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AMCOM Industrial Operations Division (IOD) required research, analysis and evaluation of proposed changes and producibility impacts pertaining to the Multiple Launch Rocket System (MLRS) launcher, carrier, and support equipment throughout its life cycle. This research effort concluded with a detailed analysis of the impacts of proposed changes on the current manufacturing processes and life cycle support activities that are currently in place within the MLRS Project Office.

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Technical Report 5-34856
Contract No. DAAH01-92-D-R006
Delivery Order No. 131

Research, Evaluation and Analysis of Design Changes And Secondary Item Support for the MLRS Launcher, Carrier and Support Equipment (5-34856)

Final Technical Report for Period
6 August 1997 through 31 March 1998

August 1999

Prepared by:

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Prepared for:

U.S. Army Aviation & Missile Command
Redstone Arsenal, AL 35898
Attn.: Mr. Doug Johnston

PREFACE

This technical report was prepared by the staff of the Research Institute, The University of Alabama in Huntsville. The purpose of this report is to provide documentation of the work performed and results obtained under Delivery Order 131 of AMCOM Contract No. DAAH01-92-D-R006. Mr. Gary Maddux was the principal investigator. Significant technical support was provided by System Studies and Simulation, Incorporated, who served as a subcontractor on this effort. Mr. Doug Johnston, Industrial Operations Division, Systems Engineering and Production Directorate, Research, Development, and Engineering Center, U.S. Army Aviation & Missile Command, provided technical coordination.

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Prepared for: Commander
U.S. Army Aviation & Missile Command
Redstone Arsenal, AL 35898

I have reviewed this report, dated 10 Aug 99 and the report contains no classified information.

Gary A Maddux
Principal Investigator

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1.0 Introduction

The System Engineering and Production Directorate (SEPD), Research, Development and Engineering Center (RDEC), U.S. Army Aviation and Missile Command (AMCOM) has an engineering support contract with the University of Alabama in Huntsville. The scope of the contract provides for activities in system engineering and manufacturing technology. The Industrial Operations Division (IOD), SEPD, RDEC, AMCOM has the mission and function of providing technical management and engineering analysis as they relate to design changes and secondary item procurement for AMCOM supported weapon systems. This management and analysis ensures that design changes and secondary item problems are resolved and incorporated only after a systematic technical evaluation and review of the total cost of the change is conducted. The systems include impacts on the manufacturability, maintainability and supportability of the overall weapon system.

In order to fulfill its mission, IOD required research, analysis and evaluation of proposed changes and producibility impacts pertaining to the Multiple Launch Rocket System (MLRS) launcher, carrier, and support equipment throughout its life cycle. This research effort concluded with a detailed analysis of the impacts of proposed changes on the current manufacturing processes and life cycle support activities that are currently in place within the MLRS Project Office.

2.0 Objective

The objective of the work performed under this task order was to support MLRS production and spare parts acquisition. UAH researched, evaluated, analyzed and developed recommendations as to the impacts of proposed design changes and resolved producibility questions relating to the MLRS launcher, carrier, and support equipment. These recommended solutions required close interaction with the MLRS Project Office, their prime and sub-contractors, and other Government agencies. Solutions were presented to the MLRS Project Office and the IOD in the form of briefings, memoranda, and other detailed presentations as required by the project office and IOD.

3.0 Statement of Work

The statement of work, as outlined in delivery order 131, was as follows:

3.1 UAH shall research, review, evaluate and analyze design changes related to the systems, subsystems, and components on the MLRS launcher and carrier including:

3.1.1 Azimuth Drive Unit (ADU), including use and limitations, static and dynamic braking requirements, and emergency stopping.

3.1.2 Launcher hydraulic and mechanical systems.

3.1.3 Launcher/carrier components that are the subject of reported field problems.

3.2 UAH shall work closely with the International Partnership Office, MLRs Project Office to perform the following research and analysis:

3.2.1 UAH shall review and evaluate requests from Memorandum of Understanding (MOU) Partner nations for Production Support Order (PSO) requirements.

3.2.2 UAH shall provide technical input on preparation of PSOs IAW DA/DOD policy.

3.2.3 UAH shall provide technical and project management advice on closure and disbursement of PSO funds and proper documentation IAW DFAS regulations and policies.

3.2.4 UAH shall provide technical input to co-production/cooperative program MOUs on recoupment/financial arrangements and third party sales policy and regulatory requirements.

3.3 UAH shall provide engineering analysis support of programmatic tasks for the MLRS Guided Rocket Integration Group (GIG), FMS, and Co-Production. This analysis and support shall require close interaction with the MLRS GIG personnel to review design changes and procedures which impact this group's design and manufacturing integration activities.

3.4 UAH shall provide engineering and technical expertise to evaluate and provide solution options related to spare parts procurement problems.

3.4.1 UAH shall analyze the producibility of the MLRS weapon system and subsystems. The analyses shall be performed on parts specifically identified by the government. UAH shall analyze TDP data (listings, engineering documentation and changes thereto) to advise the government if the present baseline and/or detail drawings are adequate for competitive procurement and/or manufacture. UAH shall, during TDP analysis, document any cost reduction opportunities in the TDP, using value engineering methodology as a generally accepted practice of cost analysis. UAH shall provide a written report for each TDP analyzed. The report shall detail any deficiencies and provide recommended solutions. UAH shall provide recommended TDP updates where applicable.

3.4.2 UAH shall perform an engineering analysis on producibility problems identified during the procurement cycle of MLRS secondary items. The analysis will require review of drawings, specifications, and related materials pertaining to the identified problem. UAH shall determine and recommend solutions to the producibility problem(s) and provide rationale to support recommendations. UAH shall, during engineering analysis, document any cost reduction opportunities in the

TDP, using value engineering methodology as a generally accepted practice of cost analysis. Results of the analysis shall be prepared and furnished in a written format.

4.0 Analysis of the MLRS System

The following table presents a detailed listing of tasks performed under this effort.
DAAH01-92-D-R006 (DO#131)

Task Title/Description	Status	Government / Contractor POC
Reviewed and discussed status of on-going task to develop common Data Base for use on PSO transactions and reports by German Project Office and US Project Office.	**Complete**	**Farris, Fee, Carter / Fitts**
Researched and attended meetings regarding establishing new standing operating procedure (SOP) for financial management of MLRS PSOs under new financial operation where local Defense Accounting Office has been relocated to operating location at St. Louis, MO.	**Complete**	**Beale, Johnson / Simmons**
Initiated changes/inputs to GMLRS ACEIT cost models to reflect previous manually calculated bottom line three point estimate for Joint GMLRS development program. Results to support development of Annex B to the MOU Supplement for GMLRS portraying Expected cost, Maximum cost and Minimum cost along with each participant's cost share.	**Complete**	**Stone, Beale / Fitts**
Developed Technical Arrangement (TA) to document Economic Price Adjustment (EPA) methodology, procedures, tracking, and required EPA Indices/sources for use by MOU participants in implementation of GMLRS cost sharing arrangements. Developed for presentation to formal EMC for review and approval prior to start of joint development program on GMLRS.	**Complete**	**Stone, Beale / Fitts**

Task Title/Description	Status	Government / Contractor POC
Developed draft language for Article VIII of the MOU Supplement for Guided MLRS (GMLRS) describing how Cost Shares among the MOU participants will be developed, tracked and maintained. Draft to support the GMLRS EMC meeting 8-9 Sep 97.	**Complete**	**Stone, Beale / Fitts**
Analyzed Recoupment Model data files to isolate problem areas and determine actions required to correct model operation to provide proper output reports for the base plan, Change 7 to the MLRS Procurement Plan.	**Complete**	**Kosis / Fitts**
Performed detail review of the MLRS Recoupment Model outputs to determine if any input errors, improper links, format problems, etc., currently exist.	**Complete**	**Kosis / Fitts**
Developed Flow Charts for the activities and reports generated by the MLRS Recoupment Model, as portrayed in Change 7 to the MLRS Procurement Plan.	**Complete**	**Kosis / Fitts**
Researched prime contractors requirement for additional hours required to finish updating the UK MLRS AT2 SPAP upgrade as required by PSO 47.	**Complete**	**Beale, Johnson / Simmons**
Prepared internal information paper with background of production support orders (PSO), as well as current status, i.e., number of PSOs, dollar value, etc.	**Complete**	**Beale, Johnson / Simmons**
Reviewed SOW for new contract with MLRS International Corporation (MIC). Recommended changes/additions based on current role of MIC.	**Complete**	**Barnette / Fitts**
Supported MLRS effort requesting Department of the Army approval in use of recurring production support cost collected from third party sales.	**Complete**	**Beale, Johnson / Simmons**

Task Title/Description	Status	Government / Contractor POC
Assisted in preparing a production support order (PSEA051) to collect the Europeans share of 1998 Industrial Engineering Services.	**Complete**	**Fee, Johnson, Gueringer / Simmons**
Assisted in reviewing projected PSO excess dollars for FPWG Meeting 21 – 23 Oct 97.	**Complete**	**Fee, Johnson / Simmons**
Assisted in reviewing recoupment changes approved by DSAA for the MLRS Extended Range Rocket.	**Complete**	**Beale, Johnson / Simmons**
IGA 97-266: Requested sources be located for eight test set parts. Sources were located for seven of the eight parts, and an alternate part identified for the remaining part. Also, the TDP has errors for which recommended changes were developed.	**Complete**	**Johnston / B. Jones**
Provided in-depth review and comments for spare part buy (preload) of 13210284-10 (microcircuit). The buy was restricted due to cancelled specification for next assembly (printed wiring board) and referred for review by Quality Engineering to determine impacts.	**Complete**	**Johnston, Maciel / B. Jones**
Initiated ECP to correct problem with SNVT cover gasket specification being cancelled without replacement. It was determined that the SNVT mounting plate and the EB cover use the same type gasket. ECP MI-C-1845 includes a fix for the cancelled specification for the EB gasket. Referred to Lockheed to determine if the EB fix is applicable to the SNVT gasket.	**Complete**	**Johnston, Maciel / B. Jones**
IGA #98-21: Requested a source and description of the material for 13030410 (set screw). A source and the material description were determined and provided to the Government POC.	**Complete**	**Johnston / B. Jones**

Task Title/Description	Status	Government / Contractor POC
Researched source for obsolete parts 13032398 and 8000303XX (microcircuits). A source was located for 8000303XX. The die for 13032398 is currently being manufactured. The information was provided to the Government.	**Complete**	**Johnston /B. Jones**
ENS flagged PRON D17B0143 through DFARS screening, stating that MIL-S-18729 had been cancelled without replacement. An investigation produced superseding documents SAE-AMS 6350, 6351, and 6345. Findings reported to Government POC.	**Complete**	**Johnston, Maciel / B. Jones**
Performed analysis of three iterations of M270A1 Cost Proposals. Provided detailed rationale for a reduction by more than one-third of proposed cost. Provided detailed spreadsheets by cost center, by WBS, by task, and summary level. Contractor accepted the recommended cost.	**Complete**	**Bridge / Austin, B. Jones**
Performed engineering analysis and researched alternate sources for Cage Travel Lock Actuator Motor. Two sources identified.	**Complete**	**D. Jones /Austin, B. Jones**
Reviewed prior year P-code ECPs to determine if proper justification codes were applied. Identified routine improper coding. Prepared final report and made view graph summary presentation.	**Complete**	**Wharton / Austin**
Developed justification rationale to support the requirement for the first six months of GMLRS EMD contract effort prior to contract award.	**Complete**	**Swaim, Stone / Fitts**
Supported the International GMLRS EMC/MOU meeting. Developed Charts to support the November 1997 International EMC meeting.	**Complete**	**LTC (P) Ward, Beale / Fitts**
Finalized funding flow options for the joint GMLRS EMD Program. Developed updates/changes to the GMLRS MOU Article VIII on Financial Arrangements and on the MOU Annex B on Cost Shares.	**Complete**	**Gentle, Stone / Fitts**

Task Title/Description	Status	Government / Contractor POC
Gathered/developed data to support development of a draft of Change 8 to the MLRS Procurement Plan. This included changes in MOU participants national requirements for MLRS hardware, approved Third Party sales, LMVS, UDLP and GDDS IES/STS contract values, and European share/payments for IES/STS effort.	**Complete**	**Fee, Beale, Williams, Kennedy / Fitts**
Finalized changes/corrections to the Recoupment Model and published the Baseline Change 7 to the MLRS Procurement for inclusion in the FPWG support documentation/presentation.	**Complete**	**Kosis, Beale / Fitts**
Performed an analysis/review of spreadsheets previously developed by Mr. Gene Orebaugh regarding the annual Third Party contributions to the IES/STS contracts for FY92 through FY97. Corrected errors and made changes to these spreadsheets as a result of this review.	**Complete**	**Orebaugh, Williams, Kosis, Kennedy / Fitts**
Developed and finalized charts to support the 21-22 October 1997 FPWG meeting. Conducted discussions and reviews with US representative, who will attend the meeting.	**Complete**	**Kosis, Fee, Cochran / Fitts**
Evaluated IPC-6012, a proposed production specification for rigid printed wiring boards. Recommended use of MIL-PRF-31032 as a replacement instead because DSCC will perform a comprehensive audit to qualify vendors. IPC-6012 does not require a qualifying activity.	**Complete**	**D. Jones / B. Jones**
Evaluated PRON PRE70564, TPN 13210284-10. A review of the higher assembly drawing, 13210245, resulted in a determination that MIL-P-46843 had been canceled without replacement, thereby restricting the buy to the prime contractor.	**Complete**	**Johnston, Maciel / B. Jones**

Task Title/Description	Status	Government / Contractor POC
Processed a request to prepare an ECP to compensate for a canceled specification flagged during processing of Technical Data Package (TDP) PRON PRE17035, APN 13030280. The ECP was to allow for competitive bidding. Investigation concluded that the ECP was not necessary because the TDP contained obsolete microcircuits, thereby restricting the buy to the prime contractor.	**Complete**	**Johnston, Maciel / B. Jones**
Assisted in preparing an internal operating procedure for management of production support orders in the International Partnership Office.	**Complete**	**Johnson / Simmons**
Assisted in preparing charts reflecting recoupment charges collected from third party sales, amounts disbursed to US Government and European Partners, voucher number, etc.	**Complete**	**Johnson, Carter / Simmons**
Assisted in preparing a production support order (PSEA052) to collect the European share of 1998 TACOM Engineering Services Contract.	**Complete**	**Johnson, Williams / Simmons**
Developed revised MLRS Recoupment Model Users Guide to reflect changes/updates to the model and to incorporate the newly developed flow charts depicting the various model inputs, processes, outputs, and reports.	**Complete**	**Kosis / Fitts**
Developed GMLRS EMD funding profiles (Expected and Maximum Cost) by quarter to support Annex B of the draft GMLRS MOU. Added justification and funding profiles to the draft Technical Arrangement regarding the initial funding outlays for the European partner country's funding outlays to support the GMLRS contract award. This documentation was to support the December 1997 International JSC Meeting.	**Complete**	**Stone, Beale / Fitts**

Task Title/Description	Status	Government / Contractor POC
Completed development on the second section of Annex D to the MLRS Procurement Plan which covers the development and tracking of Third Party annual contributions to the MLRS IES contracts.	**Complete**	**Kosis, Kennedy, Orebaugh, Williams / Fitts**
Reviewed contractor generated Life-Cycle-Cost comparison of current and new ADUs. Determined that the analysis was grossly biased toward the new ADU. Recommended that a new analysis be made.	**Complete**	**Bridge / Austin**
Reviewed older PSOs for possible close-out.	**Complete**	**Johnson / Simmons**
Assisted in reviewing LMVS Proposal for 1998, 1999, and 2000 IES contract.	**Complete**	**Johnson; Beale / Simmons**
Completed PSO PSEA053 for a feasibility study of integrating the LONGFOG missile onto the MLRS, M270 launcher, signed on 6 Feb 98 and mailed to the UK.	**Complete**	**Johnson / Simmons**
Completed PSO PSEA054 for 12 months effort of a maintenance support agreement for the UK Launcher Instrumentation and Data Acquisition Support (LIDAS), signed by the PM on 4 Feb 98 and mailed to the UK.	**Complete**	**Johnson / Simmons**
Investigated reported high failure rate of carrier engine. Determined reports to be factual. The major cause is poor QA at repair facilities with inadequate Government contract oversight. Two potential engineering deficiencies identified.	**Complete**	**Bramlett /Austin**
Generated M270A1/LRU schedule for ensuring LRU availability to support M270A1 scheduled activities through operational test.	**Complete**	**Alexander / Cox**

Task Title/Description	Status	Government / Contractor POC
Supported the safety release of the ER-MLRS rocket. This entailed reviewing documents to determine what needed to be performed, gathering data that was not on hand, performing an analysis of the data after receipt, and writing a report to be used for obtaining the safety certification of the XM451 fuze.	**Complete**	**Reese / Hill**
Provided formal vendor quote to requestor for part as follow-up to evaluation of IGA #98-90, Socket Head Cap Screw. Report provided to requestor in January.	**Complete**	**Matthews / B. Jones**
Reviewed ECP 1856- Non-Metallic Duffel Bag Box Identified four discrepancies.	**Complete**	**Wharton /Austin**

5.0 Conclusion and Recommendations

During the time frame allocated by the delivery order, members of the UAH Systems Management and Production Lab, with the cooperation of representatives from AMCOM Systems Engineering and Production Directorate and the MLRS Project Office conducted an engineering analysis of the MLRS launcher, carrier and support equipment. It is recommended that the Project Office continue to monitor the configurations of its equipment to ensure the MLRS remain cost effective and high quality.