procedure has been "tailored" by the material development and TRADOC community. It has also shown that the "tailored" results are not always used in the TOE. The numbers in the TOE reflect the application of additional considerations. These include:

- MOS 13M1058, the organizational maintainer requirement was determined to be (using factored data) two per MLRS Firing Battery. The TOE provides for only one MOS 13M10S8 because of manpower limitations. The intention to train several more MOS 13Ms as organizational maintainers does not solve the problem of how to manage them, e.g. how to be sure that they end up in the correct firing battery. Managing ASIs is acknowledged to be difficult, these extra maintenance men cannot be requisitioned as 13M1058s, but only as 13M10s. In addition, decisions must be made regarding the appropriate battery position for these "extra" maintenance men and a determination made if the maintenance or organizational concepts have been compromised. The on-going FDTE and upcoming OT-III may provide the vehicles for evaluating the alternatives.

- MOS 63T, the tracked vehicle mechanic is another illustration of the failure to accept the results of the established procedures. Three MOS 63T spaces are authorized by the TOE. Manpower computations identified, including consideration of the four M577s in the battery

a requirement for two positions. The explanation for the third position is that it is an attempt to strengthen the MLRS firing battery autonomy and reduce the need to rely on the battalion maintenance section. This judgement is questionable if the quantity of MOS 63T personnel was correctly calculated in the beginning. However, as pointed out earlier, the DPAMMH for MOS 63T, as provided by PM-FVS, are much lower than the MACRIT data, and, therefore, were apparently suspect.

- MOS 27M. The cumulative effect of 1) factoring the contractor LSA data and 2) adjusting the available APMMH has resulted in establishing a requirement for six (6) 27Ms for DS of each MLRS battery of nine (9) launchers. Including the supervisor, the total is seven (7) 27Ms per battery -- three maintenance support teams of two men each plus the supervisor.

  The justification for factoring the available APMMH is based on analysis of the MLRS operational concept, the maintenance concept, dispersion of MLRS platoons, and the estimated travel time for the DS repairers. The AR 570-2 permits such factoring but provides no guidance relevant to determination of an appropriate factor. Although MMCS personnel agree that the 27M requirement seems high -- "its how the numbers came out".

  Army-wide, these numbers generate a requirement that has been variously estimated as 230-250 MOS 27M personnel. This includes 214 for DS/GS of MLRS units, 13 requirements at the MMCS, and inspector and other unknown requirements. The 214 DS/GS requirement assumes that soldiers, not civilians, will provide GS for CONUS MLRS units. Should the CONUS based units be supported by civilian maintenance activities, thus eliminating many CONUS assignments for the MOS 27M, a Space Imbalance MOS (SIMOS) situation could develop.

7. Training

Training planning and execution followed the prescribed schedule but was complicated by late decisions such as the one establishing the MLRS System Repairer (DS) to be trained at the USAMMC&S. This late action adversely impacted on OT-III plans because the MOS 27Ms for OT III must now be contractor trained rather than TRADOC school trained. In addition, the school has identified a requirement for a training device for the MOS 27M maintenance program. The TDR is being studied by the project office and TRADOC.

8. HFE/Safety

MLRS has benefited by a sound HFE/Safety program from the start. There has been close attention by the government and by the contractor. Deficiencies identified by tests and analysis are being tracked. If required, a HFE Analysis will be prepared for ASARC IIIa. In addition, the government human factors engineer has been looking at MLRS associated equipment such as the RSV and trailer. However, unless "common commercial practices" are violated, the HFE can not influence the design of a non-development item such as the HEMTT.

One trouble spot has been with the government furnished carrier vehicle. The three most serious HFE/Safety deficiencies, identified in the 1980 HFE Analysis, are associated with the carrier vehicle and are still problems. These deficiencies are:

- o Heater/defroster system inadequacies.
- o Ventilation discharge deficiences.
- o Cab positive pressure failures.

9. Government Test and Evaluation

Important tests remain before the IOC date. The 1980 OT-I was inadequate as an operational test for the reasons discussed earlier. OT-III, scheduled to begin late in 1982, will be the first adequately equipped and manned operational test for MLRS. However, there will be little or no time between the end of OT-III and the IOC date to take corrective action. Fortunately, the next IOC battery will not be fielded for months, thus allowing the first fielded battery to be a test vehicle for organization, training, and equipment evaluations.

In addition, the Field Artillery School has directed that an FDTE be conducted in mid-1982 using Fort Sill trained personnel prior to the OT-III scheduled for later that year. The FDTE issues will include training, organizational, operational, and equipment adequacy, issues that have not previously been tested.

Tables IV-3a thru IV-3d summarize the Maturation/Initial Production Phase activities.

TABLE IV-3a

QQPRI/BOIP/AURS/TOE/MOS DECISIONS

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
BOIPFD	No Action	12 submitted	Increased to 22 (launcher plus 21 ASIOE)
QQPRI	No Action	3 submitted	4 More submitted
SPLL	---	Boeing and Vought Prototypes	Vought Only
RSV	---	5-ton truck-change to 10-ton truck w/trlr and on-board crane	HEMTT and HEMAT selected
Training Devices	---	FCP and LP/C Approved with ROC	FCP and LP/C. USAMMC&S TDR for MOS 27 M Trainer
LSAR	No Action	Contract Requirement Initiated. ILSMT Established Sep 1977	Continued Effort
Scope of Effort	---	SPLL and RSV - 105 LSA Candidates nearly completed	Expanded to over 250 Candidates 80% complete Apr 82
DPAMMH	---	Not Useful	SPLL plus 21 ASIOE, Commenced factoring of Vought LSA data
AURS/TOE	SSG identified organizational options	AURS initiated - no TOEs	TOEs developed - HQDA approved MLRS Btry & Composite RKT/HOW Bn (Div 86)
MLRS BTRY	6-9 Launchers/ Btry	Three platoons, three launchers each	No change
MLRS BN	SSG proposed MLRS Btry and Rkt/How Bn	Three Firing Batteries and HQ & HQ & SVC Btry	No change
RKT/HOW BN		One MLRS Btry, Three 8" HOW Btry	One MLRS Btry, Two 8" HOW Btry (Div 86)
MOS Decisions	None	Tentative	Final
Operator	SSG speculated use of CMF 13 for	13B, then changed to 15X	15X to 13M w/15D (E6 and above)
Organizational	Operator and Org. Maintainer	13B, then changed to 15X, then 15XP1	15XP1 changed to 13MS8
DS/GS		Total of seven MOSs identified	27M MLRS System Repairer plus fourteen other MOSs for DS/GS
Other		MLRS Opns/Intell Sp 13E to 15J	MOS 35C, EQUATE Op and Maint.

TABLE IV-3b

REQUIREMENTS, FORCE STRUCTURE, CONCEPTS

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
REQUIREMENTS DOCUMENTS	LOA - 1975	MLRS ROC Feb 1980	HEMTT & HEMAT ROCS June 1981
FORCE STRUCTURE			
Status	Replace or Add-On Not Determined. Manpower from FA Assets	Add-On. Trade Off 2-155mm How Bn. Field 26 MLRS Btrys then changed to 3-4 Bn and 14 Btry	Add-On. Trade Off I-155mm How Bn. Field 4 MLRS Bn and 14 MLRS Btry
MLRS Personnel	Not Stated	ROC-2804; MAP III-3476 MLRS Btry 109-127 (O&EM)	Fluctuated - Now 3372. MLRS Btry Strength decreased from 127 to 123
Support Personnel	Not Stated	ROC-2466; MAP III-3012	To be determined
Training Personnel	Not Stated	To be determined	To be determined
CONCEPTS			
O&O	In LOA & SSG Report	Prepared for OT-I & in ROC	Thorough O&O Prepared by USAFAC&S
Tactics	Dispersed, Shoot and Scoot Tactics, General Support	No Change - Concept Verified by OT-I	No Change
Launcher Type	Tracked	No Change	No Change
Launchers/Unit	6/Btry	9/Btry, 27/Bn	No Change
Launcher Crew Size	3 Implied	3 - Verified by OT-I	No Change
RSV/Firing Btry	Unknown	15-18 5-Ton trucks changed to 10-ton trucks. Specific vehicle not selected	18 10-ton truck w/on Board Crane and 18 10-Ton Trlr (HEMTT & HEMAT)
Maintenance	Standard Four Level Maintenance Concept. Use BITE, modules, wooden rounds.	No Change Equate Selected as ATE	Selected System Repairer and Contact Team (DS) Concept
Support	Standard	USALOGC Analysis	No Change

TABLE IV-3c

TEST, EVALUATION, AND ANALYSES

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
T&E PLANNING	Considered in the LOA & SSG Report	TRADOC issues identified	Issues from DT/OT-1
TIWG	No action	Established Oct 7[illegible]	Continuing
TEMP	No Action	Prepared 79, Published Jan 80	Updated 81
DT/OT	Planned DT/OT-I thru III	Combined DT/OT-I & II	
Test Design Plan	Planning requirements specified in SSG Report	DT-I, June 1979 OT-1, Aug 1979	DT III Late 1980 OT III Early 1982
Test	None	DT I TECOM 1979 OT I OTEA 1980	DT III TECOM - In Progress OT III OTEA - Late 1982
Report	None	DT I TECOM, May 1980 OT I OTEA, Apr 1980	To be issued for ASARC IIIa
Independent Evaluation	None	OT I OTEA, Apr 1980 DT I AMSAA, Apr 1980	To be issued for ASARC IIIa
FDTE	None	Recommended by OTEA and USAFAC&S	Scheduled mid-1982 prior to OT-III
ANALYSIS			
HFE	None	Prepared by HEL Detachment MICOM for DSARC III	To be prepared for ASARC IIIa Tracking Previously identified deficiencies
MAP	None	Prepared by USAFAC&S for ASARC III	To be prepared for ASARC IIIa
COEA	SSG Prepared for Milestone I	Prepared by USAFAC&S for ASARC III Feb 1980	To be prepared for ASARC IIIa
CTEA	None	TRASANA prepared for ASARC III Feb 1980	Will prepare for ASARC IIIa

TABLE IV-3d

TRAINING

MPT EVENTS	MLRS ACQUISITION PHASES		
	CONCEPTUAL	DEMONSTRATION AND VALIDATION	MATURATION AND INITIAL PRODUCTION
PLANNING	Guidance in LOA and SSG Report	MIRAT, Jun 1978 ICTP, Jan 1980 NETP Initiated 1978	MLRS Personnel Plan - Aug 1982 ICTP, Jan 1981 NETP Continuing Semi-Annually
TRAINING DEVICES	No Action	FCP and LP/C Trainers Identified in ROC. TDRs Not Submitted	Considering MOS 27M Maintenance Trainer
TRAINING	No Action - But Requirement Specified in SSG Report.	Test Personnel, Instructors, & OT-I Players Trained by Contractor and/or TRADOC.	I&KP, Staff Planners, Testers, and Maintainers Trained by Contractor and TRADOC. Commenced Resident Training at FT Sill - Op and Org Maint. USAMMC&S Starts 27M in 1983. Unit Training w/FDTE at Fort Sill.
PUBLICATIONS		LSAR Generated Tasks.	LSAR Continuing
TMs	---	Contractor Drafts for OT-I	Available for OT-III & IOC Btry
FMs	---	Input from O&O Concepts	Draft FM 6-60, MLRS Sep 1981
Soldiers Manuals	---	Vought Provides Task Analysis Info Sheet	Draft for IOC - Validation by Feedback
Job Book	---	Produced from Soldier's Manual	Draft for IOC
ARTEP	---	---	Developed after FDTE, OT-III, & IOC
SQT	---	Produced from SM and TRADOC Common Tasks Manual	After IOC - Validate by TRADOC Teams

V. CONCLUSIONS

A. GENERAL

The MPT requirements determination process, as provided for in the LCSMM and other governing DOD and Army documents, is generally manageable and is capable of providing the required data in a timely manner under normal acquisition.

The most obvious problem with the LCSMM process is associated with attempts to adapt it to an accelerated and competitive program such as the MLRS. In addition, problems are identified with the process itself as well as the tools and techniques used.

B. PROBLEM AREAS

1. Acquisition Strategy Considerations/Impacts

a. DODD 5000.1 and DODI 5000.2, as well as OMB Circular 109, state that acquisition strategies should be tailored to the project circumstances. Yet, none of these references or the implementing Army Regulations covering materiel research, development, acquisition, and evaluation or the DA Pamphlets covering the LCSMM or ILSMM provided definitive guidance to the MLRS project for managing an acquisition program that omitted the Advanced Development Phase, had only a DT/OT I before going into initial production, and had a competitive Validation Phase.

When the decision to accelerate the MLRS project was made at ASARC/DSARC in April 1977, there was not an official HQDA method for transmitting that fact to all members of the R&D community, many of whom continued "business as usual" in spite of the urgency or problems perceived by others. The problem of informing and gaining cooperation was left to the MLRS project office.

b. Integrated logistic support elements are particularly hard hit by an accelerated project. The problem is simply that there is not sufficient time to do all that has to be done at the normal pace and sequence; therefore:

- o actions must be concurrent rather than sequential
- o the logistic support division of the project office should be established as quickly as possible
- o early decisions must be based on incomplete information
- o changes must be expected throughout the life cycle
- o the acquisition community must be made aware of the nature of the ILS planning problems and their solutions.

c. The LSA is a dynamic and iterative process which cannot be completed until the engineering effort is concluded. The MLRS design is not yet frozen (as of May 1982), so the LSA effort continues. Consequently, the manpower planner must recognize the inadequacies inherent in estimates based on incomplete LSA and not depend solely on LSA data as a basis for early manpower requirement predictions.

2. Government/Contractor Interaction

a. Target Audience Descriptions

Vought Corporation complained about the lack of an adequate target audience description. Because of its inability to predict the user population several years ahead or to "age" the current force, the Army only provided piecemeal guidance, e.g., "consider CMF 13 as described in AR 611-201."

b. Logistic Support Analysis

The government and the contractor need a better understanding of LSA, the effort it requires, how it is affected

by accelerated programs, how to describe it in the RFP (government) how to bid it (contractor) and how to evaluate the proposal (government).

c. Logisticians and personnel people need to play a stronger role in the Request for Proposal and Source Selection Plan process as well as in the source selection evaluation procedures if MPT and HFE considerations are to be addressed early-on and influence equipment design. This is one significant way MPT personnel can fully meet their responsibilities in the system acquisition process.

3. Organizational and Operational Concepts.

A new system such as MLRS that requires the activation of new organizations and the development of new operational concepts must have an early and thorough O&O concept. Too many MPT issues rely on the O&O concept. To wait until the Maturation/Initial Production Phase for its development, had a negative impact on TO&E development, associated items of equipment requirements, training planning, and manpower requirements.

4. QQPRI/BOIP Process.

The QQPRI/BOIP process needs attention. The recently published AR 70-2 made some improvements of an evolutionary nature but many problems remain. These serious flaws, many of which have been illustrated in this report, may require revolutionary solutions, e.g., restructing the entire process to assure early and direct involvement of manpower, personnel, and training planners.

Flaws with the tools and techniques and in the process itself have led to the adoption of an undisciplined approach to the

critical process of determining manpower requirements for MLRS. Evidence illustrated in this report indicates that new system manpower planners, in an honest effort to determine realistic requirements, are using inconsistent methodologies and a variety of generally undocumented "factoring" techniques. In some cases there has been an attempt to obtain a concensus among the planners in various agencies about the methodology and factors to be applied for a given system. However, it is apparent that the system has become undisciplined to the extent that the LSA, QQPRI, and MACRIT data are all being manipulated because of misunderstanding and/or lack of confidence. As a result, MLRS maintenance manpower requirements are questionable. Furthermore, because of the manipulations, some of the audit trail is lost, making later evaluations of the process difficult.

5. MPT Planning for New Systems.

No one seems to be "in-charge" of the manpower and personnel events associated with system acquisition to assure that the necessary actions and inputs are initiated at the proper time and followed through to completion. When MILPERCEN produced the MILPERCEN Initial Recruiting and Training (MIRAT) Plan in June 1978, one of the conclusions was that the planning process used in developing the MIRAT had been useful in requiring the personnel, training, and acquisition communities to look at the personnel implications of MLRS. However, the MIRAT effort was discontinued after the MIPERCEN - Soldier Support Center reorganization. It was replaced by the MILPERCEN Personnel Plan but the MLRS plan had not been completed as of 31 May 1982.

6. MPT Documentation.

Some of the MPT related MLRS documentation accomplished for

each milestone or for other requirements apear to have had, at best, limited application or value other than the fact that they met a requirement for ASARC/DSARC preparations. Many people have been involved in the process of drafting, coordinating, reviewing, and staffing documents of questionable utility, e.g., three Validation Phase QQPRIs. Often these documents are based on different assumptions, use different baseline data, or merely repeat what is already available in other sources. However, two of the most useful documents discovered during this study effort were the MILPERCEN Personnel Plan, its predecessor the MIRAT, and the MLRS Master Program Plan produced by the PMO -- none of which are required by Army Regulations.

7. Training Device Requirements.

The MLRS program does not have approved Training Device Requirements (TDR) for the FCP and LP/C Trainers. It does, however, have an approved ROC which identifies the training devices needed for MLRS. The approved ROC was used as authority to proceed with development of the training devices (a procedure that worked well). HQTRADOC has requested of HQDA that the TDR document be eliminated and that training device requirements be included in the system requirement document (ROC).

8. Maintenance.

Organizational maintenance training and performance has been evaluated but the Direct Support Contact Team concept has not been established to everyone's satisfaction. In addition, the concept of operation of EQUATE has yet to be finalized or evaluated. Personnel and equipment requirements may change as these concepts are developed.

9. Government Personnel Turnover.

Personnel turnover in the acquisition community frustrated efforts to obtain documents and the benefits of personnel experience and observations. The turnover was most noticeable among the military personnel assigned to headquarters, such as TRADOC and the DA staff. Military personnel at lower echelons were also moving about more frequently than the DA civilians who were the stable element in the community. For example, MLRS has had five Project Managers since 1976. No one PM has managed MLRS throughout an acquisition phase. Fortunately, the Deputy Program Manager has been with the program since the Conceptual Phase. Personnel turnover is costly and in cases where it occurs at higher levels, can cause program redirections or changes that could have an adverse impact on the program (Figure V-1). Vought Corporation personnel specifically mentioned the turbulence and wasted effort caused by the military turnover.

PERSONNEL TURBULENCE

ARMY Magazine, July 1982

APPENDIX A

MAJOR MPT RELATED REFERENCES

POLICIES & PROCEDURES

Department of Defense

DoD Directive 5000.1, Major System Acquisition

DoD Directive 5000.39, Acquisition and Management Support for Systems and Equipment

DoD Instruction 5000.2, Major Systems Acquisition Process

ASD(MRA&L) Memorandum, "Manpower Analysis Requirements for System Acquisition", August 1978.

MIL-STD-1388 Logistic Support Analysis, October 1973

Proposed MIL-STD-1388A, Weapon System and Equipment Support Analysis, November 1981 (Draft)

MIL-STD-1472B, Human Engineering Design Criteria for Military Systems, Equipment, and Facilities, December 1974

MIL-H-46855B, Human Engineering Requirements for Military Systems, Equipment, and Facilities

Department of the Army

AR 1-1	Planning Programming and Budgeting Within the Department of the Army
AR 10-4	US Army Operational Test and Evaluation Agency
AR 10-5	Department of the Army
AR 10-11	US Army Materiel Command
AR 10-25	US Army Logistics Evaluation Agency
AR 10-41	US Army Training and Doctrine Command
AR 11-4	System Program Reviews
AR 11-8	Principles and Policies of the Army Logistic System
AR 15-14	Systems Acquisition Review Council Procedures
AR 70-1	Army Research, Development and Acquisition
AR 70-2	Materiel Status Recording

AR 70-10	Test and Evaluation During Development and Acquisition of Materiel
AR 70-16	Department of the Army System Coordinator (DASC) System
AR 70-27	Outline Development Plan/Development Plan, Army Program Memorandum/Defense Program Memorandum/ Decision Coordinating Paper
AR 70-61	Type Classification of Army Materiel
AR 71-1	Army Combat Developments
AR 71-2	Basis of Issue Plans
AR 71-3	User Testing
AR 71-9	Materiel Objectives and Requirements
AR 71-10	Department of the Army Force Integration Staff Officer (FISO) System
AR 310-31	Management System for Tables of Organization and Equipment (The TOE System)
AR 310-34	Equipment Authorization Policies and Criteria, and Common Tables of Allowances
AR 310-49	The Army Authorization Documents System (TAADS)
AR 350-1	Army Training
AR 350-10	Management of Army Individual Training Requirement and Resources
AR 350-35	New Equipment Training and Introduction
AR 570-2	Organization and Equipment Authorization Tables - Personnel
AR 602-1	Human Factors Engineering Program
AR 611-1	Military Occupational Classification Structure Development and Implementation
AR 611-201	Enlisted Career management Field and MOSs
AR 70-18	Provisioning of U.S. Army Equipment
AR 700-127	Integrated Logistic Support
AR 702-3	Army Materiel Reliability, Availability and Maintainability (RAM)

AR 750-1 Army Materiel Maintenance Concepts and Policies

AR 750-43 Test, Measurement, and Diagnostic Equipment

AR 1000-1 Basic Policies for Systems Acquisition

DA PAM 11-2 Research and Development Cost Guide for Army Materiel Systems

DA PAM 11-3 Investment Cost Guide for Army Materiel Systems

DA PAM 11-4 Operating and Support Cost Guide for Army Materiel Systems

DA PAM 11-5 Standards for Presentation and Documentation of Life Cycle Cost Estimates for Materiel Systems

DA PAM 11-25 Life Cycle System Management Model for Army Systems

DA PAM 700-125 Integrated Logistics Support (ILS) Management Model and Glossary

Army Modernization Information (AMIN), 1979, 1980, 1981.

U.S. Army Training and Doctrine Command (TRADOC)

TRADOC Reg 11-1 Manpower Analysis and Force Structuring in the Combat Development Process

TRADOC Reg 11-8 Combat Development Studies

TRADOC Reg 71-9 User Test and Evaluation

TRADOC Reg 71-12 Total System Management - TRADOC System Manager (TSM)

TRADOC Reg 71-77 Unit Reference Sheets

TRADOC Reg 350-4 The TRADOC Training Effectiveness Analysis (TEA) System

TRADOC Cir 351-8 ICTP for Developing Systems

TRADOC PAM 70-2 DARCOM/TRADOC Materiel Acquisition HDBK, January 1980

TRADOC PAM 351-4 Job and Task Analysis Handbook, August 1979.

U.S. Army Materiel Development and Readiness Command (DARCOM)

DARCOM HDBK 700-1.1-81 ILS primer (1st and 2nd Editions)

DARCOM HDBK 700-2.1-81 LSA, December 1981

DARCOM PAM 70-2 DARCOM/TRADOC Materiel Acquisition HDBK, January 1980

STUDIES

Betaque, Norman E., Jr. et al, Manpower Planning for New Weapon Systems, WN ML 801-1 Through WN ML 801-9. Logistics Management Institute. July - December 1978.

Blanchard, George S. & Kerwin, Walter, T., Man/Machine Interface-A Growing Crisis, Army Top Problem Areas, Discussion Paper Number 2, U.S. Army Materiel Systems Analysis Activity, August 1980.

Bonder, Seth, A Review, of Army Force Modernization and Associated Manpower, Personnel, and Training Processes, Work Paper PUTA 81-2, ARI, January 1981.

GAO, Effectiveness of U.S. Forces Can Be Increased Through Improved Weapon System Design, Report Number PSAD-81-17, January 29, 1981.

HQDA, Office of the Chief of Staff, BOIP/QQPRI Task Force Report, 9 January 1980.

O'Connor, Francis E., et al, MLRS -- A Case Study of MPT Requirements Determination, 30 November 1982.

O'Connor, Francis E., et al, AN/TTC-39 Program -- A Case Study of MPT Requirements Determination, 31 March 1983.

O'Connor, Francis E., et al, BLACKHAWK (UH-60A) -- A Case Study of MPT Requirements Determination, April 1983.

O'Connor, Francis E., et al, FIREFINDER -- A Case Study of MPT Requirements Determination, April 1983.

Rhode, Alfred S., et al, Manpower, Personnel and Training Requirements for Materiel System Acquisition, ARI, February 1980.

APPENDIX B

MLRS Program Data Collection Sources

Headquarters, Department of the Army (HQDA), Washington, D.C.

- o DA System Coordinator (DASC), Ofice of the Deputy Chief of Staff, Research, Development, and Acquisition (ODCSRDA).
- o Force Integration System Officer (FISO), Office of the Deputy Chief of Staff, Operations (ODCSOPS).
- o Requirements Directorate, ODCSOPS
- o Army Force Modernization Coordination Office (AFMCO), ODCSOPS
- o Manpower Programs and Budget Directorate, Office of the Deputy Chief of Staff, Personnel (ODCSPER)

US Army Materiel Development and Readiness Comand (DARCOM)

- o Headquarters, DARCOM, Alexandria, VA
  - Office of Project Management
  - Equipment Authorization Review Activity (EARA)
- o Missile Command (MICOM), Redstone Arsenal, AL
  - Project Management Office, MLRS
  - Maintenance Engineering Directorate
- o Materiel Readiness Support Activity (MRSA), Lexington Blue Grass Army Depot, KY
  - Maintenance Division
  - Readiness Division
- o Human Engineering Laboratory (HEL), Aberdeen, MD
  - HEL Detachment, Redstone Arsenal, AL
  - HEL Detachment, Fort Sill, OK

- o Materiel Systems Analysis Activity (AMSAA), Aberdeen, MD
  - Combat Support Division
  - Reliability, Availability, and Maintainability Division

US Army Training and Doctrine Command (TRADOC)

- o Headquarters, TRADOC, Ft Monroe, VA
  - Deputy Chief of Staff, Combat Developments
- o US Army Field Artillery Center and School, Fort Sill, OK
  - TRADOC System Manager (TSM), MLRS
  - Combat Developments Directorate
  - Training Developments Directorate
  - Field Artillery Board
- o US Army Missile and Munitions School, Redstone Arsenal, AL
  - Combat Developments Directorate
- o US Army Ordance Center and School, Aberdeen Proving Ground, MD
  - Combat Developments Directorate
- o US Army Transportation School, Fort Eutis, VA
  - Combat Developments Directorate
  - Training Developments Directorate
- o Soldier Support Center - National Capital Region (SSC-NCR), Alexandria, VA
  - Military Occupational Development Directorate
  - Personnel Resources Analysis Directorate
- o Logistics Center, Lt Lee, VA
- o Training Support Center, Ft Eustis, VA

US Army Operational Test and Evaluation Agency (OTEA), Falls Church, VA

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APPENDIX C

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APPENDIX D

GLOSSARY OF ACRONYMS

AAO--Authorized Acquisition Objective
AAPMH--Available Annual Productive Man-Hours
AD--Advanced Development
ADP--Automatic Data Processing
ADTA--Aircraft Development Test Activity
AEFA--Aviation Engineering Flight Activity
AFH--Annual Flight Hours
AFMCO--Army Force Modernization Coordination Office
ALMC--Army Logistics Management Center
AMIM--Army Modernization Information Memorandum
AMMH--Annual Maintenance Manhours
AMSAA--Army Material Systems Analysis Activity
AP--Acquisition Plan
APA--Aviation Procurement-Army
APM--Army Program Memorandum
AR--Army Regulation
ARI--Army Research Institute for the Behavioral and Social Sciences
ARTEP--Army Training Evaluation Program
ASARC--Army System Acquisition Review Council
ASD,C^3I--Assistant Secretary of Defense, Command, Contro, Communications, and Intelligence
ASD, MRAL--Assistant Secretary of Defense, Manpower, Reserve Affairs, and Logistics
ASI--Additional Skill Identifier
ASIOE--Associated Support Items of Equipment
ASP--Ammunition Supply Plant
ASVAB--Armed Services Vocational Appitude Battery
ATE--Automatic Test Equipment
ATSC--Army Training Support Center
AURS--Automated Unit Reference Sheet
AUTODIN--Automatic Digital Network
AVIM--Aviation Intermediate Maintenance
AVUM--Aviation Unit Maintenance
BCE--Baseline Cost Estimate
BCS--Battery Computer System
BITE--Built-In Test Equipment
BLACKHAWK--UH-60 Utility Helicopter
BN--Battalion
BOI--Basis of Issue
BOIP--Basis of Issue Plan
BTA--Best Technical Approach
BTRY--Battery
C^3--Command, Control & Communications
C^3I--Command, Control, & Communications, and Intelligence
CAC--US Army Combined Arms Center
CAIG--Cost Analysis Improvement Group
CARDS--Catalog of Approved Requirements Documents
CD-Combat Developer
C-E--Communications-Electronics
CECOM--US Army Communications and Electronics Command
CEFR--Communications-Electronics Functional Review
CFE--Contractor Furnished Equipment
CFP--Concept Formulation Package
CFV--Cavalry Vehicle System
CM--Configuration Management
CMF--Career Management Fueld
CMMH--Corrective Maintenance Manhours
COA--Comptroller of the Army
COEA--Cost and Operational Effectiveness Analysis
COMSEC--Communications Security
CONUS--Continental United States
CPFF--Cost Plus Fixed Fee
CPIF--Cost Plus Incentive Fee
CPG--Central Processor Group
CPX--Command Post Exercise
CSA--Chief of Staff, US Army

CTA--Common Table of Allowances
CTEA--Cost and Training Effectiveness Analysis
CTP--Coordinated Test Program
DA--Department of the Army
CSAC--Combat Support Aviation Company
DAPAM--US Army Materiel Development and Readiness Command
DASC--Department of the Army System Coordinator
DCA--Defense Communication Agency
DCP--Decision Coordinating Paper
DCSLOG--Deputy Chief of Staff for Logistics
DCSOPS--Deputy Chief of Staff for Operations and Plans
DCSPER--Deputy Chief of Staff for Personnel
DCSRDA--Deputy Chief of Staff for Research, Development, and Acquisition
DDRE--Director of Defense Research and Engineering
DEPSECDEF--Deputy Secretary of Defense
DIO--Director of Industrial Operations
DOD--Department of Defense
DODD--Department of Defense Directive
DODI--Department of Defense Instruction
DP--Development Plan
DPAMMH--Direct Productive Annual Maintenance Manhours
DPM--Defense Program Memorandum
DS--Direct Support
DSARC--Defense System Acquisition Review Council
DSMC--Defense Systems Management College
DT--Developmental Testing
DT (I, II, III)--Development Test (I, II, III)
DTC--Design to Cost
DTUPC--Design to Unit Production Cost
EARA--Equipment Authorization Review Activity
ECP--Engineering Change Proposal
EQUATE--Electronic Quality Assurance Test Equipment
FACS--Field Artillery Center & School
FAMAS--Field Arfillery
Meteorological Acquisition System
FDTE--Force Development Testing and Experimentation
FIREFINDER--AN/TPQ-36 Mortar Locating Radar & AN/TPQ-37 Artillery Locating Radar
FISO--Force Integration System Officer
FM--Field Manual
FMMRS--Force Modernization Milestone Reporting System
FOE--Follow-On Evaluation
FORSCOM--US Army Forces Command
FQQPRI--Final QQPRI
FSED--Full Scale Engineering Development
FVS--Fighting Vehicle System
FY--Fiscal Year
FYTP--Five Year Test Program
GCT--Government Competitive Test
GEMM--Generalized Electronics Maintenance Model
GFE--Government Furnished Equipment
GS--General Support
GSRS--General Support Rocket System
HEL--US Army Human Engineering Laboratory
HEMAT--Heavy Expanded Mobility Ammunition Trailer
HEMTT--Heavy Expanded Mobility Tactical Truck
HET--Heavy Expanded Truck
HF--Human Factors
HFE--Human Factors Engineering
HHS--Headquarters and Headquarters & Service Battery
HQDA--Headquarters, Department of the Army
ICTP--Individual and Collective Training Plan
IEP--Independent Evaluation Plan

IER--Independent Evaluation Report
IFV--Infantry Fighting Vehicle
ILS--Integrated Logistic Support
ILSM--Integrated Logistic Support Manager
ILSMM--Integrated Logistic Support Management Model
ILSMT--Integrated Logistic Support Management Team
IOC--Initial Operational Capability
IPR--In Process Review
IPS--Integrated Program Summary
IPTF--Indirect Productive Time Factor
ISI--Information Spectrum, Inc.
ISMMH--Inspection & Servicing Maintenance Manhours
ITV--Improved TOW Vehicle
JCS--Joint Chiefs of Staff
JTA--Joint Table of Allowances
JWG--Joint Working Group
LCSMM--Life Cucle System Management Model
LEA--US Army Logistics Evaluation Agency
LIN--Line Item Number
LLM--Launcher Loader Module
LOA--Letter of Agreement
LOGCEN--US Army Logistics Center
LOGSACS--Logistic Structure & Composition Sys.
LON--Letter of Notification
LP/C--Launch Pod/Container
LR--Letter Requirement
LRIP--Low Rate Initial Production
LSA--Logistic Support Analysis
LSAR--Logistic Support Analysis Record
LSP--Logistic Support Plan
MAA--Mission Area Analysis
MACOM--Major Army Command
MACRIT--Manpower Authorization Criteria
MADP--Material Acquisition Decision Process
MAP--Manpower Analysis Paper
NCC--Mission Configuration Change
MD--Material Developers
MDC-Material Development Command
MEA--Maintenance Engineering Analysis
MENS--Mission Element Need Statement
MFK--Mission Flexibility Kit
MFP--Material Fielding Plan
MICOM--US Army Missile Command
MILPERCEN--US Army Military Personnel Center
MIRAT--MILPERCENT Initial Recruiting & Training Plan
MIST--Man Integrated System Technology
MLRS--Multiple Launch Rocket System
MOE--Measure of Effectiveness
MOS--Military Occupation Specialty
MPT--Manpower, Personnel, and Training
MRC--Materiel Readiness Command
MRF--Milestone Reference File
MRSA--US Army Material Readiness Support Activity
MTBF--Mean-Time Between Failures
MTBM--Mean Time Between Maintenance
MTBR--Mean Time Between Removal
MTOE--Modification Table of Organization Equipment
MN--Material Need
MTTR--Mean-Time-To-Repair
NET--New Equipment Training
NETP--New Equipment Training Plan
NETT--New Equipment Training Team
NSA--National Security Agency
OCO--Operational Capability Objective
ODP--Outline Development Plan
OLM--Organizational Maintenance
OOC--Operational & Organizational Concept
OPA--Other Procurement-Army
OSA--Orrice, Secretary of the Army
ODS--Office, Secretary of Defense
OT--Operational Testing
OT--(I, II, III)--Operational Test (I, II, III)
OTE--Operational Test and Evaluation

OTEA--US Army Operational Test and Evaluation Agency
OTP--Outline Test Plan
PCB--Printed Circuit Board
PERSACS--Personnel Structure and Composition System
PGSE--Peculiar Ground Support Equipment
PIP--Product Improvement Proposal
PLDMD--Platoon Leader's Digital Message Device
PM--Project Manager
PMP--Project Management Plan
POC--Point of Contact
POM--Program Objective Memorandum
PPBS--Planning, Programming, and Budgeting System
PQQPRI--Provisional QQPRI
PTTDAR--Personnel, Training, and Training Device Analysis Report
QQPRI--Qualitative and Quantitative Personnel Requirements Information
RAM--Reliability, Availability, Maintainability
RDTE--Research, Development, Test and Evaluation
REOC--Replenishment of Expendables and Operational Checks
RFP--Request for Proposal
ROC--Required Operational Capability
SA--Secretary of Army
SACS--Structure and Composition System
SECDEF--Secretary of Defense
SIMOR--Space Imbalance MOS.
SISMS--Standard Integrated Support Management System
SME--Subject Matter Expert
SMI--Soldier-Machine Interface
SMIR--Soldier-Machine Interface Requirements
SOW--Statement of Work
SPAS--Skill Performance Aids
SPLL--Self-Propelled Launcher Loader
SQT--Skill Qualification Test
SRC--Stadard Requirements Code
SSC-NCR--Soldier Support Center - National Capital Region
SSEB--Source Selection Evaluation Board
SSG--Special Study Group
SSI--Specialty Skill Identifier
STF--Special Task Force
STOG--Science and Technology Objectives Guide
TAADS--The Army Authorization Documents
TACFIRE--Field Artillery Tactical Fire Direction System
TAMMS--The Army Maintenance Management System
TC--Type Classification
TDR--Training Device Requirement
TDA--Table of Distribution and Allowances
T&E--Test and Evaluation
TECOM--US Army Test and Evaluation Command
TEMP--Test and Evaluation Master Plan
TIWG--Test Integrated Working Group
TM--Technical Manual
TMOS--Tentative Military Occupation Specialty
TOA--Trade-Off Analysis
TOD--Trade-Off Determination
TOE--Table of Organization and Equipment
TRADE--Training Devices
TRADOC--US Army Training and Doctrine Command
TRASSO--TRADOC System Staff Officer
TRITAC--Tri-Service Tactical Communication System
TSARCOM--US Army Troop Support and Aviation Material Readiness Command
TSM--TRADOC System Manager
USAAC--US Army Aviation Center
USAFAC--US Army Field Artillery Center
USAMMCS--US Army Missile & Munitions Center and School
USAREUR--US Army Europe
USASC--US Army Signal Center
USATSC--US Army Training Support Center
UTTAS--Utility Tactical Aircraft System
VCSA--Vice Chief of Staff Army