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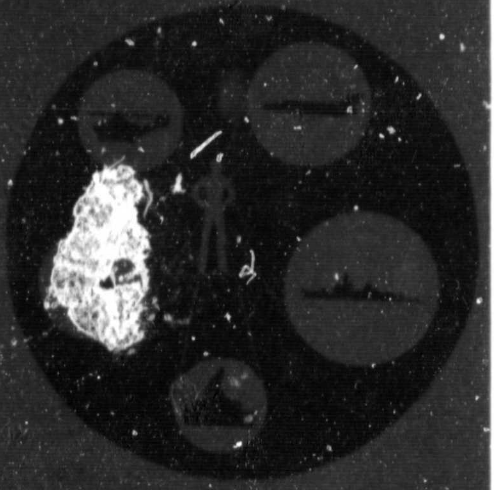

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APPLICATION OF THE HARDMAN METHODOLOGY TO THE ARMY REMOTELY PILOTED VEHICLE (RPV)

VOL. I TECHNICAL REPORT

DYNAMICS RESEARCH CORPORATION

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APPLICATION OF THE HARDMAN METHODOLOGY TO THE ARMY REMOTELY PILOTED VEHICLE (RPV)

APRIL 8, 1983

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PREFACE

This report describes the application of the HARDMAN Methodology to the Army Remotely Piloted Vehicle (RPV). The methodology was used to analyze the manpower, personnel, and training (MPT) requirements of the proposed RPV system design for a number of operating scenarios. The Army RPV system is defined as consisting of the equipment, personnel, and operational procedures needed to perform five basic artillery missions: reconnaissance, target acquisition, artillery adjustment, target designation and damage assessment.

The RPV design evaluated includes an Air Vehicle (AV), a Modular Integrated Communications and Navigation System (MICNS), a Ground Control Station (GCS), a Launch Subsystem (LS), a Recovery Subsystem (RS), and a number of ground support requirements.

The HARDMAN Methodology is an integrated set of data base management techniques and analytic tools, designed to provide timely and fully documented assessments of the human resource requirements associated with an emerging system's design. Additionally, the methodology provides the capability to determine the impact of a system's manpower, personnel, and training resource demand on the Army's current and/or projected supply of those assets, thereby targeting problem areas in system supportability. Effective tradeoff analyses can then be conducted through interaction of the methodology.

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Volume I of this report details the application of the six steps of the HARDMAN Methodology to the RPV and also presents the project's findings. Volume II provides supporting or supplemental data in a number of appendices.

The project effort was authorized under contract number 956-320 with the California Institute of Technology, Jet Propulsion Laboratory (JPL). The contract monitors were Mr. Warren Apel and Mr. Joseph Gleason of the JPL. Work on the project was performed by members of the Man-Machine Systems Department, Dynamics Research Corporation, Wilmington Massachusetts. The contract Program Manager was Charles Vehlow. The Report Manager was John Glasier. Principal analysts and authors of the report were Kathryn Bisack, Robert Guptill, Paul Hunt, John Snow, Cecil Wakelin and Annemarie Walsh. Other contributors were Marjorie Bristol, Richard Dowd, Stephen Dimaio, Ed Marquardt, and Richard Mills. The principal programming was accomplished by William Powers. Administrative support was provided by Donna Fentross, Corinne Perkins, Sharon Doherty, and Dianna Digregorio.

The success of the project was due in large part to cooperation of a number of government individuals and organizations who provided information and assistance but bear no responsibility for the results of the study. DRC is particularly grateful for the assistance provided by the staff of the Tactical Airborne Remotely Piloted Vehicle/Drone System Project Manager (DRCPM-RPV), U.S. Army Aviation Research and Development Command, St. Louis Missouri; the MICNS Project Manager's staff (DRCPM-MI-L), U.S. Army Electronics Research and Development Command, Fort Monmouth, New Jersey; Defense Manpower Data Center, Santa

Barbara, California; Navy Composite Aircraft Squadron Six (VC-6) Norfolk, Virginia; Tank and Automotive Command (TACOM), Ground Vehicles, Warren, Michigan; Pacific Missile Test Center, Point Mugu, California; and members of the RPV development team of the Lockheed Missile and Space Company, Inc., Sunnyvale, California.

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SECTION 1 - EXECUTIVE SUMMARY

1.1 PURPOSE

In June 1982, Dynamics Research Corporation (DRC) was placed under contract by the California Institute of Technology's Jet Propulsion Laboratory (JPL). The purpose of the contract was to apply the HARDMAN Methodology to the Army's Remotely Piloted Vehicle (RPV).

The HARDMAN Methodology is an integrated set of data base management techniques and analytic tools designed to assess the human resource implications of design decisions. The HARDMAN Methodology was originally developed by DRC for the U.S. Navy to determine the manpower, personnel, and training (MPT) requirements of emerging weapon systems. The methodology has since been adapted to and already benefited the Army by identifying adverse MPT impacts of conceptual weapon systems early enough in the acquisition process to allow corrective actions. When applied to the Division Support Weapon System (DSWS), HARDMAN provided useful MPT information to the Program Manager, Cannon Artillery Weapon Systems, in preparation for the DSWS Milestone I review by the Army Systems Acquisition Review Council (ASARC). Additionally, through its analytic processes and algorithms, and by requiring classification of numerous previously unspecified variables, the HARDMAN Methodology was effective in providing to the Corps Support Weapon System (CSWS) Special Task Force meaningful estimates of manpower, personnel and training resource requirements for that system.

1.2 SCOPE OF THE STUDY

The Remotely Piloted Vehicle (RPV) system is being developed to provide the Army with a target acquisition, target location, and laser designation capability which will significantly enhance the effectiveness of the artillery. This RPV system will provide important assistance in reducing the operational deficiencies which exist in currently fielded and projected target acquisition systems. Its ability to see battlefield areas at longer ranges or targets hidden from line-of-sight of ground sensors, and to recognize and identify targets through use of its onboard imaging sensors, is key to its utility.

The Aquila RPV system will operate from unimproved sites approximately 10 kilometers behind the line of contact. The Air Vehicle (AV) returns real-time video imagery and target-location information via a jam-resistant data link. Mission planning and AV control is accomplished in the Ground Control Station (GCS), the self-contained mobile command and control center for the RPV system. The GCS is mounted on one of the section's six, 5-ton tactical vehicles. Besides the GCS, the RPV section includes five air vehicles, one remote ground terminal for communication, one launcher and one recovery subsystem, ancillary vehicles, and other support equipment. The RPV section provides its own organic mobility for all necessary equipment.

RPV is in the demonstration and validation phase of development. Development Test/Operational Test I was waived based upon the RPV system's technical model. An amended Required Operational Capability (ROC), which authorized the addition of a Forward Looking Infrared (FLIR) capability, was approved in late 1981. The present development schedule calls for Development Test II in Fiscal Year (FY) 84-85 and Operational Testing II to be conducted in FY85.

Presently there is no firm date set for the Milestone II review by the Army Systems Acquisition Review Council (ASARC). Therefore, the potential baseline solutions for RPV design, operation and support could still theoretically change. As a result, the DRC program analysis team has, in conjunction with the RPV project office, explicitly defined the RPV baseline system to be examined during the study. The scope of the study involved the following considerations:

(1) All six steps of the HARDMAN Methodology;

(2) Those equipments presently found in a RPV section;

(3) Direct manpower requirements for operators and maintainers of the above equipment;

(4) Crew, organizational, and direct support levels of maintenance; and

(5) The impact of human resource requirements of the RPV system on the Army.

1.3 RESULTS

Table 1.3-1 illustrates the results of the study with respect to the reference and baseline systems analyzed for RPV. The values shown are for the total Army procurement which contains 56 RPV sections. The reference system is a notional design which includes existing DoD/NATO equipments functionally capable of performing RPV requirements. The baseline system consists of those equipments which will be fielded at the Initial Operational Capability (IOC) date, and whose technology enhanced capabilities are coincident with the functional requirements of the RPV. The boxed figures highlight the lowest resource demands for manpower, personnel and training requirements. Some of the more specific results are contained in the following paragraphs, and are discussed in more detail in the appropriate sections of the report.

<u>Mission</u>

- The equipment which defines the baseline RPV section is adequate to perform those target acquisition missions assigned to the section.

- The Organizational and Operational (O&O) concept scenario is the most ideal in terms of weather conditions and AV loss parameters. However, when realistic values are added for these parameters under a sustained tempo of operations, the amount of workload an RPV section must accomplish decreases.

TABLE 1.3-1 RPV SYSTEM SUMMARY

CATEGORY	REFERENCE SYSTEM SUSTAINED	REFERENCE SYSTEM O&O	BASELINE SYSTEM SUSTAINED	BASELINE SYSTEM O&O
Manpower				
Crew*	812	868	$\boxed{756}$	812
DS Maintenance	294	294	$\boxed{252}$	266
Personnel				
Number of MOS	24	24	$\boxed{21}$	$\boxed{21}$
Personnel Requirement*	2,932	3,066	$\boxed{2,616}$	2,750
Annual Recruit Rate	1,080	1,124	$\boxed{973}$	1,017
Training				
Annual Training Man-Days	76,133	78,232	$\boxed{64,208}$	66,462
Annual Instructor Requirement	73.0	74.8	$\boxed{63.5}$	65.5

* Includes enlisted requirements of the Platoon Headquarters

Systems Analysis

- The government furnished equipment (GFE) was the principal cause of both preventive and corrective maintenance workload. The trucks were the major contributors to these maintenance requirements.

- The M939 series 5-ton truck shows a potential improvement over the M809 series of as much as 2:1 in reducing corrective maintenance (CM) workload.

Manpower

- Differences in manpower requirements are influenced more from a combination of operational scenario assumptions than by a large difference in system reliability and maintainability values.

- The operational manning requirements account for at least 60% of the overall workload, regardless of scenario.

- Most of the operational manning (68 percent) requires no specific MOS or skill level to accomplish.

- Total Crew/Organizational maintenance (MOS's 13TP9, 63B, 31V) Army manpower requirements to support the RPV section level are 168 for the baseline and 224 for the reference system. The difference results from the 31V MOS requirement in the reference RPV section.

Personnel

- The baseline system required three fewer Military Occupational Specialties (MOS) than was assigned to the reference system (21 vs 24). Of the three MOS's, one was assigned at the RPV section level and two are required at the DS maintenance level.

- The 13T10 MOS availability ratio for the RPV system projects a ten percent personnel shortfall (based on FY-1984 estimates).

- The RPV 13T MOS personnel structure indicates a larger demand at the E-3 and E-4 levels than is available from the inherent 13T E-1 and E-2 levels.

Training

- Two new Army MOS's are required by RPV. The enlisted MOS for RPV Crewmember is 13T. An additional skill identifier (ASI) P9 is used to designate the RPV Organizational Mechanic. A new warrant officer MOS is designated MOS 211B.

- A total of nine new or modified courses were required for the reference system. Seven of the courses were modified to reflect the training differences between the reference and baseline configurations and two courses were deleted.

- The training for five existing maintenance MOS must be modified to accommodate training for the RPV. These are MOS's 26L, 31E, 31V, 34Y, 35E, (Reference only) and 63W (Baseline only).

- The requirement exists for a system-specific organizational maintenance MOS and a direct support maintenance MOS. A critical factor in this determination included the consideration of the ability of the proposed built-in test (BIT) equipment to perform to design specifications.

Impact

- The contractor furnished equipment (CFE) baseline failure rates or time-to-repair values could be increased by a factor of six before another section position would be required.

- RPV manpower requirements include MOS's already projected to be in short supply in Fiscal Year 1984. Among the most critical of these are:

13T	RPV Crewmember	10%
31S	Field General COMSEC Repairer	77%
34Y	Field Artillery Computer Repairer	24%
41B	Topographic Instrument Repairer	32%
45G	Fire Control Systems Repairer	13%

Smaller shortfalls (i.e., less than 10%) are projected for four other MOS's: 35E, 35H, 44B, and 52C.

Tradeoffs

- Concept - Internal Security

  Given a 12 hour operating scenario, workload requirements preclude internal security guards being provided from RPV section personnel.

- Equipment - M809 Series Versus M939 Series 5-Ton Cargo Truck

  The same maintenance manpower requirements exist regardless of the series truck fielded at the Initial Operational Capability (IOC) date.

- Operations - Site Displacement Times

  Fifty-four minutes is required for 13 personnel to displace the minimum operations RPV site. 114-120 minutes is required for 13 personnel to displace the 100% improved RPV site.

1.4 FACTORS INFLUENCING STUDY RESULTS

The character of this study was influenced by a number of underlying assumptions and/or constraints. A brief summary of the most significant is provided below.

Force Structure:

- RPV will represent a complete addition to the Army's force structure, i.e. RPV will not replace an existing system.

- Aggregated RPV MPT requirements are based on a total requirement for 14 RPV platoons within the active Army. Each platoon is composed of a platoon headquarters and four operational RPV sections per platoon.

System Design:

- Each item of equipment selected for both the reference and the baseline system satisfied all projected RPV operational requirements specified in the Organizational and Operational (O&O) concept and other program documentation.

System Operation:

- Mission profile/operational mode information represents that obtained from RPV system documentation and from the RPV Project Office. In cases where operational information was not clearly defined, "best estimates" were made by DRC personnel, and then verified with the RPV Project Office.

Manpower:

- Allowances and constraints for estimating manpower using the Army Manpower Authorization Criteria (MACRIT) process, contained in Army Regulation 570-2, were incorporated into the analysis.

- The DRC-developed model, Interactive Manpower Aggregation Estimation System (IMAGES), was used to determine workload requirements from which system manpower requirements are calculated. Besides determining workload, the model also accommodated sensitivity analysis of workload requirements to variations in key system parameters. These parameters included system concepts, equipment and operational considerations.

Personnel:

- The DRC-developed Interactive Manpower-Personnel Assessment and Correlation Technology (IMPACT) model, which computes system-specific personnel requirements, is driven by steady-state manpower requirements. It was assumed that initial personnel requirements where therefore already filled.

Training:

- Training associated with the operational test and evaluation of the proposed system and training associated with the initial fielding of the system (e.g., new equipment training) were not estimated.

- All established training is assumed to be adequately meeting existing system performance requirements.

1.5 CONCLUSIONS AND RECOMMENDATIONS

The RPV Section, operating as described in a sustained scenario concept, emerges as the preferred candidate from a manpower, personnel, and training (MPT) standpoint, due to its low demand for these resources. This outcome appears to be the result of a combination of several factors: scenario assumptions which tend to decrease the amount of operational workload, and qualified 13T and 13TP9 operators and maintainers. Without the influence of these factors, RPV section manpower requirements could increase by as many as two positions.

Regarding personnel, the RPV 13T MOS personnel structure indicates a larger demand at the E-4 and E-3 levels than is available from the inherent 13T E-2 and E-1 levels. This was in spite of accomplishing much of the non-skill level specific workload at the E-2 level.

A number of potential solutions to this "hump" in the structure include (1) reinforcing the 13T MOS at the E-4 level with personnel cross-trained from another MOS, (2) cross-training with other systems so that a greater E-1 and E-2 pool would be available (i.e., create a secondary MOS), or (3) shift workload through system engineering analysis to incorporate a greater E-1 and E-2 requirement.

Concerning training, the requirement may exist for a system-specific organizational maintenance MOS (rather than an ASI P9) and a direct support maintenance MOS as well. A critical factor will be the ability of the built-in-test (BIT) to perform to design specifications.

Finally, the type of training that will be required for the mission payload operators and air vehicle operators is in keeping with those duties required of the section commander and section chief. In most instances, this training is similar to that normally provided to senior NCO's and officers. Thus the personnel selected for this training must possess the proper background, aptitude, and maturity. This fact, coupled with the expectation that 13T MOSs will not be using these skills for some time after reaching the field, may dictate a two step training program. The first level would center on those duties involving the operation of launcher, recovery and AV handling systems and associated safety. Then, based on aptitude and potential demonstrated during their Supervised On-The-Job Training (SOJT) program, personnel would be selected for advanced operator training.

There are three general recommendations in this report. First, a manpower, personnel and training requirements analysis should be applied to the RPV baseline system operating under the sustained scenario, but operating 24 hours-a-day rather than 12 hours-a-day as assumed in this study. Incorporating a 24 hours-a-day operational tempo would add the dimension of alternative air vehicle payloads (e.g., forward looking infrared (FLIR), electronic jammer, etc.) and a more realistic wartime scenario to the analysis.

Second, a human resource requirements assessment of a RPV section deployed with operational elements (Ground Control Station and Remote Ground Terminal) forward and support elements (Launcher Subsystem, Recovery Subsystem and associated handling and maintenance equipment) in a rear area should be conducted. The present study identified the possibility that workload associated with maintenance actions at the section level could be incorporated, or shifted, into existing direct support positions, or better performed in a rear area. The proposed investigation should therefore include a sensitivity and trade-off analysis regarding the level at which operational and maintenance workload should be performed.

Third, an analysis should be performed to evaluate the requirement for a system-specific organizational maintenance MOS and a direct support maintenance MOS. A critical factor in determining the necessity for such skills is the ability of the built-in test (BIT) to perform to design specifications.

SECTION 2 - THE HARDMAN METHODOLOGY

2.1 APPLICATION DURING THE WEAPON SYSTEM ACQUISITION PROCESS (WSAP)

The HARDMAN Methodology is designed primarily for front-end analysis; it determines human resource requirements, identifies high resource drivers, and provides the necessary information to conduct human resource/equipment design tradeoffs during the early phases of the Weapon System Acquisition Process (WSAP). Studies have shown that at the time of the initiation of full scale engineering development at DSARC II, as much as 80 percent of a weapon system's design has been fixed. Thus, MPT analysis can most effectively influence design during the concept exploration and validation phases of weapon system development. Performing front-end analysis of MPT requirements even earlier in the development/acquisition process, during Mission Area Analysis (MAA), contributes to the selection of an appropriate (i.e., supportable as well as mission capable) response to an identified missic need. Therefore, front-end analysis, as it pertains to the HARDMAN Methodology, can be defined as:

> A process that evaluates requirements for manpower, personnel, and training (MPT) during the early stages of the military systems acquisition cycle. Its purpose is to (a) determine MPT requirements under alternative system concepts and designs, and (b) estimate the impact of these MPT requirements on system

effectiveness and life cycle costs. Its end-product should be the information needed to insure that effective resources (human, equipment, materiel) will be available when and as required for each system to achieve its intended contribution of military readiness and effectiveness[1].

In addition to front-end analysis, the methodology is designed to serve useful functions later in the acquisition process (see Figure 2.1-1). During the full-scale development phase, it can be used to contribute to detailed-level logistics support analyses (LSA) and the development of such documents as the Logistics Support Analysis Record (LSAR), the Quantitative and Qualitative Personnel Requirements Information (QQPRI), the Basis of Issue Plan (BOIP), the Outline Individual and Collective Training Plan (OICTP), and the New Equipment Training Plan (NETP). After production and deployment, the methodology can be used to analyze the impact, in terms of MPT requirements, of proposed modifications to a weapon system.

2.2 AN ACQUISITION MANAGEMENT TOOL

The HARDMAN Methodology provides techniques for (a) resource requirements determination, (b) resource availability assessment, (c) impact analysis, and (d) tradeoff analysis. The human resource requirements analysis projects the dollar cost of manpower, personnel and training resources for a

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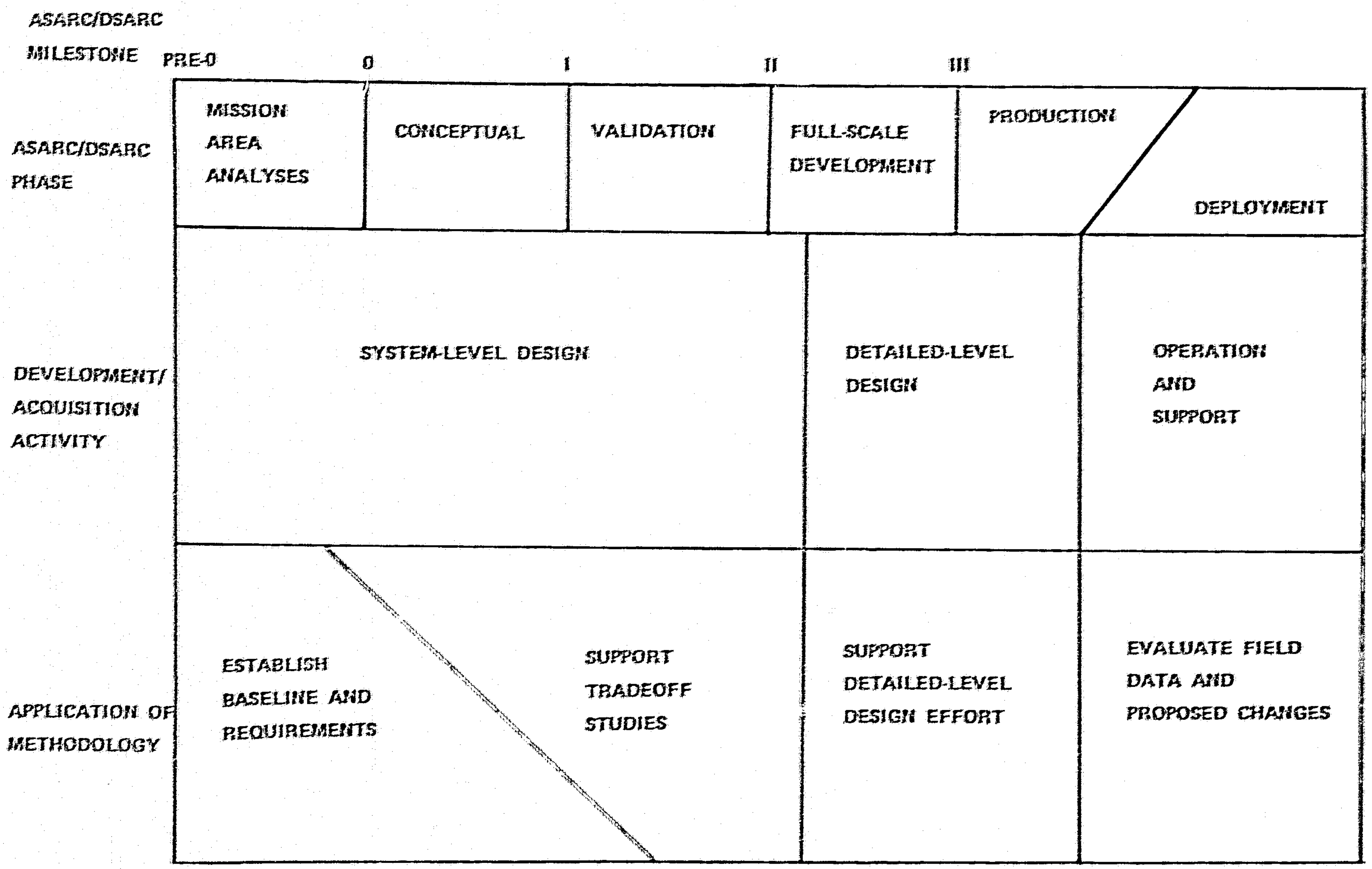
1 Front-End Analysis to Aid Emerging Training Systems, Workshop Summary, HUMRRO SR-ETSD-80-3, February 1980.

Figure 2.1-1 Use of the Methodology



baseline (conceptual) weapon system. These findings approximate the human resource demand of the conceptual system.

Resource availability assessment identifies the supply of personnel and training resources that can be expected at critical dates in the conceptual system's acquisition schedule. Personnel availability analysis projects the future supply of operators, maintainers, and support personnel given current supply and expected accession and retention rates, career progression, and duty rotation rates for each Military Occupational Specialty (MOS) of interest. Training availability analysis performs the same function for critical training resource elements, such as instructors. While both of these analytic tools are in a rudimentary state, the flexible format of the methodology allows incorporation of state-of-the-art supply projection methodologies as they become available.

The impact analysis matches demand to supply and identifies shortfalls in skills, new skill requirements, and high resource drivers. The tradeoff analysis then determines alternatives to lessen or shift these impacts and examines their benefits in relation to their costs. This evaluation is performed by iterating the methodology.

The methodology utilizes two important analytic techniques to accomplish its objectives. First, comparability analysis is employed to derive systematic estimates of the human resource requirements of conceptual (also called baseline) systems during the earliest phases of their development. Determination of the requirements for these baseline systems occurs in a two-step process. In the first step, a reference system is constructed and reference data are collected. The reference system consists of comparable components/equipments from existing systems in DoD/NATO inventory, configured to satisfy the functional requirements (operation and support) specified for the projected system. In the second step, reference data are modified to reflect the impact of design differences between the reference system and a second, equally capable, conceptual system. This conceptual system, termed the baseline, incorporates low risk technological advances likely to be extant prior to the Initial Operational Capability (IOC) date for the projected system. Estimated requirements are thus a function of relatively mature data and carefully controlled comparisons between fielded and emerging technologies.

The methodology's second key analytic tool is a Consolidated Data Base (CDB) employing advanced data base management techniques. The CDB includes all of the data necessary to apply the HARDMAN Methodology; this information characterizes the equipment, maintenance concept, operator and supervisor tasks, and resultant human resource requirements associated with all systems and subsystems. Consequently, all members of the project management office and the design community use identical data definitions and formats. Design engineers, training developers, and manpower planners have access to and employ the same data in their individual analyses. Further, the CDB also contains a detailed audit trail which describes all internal documentation (such as worksheets, computer printouts, and programming sheets) used in the application of the methodology.

2.3 MAJOR STEPS IN THE HARDMAN METHODOLOGY

The HARDMAN Methodology is composed of six major interrelated steps. The first two steps involve collection, generation, and formatting of data, while the final four involve data evaluation (see Figure 2.3-1). A general description of each step follows:

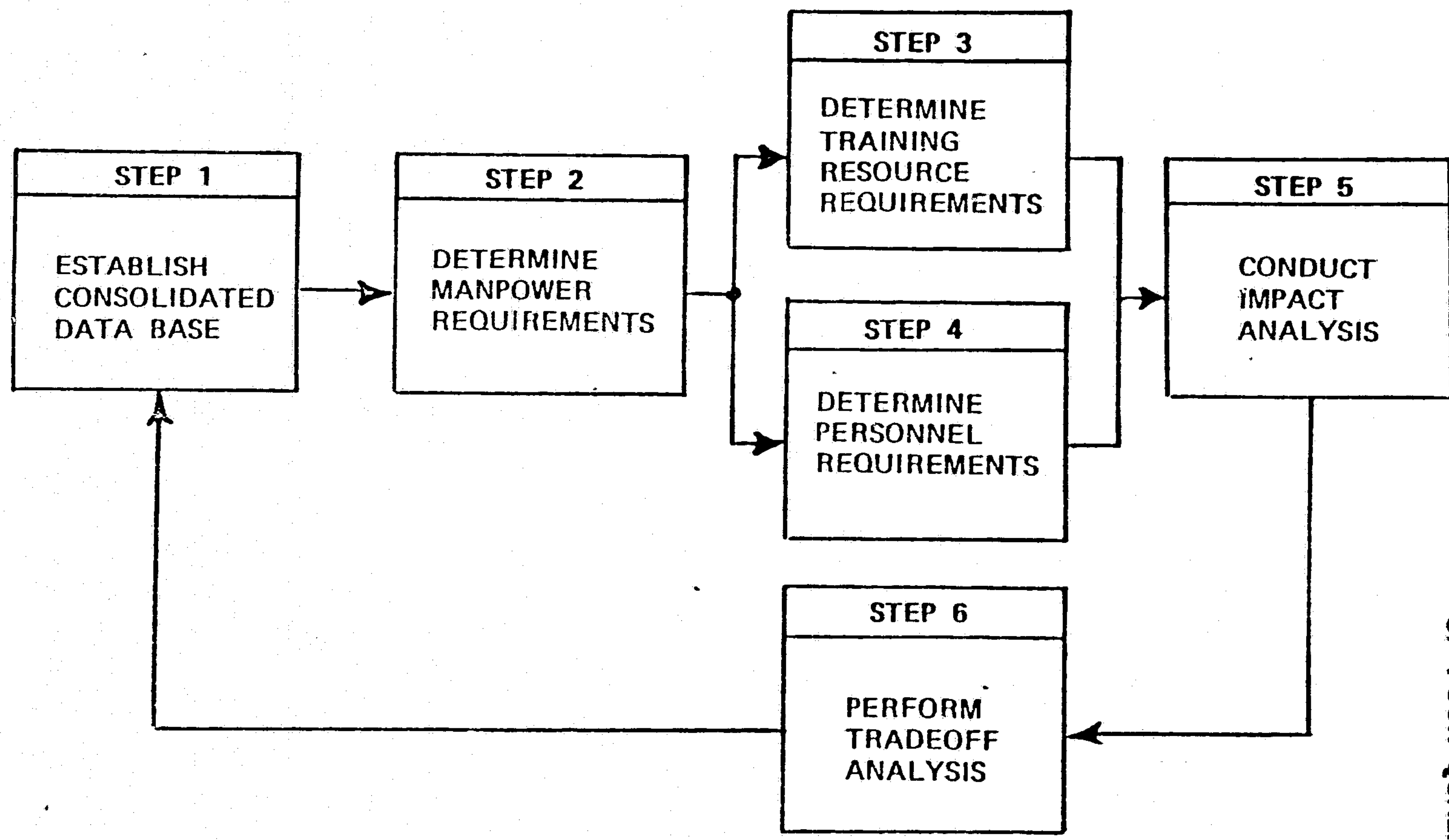
Step 1 - Establish a Consolidated Data Base (CDB)

During Step 1, two major functions are accomplished. First, the reference and baseline systems are developed and the design differences are evaluated in terms of their projected impact on the reference system's operational and/or support characteristics. Second, all data required to support this and subsequent HARDMAN analyses are identified, collected, and formatted. These data include operational and support specifications for the baseline weapon system; systems engineering data; and manpower, personnel, training, training resource, and cost data.

Step 2 - Determine Manpower Requirements

In the Manpower Requirements Analysis, systematic descriptions of the operator and maintainer tasks/events are developed for the reference system. Task/events describe functional activity at a more general level than the "tasks" typically used by training analysts. Included in these task/event networks are empirically based estimates of the time, support equipment, and number and skill level of personnel required to perform each task/event. Given a mission scenario, the reference system task/event networks can be used to derive the workload for periodic or preventive

Figure 2.3-1 Steps in the Methodology



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maintenance, scheduled and unscheduled maintenance, operational manning, and indirect or own unit support. Further, the reference system task/event descriptions can be modified to reflect the impact of the design differences and then used to determine workload estimates for the baseline system. These findings can then be used with the Army Manpower Authorization Criteria (MACRIT) process and/or a similar manpower determination model to estimate the number of productive personnel (operators and maintainers) and support and administrative personnel required to "man" the system. Additionally, the reliability and maintainability analysis, used in developing the maintenance task/event networks, will provide a range of metrics for identifying subsystem sources of high resource demand and for comparing performance among systems.

Step 3 - Determine Training Resource Requirements

During the Training Resource Requirements Analysis, training data are collected for the reference system. These data are then modified to reflect the design differences in the baseline design. Thus, changes are made in the operational and maintenance tasks to be performed, in individual courses (to account for the general task changes), and in course resources and cost. The impact of these changes are aggregated to determine estimates of training, training resources, and cost for the conceptual system. Additionally, a representation of the training paths for reference system personnel is developed. In this way, the impact of changes in training on the Army's personnel and training systems can be assessed.

Step 4 - Determine Personnel Requirements

The purpose of the Personnel Requirements Analysis is to determine the total personnel demand of the reference and baseline systems. This total requirement consists of (1) personnel required "on-board" to operate and maintain the system, plus (2) the pipeline personnel who must be "grown" in the system to consistently meet the unit manpower requirements. This latter category of personnel is determined by constructing career paths which describe training paths, attrition rates, and advancement probabilities for the MOS's required by the reference system. These reference system career paths are then modified to reflect changes in baseline system manning (determined in Step 2) and training (determined in Step 3). The Interactive Manpower-Personnel Assessment and Correlation Technology (IMPACT) model is applied to these parameters to determine the total personnel requirements of the conceptual system.

Step 5 - Conduct Impact Analysis

The Impact Analysis determines the Army's supply of those personnel and training resources required by the baseline system and measures that supply projection against the MPT demand (determined in Steps 2 through 4). It identifies (1) new requirements for skills, training, and training resources; (2) design and other sources of high human resource demand; (3) requirements for scarce assets such as skills and training resources; and (4) high cost components of the manpower, personnel, and training requirements associated with the baseline system. These products include many of the data elements required in current Department of Defense/Department of the Army documentation for program reviews. These products will also assist the program manager in targeting areas for human resource/equipment design tradeoff studies.

Step 6 - Perform Tradeoff Analysis

The Tradeoff Analysis prioritizes the critical requirements (established in Step 5) according to their impact on resource availability. In keeping with this schedule, a range of potential solutions to each requirement is also determined and prioritized for analysis. The HARDMAN Methodology is then iterated to develop the most effective response to each critical resource requirement. Both the data for and the findings of these analyses are included in the CDB, thereby insuring that a complete audit trail is generated and that the most up-to-date data are available to all members of the program staff.

2.4 BENEFITS OF USING THE HARDMAN METHODOLOGY

Systematic application of the HARDMAN Methodology to an emerging weapon system provides the following benefits:

- Provide Early Estimates of MPT Requirements

  The HARDMAN Methodology determines the demand of a weapon system design in terms of manpower, personnel, training, and training resource requirements. It provides these assessments during the early phases of the weapon system acquisition process, when they can have the greatest impact on the system's emerging design.

- Provides Visibility to High Resource Drivers

  System design characteristics, operational/support concepts and/or service policies which generate a significant demand for MPT resources are identified. This information is critical if the impacts of these requirements are to be decreased or their growth effectively managed during design maturation.

- Provides a Tradeoff Analysis Capability

  The HARDMAN Methodology is designed to conduct human resource/equipment design tradeoffs during the early phases of the WSAP. Hence, supportability considerations can be incorporated in any analysis of a systems's capability and affordability.

- Provides a Fully-Documented Audit Trail

  A comprehensive record of all analyses and their findings is developed during each application of the methodology. Consequently, each estimate of MPT requirements associated with a system design can be systematically updated and/or verified.

- Provides Data Elements for Required Program Reports

  The HARDMAN Methodology develops many of the data elements required in program reports, as specified by Department of Defense Directive 5000.1, Department of Defense Instruction 5000.2, and Department of Defense Directive 5000.39.

- Supports Detailed Level Analysis Later in the WSAP

  The data base and resource estimates, developed by the HARDMAN Methodology during the early phases of the acquisition process, provide a solid foundation for more of the rigorous analyses conducted in the later phases (e.g., logistics support analysis, instructional systems development). Thus, estimates of MPT resource requirements are systematically updated and refined in a coherent and coordinated analytic process.

- Integrates Advanced Analysis Techniques and Current/Approved Army Analytic Tools

  The HARDMAN Methodology uses a flexible format capable of effectively joining the data requirements and products from both state-of-the-art analytic processes (e.g., average value modeling, regression analysis) and approved Army models. Consequently, all findings can be clearly related to Army standards, procedures, and practices.

SECTION 3 - ESTABLISH THE CONSOLIDATED DATA BASE

3.1 BACKGROUND

The HARDMAN Methodology permits flexibility in its application. It can be tailored to the requirements of each study, and is able to account for a system's design influence regardless of its status in the Weapons System Acquisition Process (WSAP). The application of HARDMAN to the Remotely Piloted Vehicle (RPV) was similar in some respects to previous applications conducted by DRC on land/air weapon systems as the RPV contains elements of both. However, the Consolidated Data Base (CDB) for a weapon system under study contains data and information files necessary to determine that specific system's human resource requirements. The data, therefore, is peculiar to that system. The CDB also includes historical information from a comparable or predecessor system, if one exists. Additionally, elements of the CDB include not only inputs, but working data and information resulting from analysis of the system to which HARDMAN is being applied. As a result, the CDB serves as the central repository for data necessary to maintain an audit trail of each iteration of the methodology.

3.2 COLLECT AND REVIEW INITIAL INFORMATION

DRC's management plan, entitled Plan for Application of the HARDMAN Methodology to the Army Remotely Piloted Vehicle (RPV), was prepared as a deliverable under JPL Contract 956-310. This plan detailed the procedural steps that were to be followed in completing the RPV HARDMAN analysis. Additionally, data sources to be used for the RPV study were identified and the acquisition of data was also begun.

The initial step in the HARDMAN Methodology application embodies the system analysis and definition phase divided, as shown in Figure 3.2-1, into the following activities:

(1) Defining the scope of the study in terms of system requirements and procurement constraints (Step 1.1);

(2) Identifying sources of information and collecting data to support the analytic process (Step 1.2);

(3) Processing and storing the data (Step 1.3);

(4) Performing system analysis to determine the equipment needed to fulfill system functional requirements by identifying a reference system of existing equipments, and defining additional technological design improvements to be incorporated into a conceptual system (Step 1.4);

(5) Reviewing the design improvements to determine their impact on the manpower, training, and personnel analyses (Steps 2, 3, and 4, respectively), and data requirements (Step 1.5); and,

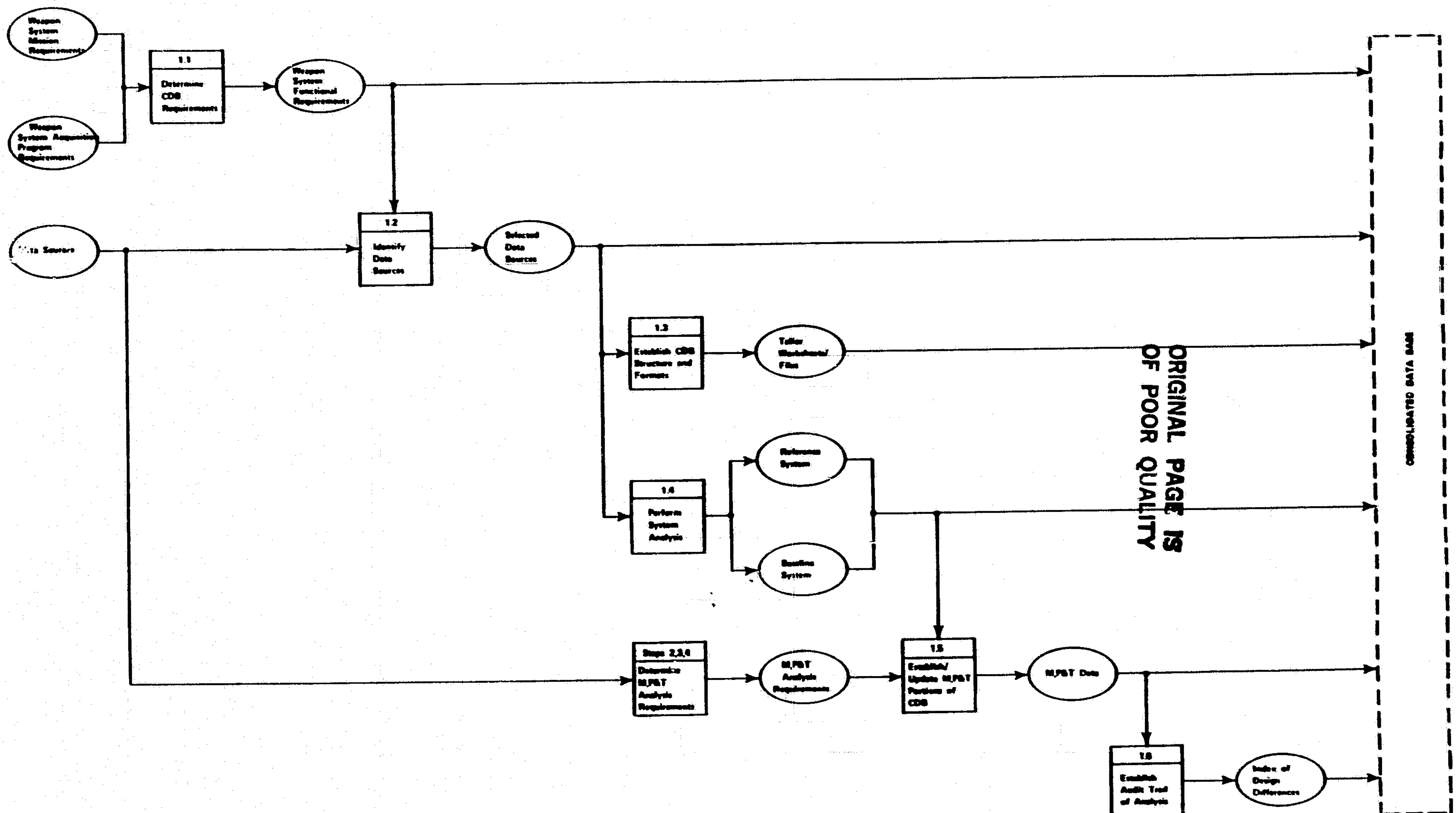

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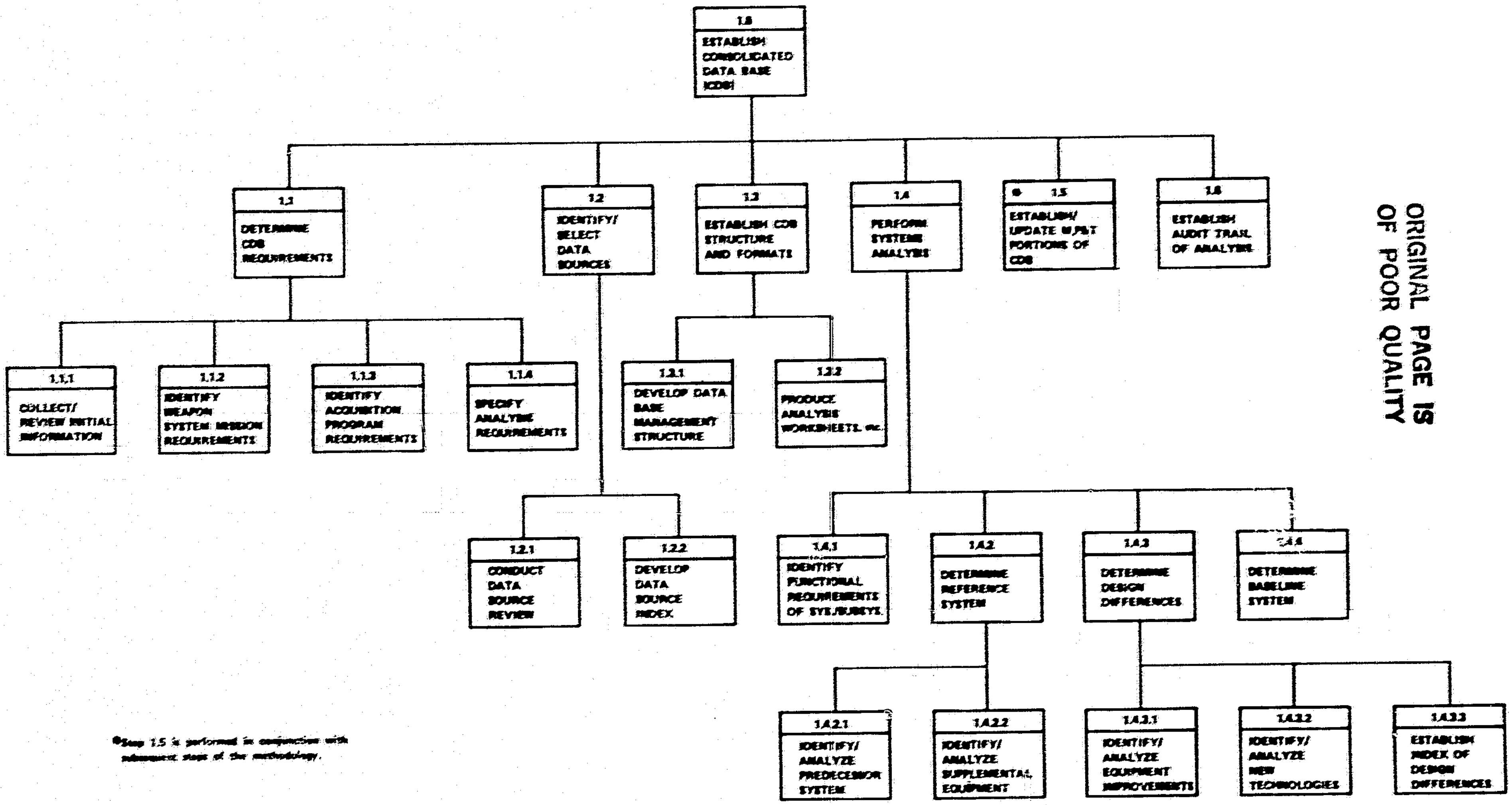
Figure 3.2-1 Step 1 (Establish Consolidated Data Base) Flow Diagram

(6) Indexing any changes in CDB content to provide an audit trail of the entire analytic process (Step 1.6).

Each CDB step is also depicted in a hierarchy diagram. The hierarchal diagram for Step 1 is shown in Figure 3.2-2.

Before conducting manpower, personnel, and training (MPT) analyses, equipment analyses are performed to identify the equipment-related parameters, such as reliability, maintainability, and task requirements, which drive MPT requirements. Estimates of these equipment parameter values, if necessary, are based on comparability analysis, (i.e., comparing the conceptual design with the system being replaced or one of similar design using historical data). The capabilities, environmental conditions, and support characteristics of the system from which data are extracted must be known. These include such integrated logistics and support characteristics as maintenance/logistics concepts, support and test equipment, self-test features, special tools, training programs, special skills, manuals and other aids and facilities.

In addition to providing the necessary equipment-related data, the CDB also provides a tracking mechanism for updating system information as the system evolves from design through development. These updates become progressively more accurate and detailed as initial estimates based on comparable historical data are replaced with operational and test data.



*Step 1.5 is performed in conjunction with subsequent steps of the methodology.

Figure 3.2-2 Step 1 (Establish Consolidated Data Base (CDB))Hierarchy Diagram

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At the initiation of this study effort, the RPV had moved into the demonstration and validation phase of the acquisition cycle. Due to this fact, substantial amounts of documentation already existed regarding the system's requirements and operational scenario. Some of the major documents which provided the basis of the analysis were the US Army Training and Doctrine Command (TRADOC) Updated and New Basis of Issue Plans (BOIP) for the RPV, the RPV Organizational and Operational Concept for OTII, and the US Army's RPV System Operational Concept (Functional Baseline).

Examination of available sources provided sufficient detail for the conceptual RPV configuration as well as the descriptions needed for that equipment designed, being constructed, or already available to the RPV system. However, since the RPV system is a totally new concept to the Army, there was no predecessor or existing system against which the proposed RPV system could be compared. This problem was partially overcome by the existence of a baseline design. Therefore, with the scope of the study defined, work began on collecting generalized reference information files. These files represent the compilation of documents, papers, and other pertinent information used in the HARDMAN process and henceforth referred to as the Consolidated Data Base (CDB).

3.3 PERFORM SYSTEMS ANALYSIS

Systems analysis in the HARDMAN Methodology essentially consists of two analytic processes:

- Functional requirements analysis identifies the full range of functions that the system should perform.

- Engineering analysis defines what specific equipment/ components will be employed by the system to perform these functions.

As a general technique, both processes move from the generic to the specific; e.g., generic system functional requirements are delineated first and, through subsequent iterations, become progressively more detailed. At some level of detail of system functional requirements, it is possible to construct both a generic equipment list and a generic task taxonomy for the new system. The former is used in engineering analysis to construct the reference and baseline systems; the latter is used similarly in manpower analysis to determine reference and baseline tasks. An additional consideration applied while performing the RPV system analysis was that a large portion of the system's baseline equipment had already been designed and built. Therefore, this baseline equipment acted as a "configuration driver" in the definition of the reference system.

Figure 3.3-1 depicts the detailed sequence of the procedures used in performing the RPV system analysis. While distinctly delineated in theory, in practice the functional analysis and the engineering analysis are interdependent and the lines of demarcation between them become less explicit. Thus, the remainder of this section describes the sequence only at the general level of the two major analytic

Figure 3.3-1 Perform System Analysis.

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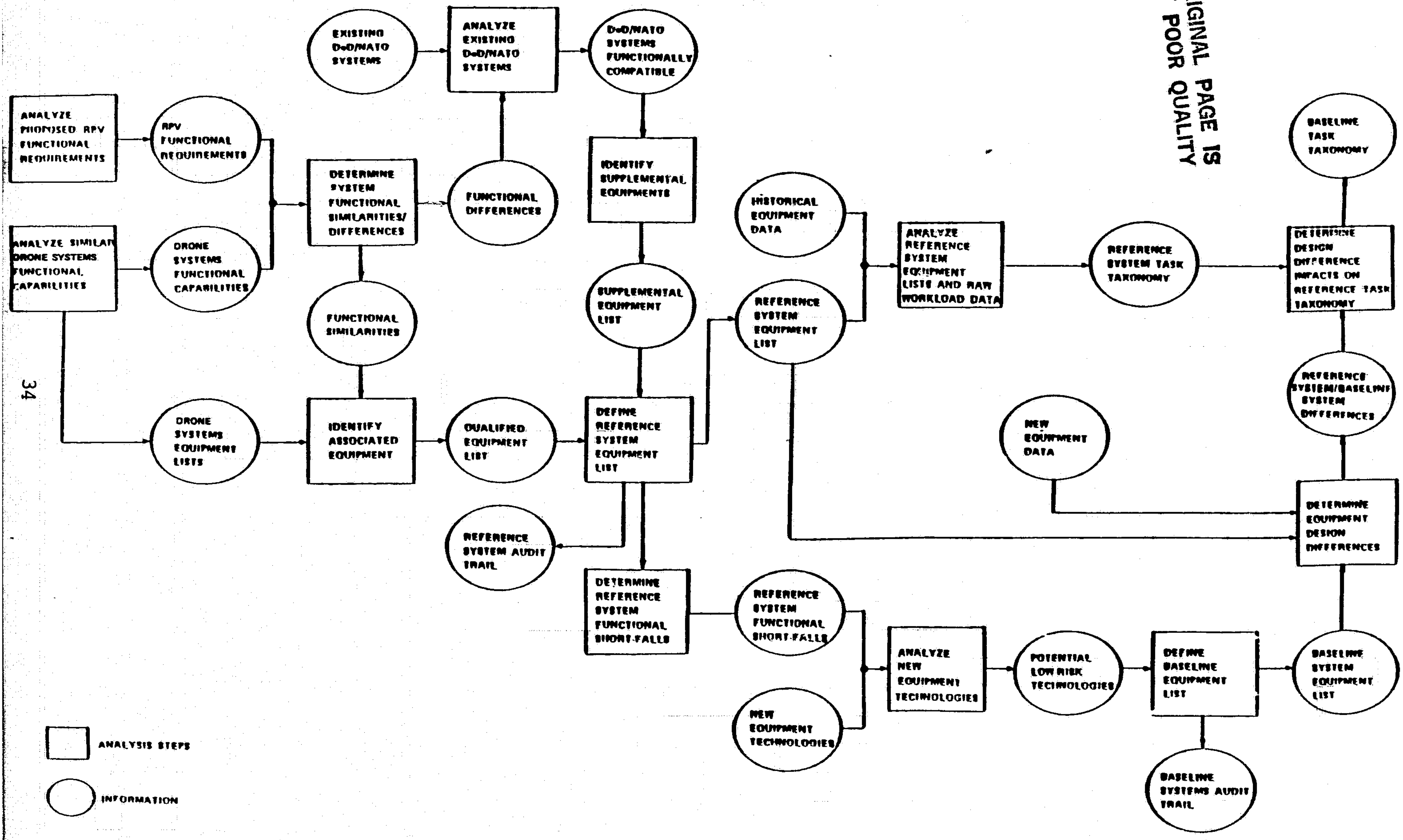

processes, the functional requirements and engineering analyses.

3.3.1 System Functional Requirements Analysis

The RPV system functional requirements were defined in three steps:

- o The mission requirements were defined for a generic remotely piloted vehicle system.

- o The system requirements of the Army's RPV section were identified and, using baseline equipment already defined, converted into a generic equipment configuration.

- o The Army's RPV system functions and equipment were used to develop the structure of the system task taxonomy.

<u>Identifying RPV Mission Requirements</u>

Many RPV mission requirements were defined in response to the description of the enemy threat. Some of the major characteristics of this threat are (1) U.S. forces may be out-numbered, (2) Enemy tactics will employ deep second echelons for reinforcing front line units, (3) Enemy forces will be highly mobile, (4) Enemy forces have NBC weapons available for use in a sustained conflict, and (5) Enemy forces will employ electronic warfare.

The RPV system was designed to counter these threats by acquiring targets and combat information in real-time and beyond the line of sight of supported ground forces, while reducing the exposure of manned aircraft to enemy anti-aircraft fire. Thus, the system has the capability to detect, recognize and identify targets deep within enemy territory with sufficient accuracy for effective field artillery and other weapons engagement.

The normal method of employment of a RPV section will be characterized by its attachment to a Field Artillery Battalion assigned a mission of direct support to a committed maneuver brigade. This is, however, situation dependent and the capability always exists to attach more than one section if the situation warrants. This new target acquisition capability will give the battlefield commander an added dimension in destroying targets while minimizing the danger associated with normal observer requirements.

System Requirements

In this phase of the analysis, the generic functions/ subfunctions performed by a RPV system in accomplishing its mission were identified and documented. By definition, functions are actions that a system performs in order to accomplish its objectives and goals. They are generally identified through review of documentation that describes the system's operational requirements and missions. Tasks are the first order descriptions of the operator (or maintainer) actions needed to implement the system functions.

Performing a functional analysis is a means for ensuring that the scope of the system is adequately defined. This functional identification is actually a synthesis process whereby an exhaustive listing of functions/subfunctions/ tasks are prepared which define the system requirements. The generic function/task list prepared for the RPV are shown in Appendix A1. It should be noted that this list encompasses proposed equipment as well as functions. Therefore, this list ensures that the generic equipment configuration as well as functions are accounted for.

System Task Taxonomy

The RPV function/task listing contained in Appendix A was developed in a heirarchical format. The major functions are subdivided into subfunctions which are then broken down by major task. The task numbers in the left column indicate this breakdown and serve as a cross reference index to other files. In particular, this task list becomes the nucleus of the generic system task taxonomy which relates tasks to workload. Thus, these task numbers were used interchangeably as Logistics Control Numbers (LCN) for operational tasks in the workload model (See Appendix B). Once generated, this system task taxonomy served as the matrix for the manpower task networks. Task frequency, manhours per task, MOS, skill level, paygrade and additional skill indicators were added to the matrix for manpower analysis. The resultant task networks are presented in Appendix B.2.

3.3.2 Engineering Analysis

3.3.2.1 System Description

The available information on the RPV baseline operational and maintenance concepts was sufficient to formulate the system functional requirements discussed in Section 3.3.1. To conduct an engineering comparability analysis, a reference system had to be created. As defined in the HARDMAN Methodology, the reference system is comprised of fielded equipment with mature reliability, availability, maintainability (RAM) data. Presented with an established RPV baseline design, the engineering analysis developed an RPV reference system from government furnished equipment (GFE) and contractor furnished equipment (CFE). The utilization of CFE in the reference design was predicated on the lack of a comparable, fielded RPV design (predecessor system) within the Army's inventory. Therefore, the determination of an optimal reference system dictated not only this mix of equipment, fielded and conceptual, but required the selection of additional reference equipment from other service sources. The GFE selected for the RPV reference and baseline systems are illustrated in Table 3.3.2-1 by model designations and, when applicable, by their derivative weapon platforms.

Equipment configuration data was collected for each subsystem identified in the study. The supportive reliability and maintainability (R&M) data collected for the reference system components proved to be reliable due to its relative maturity. This was important to the engineering analysis because R&M values directly relate to operator and

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Table 3.3.2-1 RPV Government Furnished Equipment

RPV SUBSYSTEMS	BASELINE SYSTEM MODEL	BASELINE SYSTEM DERIVATIVE PLATFORM	PERFORMANCE SYSTEM MODEL	PERFORMANCE SYSTEM DERIVATIVE PLATFORM
GROUND VEHICLES				
• 5-ton truck, cab/chassis	M942	Army M939 series	M811	Army M809 series
• 5-ton truck, cargo	M927	Army M939 series	M814	Army M809 series
• 1 1/4-ton truck, cargo	M882	Army M880/890 series	M882	Army GFE
• 2 1/2-ton trailer, chassis	M200A1	Army GFE	M200A1	Army GFE
• 3/4-ton trailer, chassis	M116A1	Army GFE	M116A1	Army GFE
ELECTRICAL GENERATORS				
• 30 KW generator unit	MEP-005A	Army GFE	MEP-005A	Army GFE
• 1.5 KW generator unit	MEP-015A	Army GFE	MEP-015A	Army GFE
TACTICAL COMMUNICATIONS EQUIPMENT				
• VHF-FM radio set, vehicular	AN/VRC-46	Army AN/VRC-12 series	AN/ARC-131	Navy CH-46 helicopter
• VHF-FM radio set, manpack	AN/PRC-68	Army GFE	AN/PRC-68	Army GFE
• speech security set	TSEC/KY-57	Army GFE	TSEC/KY-28	Navy CH-46 helicopter
• telephone set	TA-312/PT	Army GFE	TA-312/PT	Army GFE
• antenna group	OE-254/GRC	Army GFE	OE-254/GRC	Army GFE
• teletypewriter set	AN/UGC-74	Army GFE	AN/UGC-20	Navy C-130 aircraft
• digital message device	AN/PSG-2A	Army GFE	AN/UYQ-26	Navy C-130 aircraft
COMMAND & CONTROL EQUIPMENT				
• data link terminals airborne unit	OW-94	Army AN/USQ-86 series	AN/ASW-27	Navy F-14 aircraft
• ground unit	OW-96	Army AN/USQ-86 series	AS2719/AP & AN/APN-59	S-3&C-130 aircraft

Table 3.3.2-1 (continued)

RPV SUBSYSTEMS	BASELINE SYSTEM MODEL	BASELINE SYSTEM DERIVATIVE PLATFORM	PERFORMANCE SYSTEM MODEL	PERFORMANCE SYSTEM DERIVATIVE PLATFORM
• interface unit	--	Army AN/USQ-6 series	CV3225 & RP7042	Navy C-130 aircraft
• control & display consoles	NA	Army AN/NA-86 series	OJ-194	Navy FFG7 ship
DATA HANDLING EQUIPMENT				
• central processor	NA	NA	AN/UYK-45	Navy C-130 aircraft
ENVIRONMENTAL CONTROL EQUIPMENT				
• air conditioning	MCPE	Army GFE	Air cond.	Navy E-2 aircraft
• positive pressure	MCPE	Army GFE	press. sys.	Navy E-2 aircraft
AIR VEHICLE				
• airframe assembly	NA	NA	ROTODOME	Navy E-2 aircraft
• engine module	NA	NA	air turbine motor	Navy C-130 aircraft
• flight control package	NA	NA	trim computer	Navy F-14 aircraft
• attitude reference assembly	NA	NA	AHRS	Navy C-130 aircraft
• airspeed/altitude sensors	NA	NA	air data computer	Navy E-2 aircraft
• NIR source	NA	NA	taxi light	Navy C-130 aircraft
• mission payload				
TV camera set	NA	NA	AN/AXX-1	Navy F-14 aircraft
Laser set	NA	NA	AAS-33A	Navy A-6 aircraft

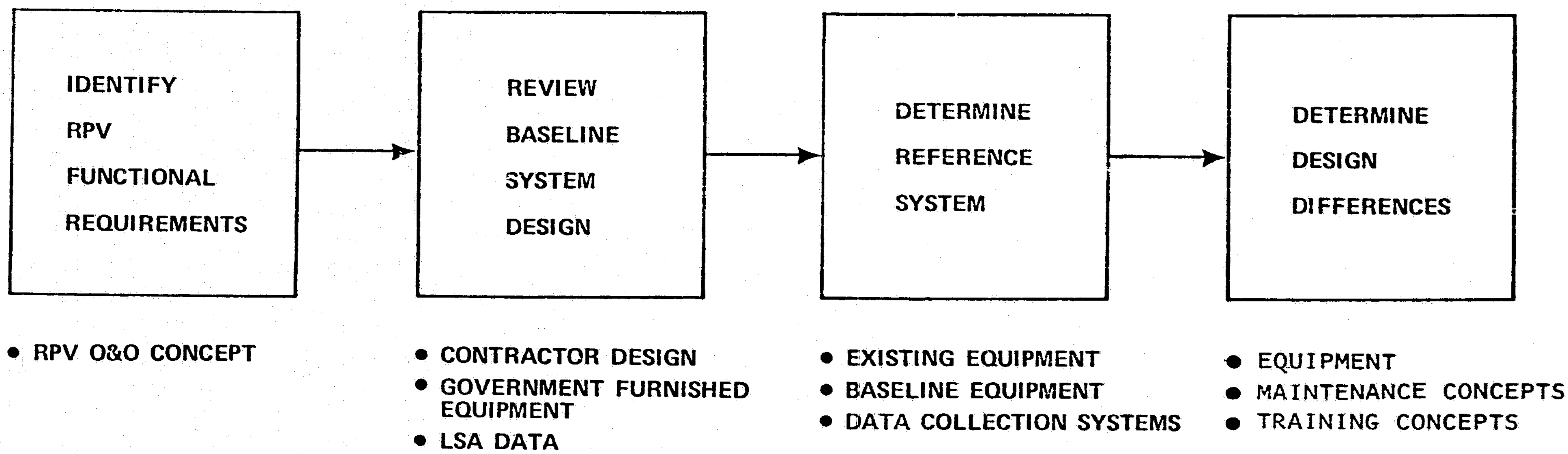
maintainer workload calculated during the Manpower Requirements Analysis. There were, however, instances where specific items of unique baseline equipment could not be defined in terms of reference equipments; e.g., recovery and launcher subsystems and peculiar ground support equipment. In these cases, baseline configuration R&M data were incorporated into the reference system analysis.

3.3.2.2 Equipment Analysis

The front-end engineering analysis conducted in conjunction with the HARDMAN Methodology was accomplished through the use of the comparability analysis technique. This analytic process was iteratively applied to equipment/systems encompassing a wide range of technologies and operating environments contained in both the baseline and reference systems. Functional differences in capability between existing equipment/systems and the requirements for the proposed RPV system were identified with this technique. Further analyses outlined design differences and necessary capability improvements. Figure 3.3.2-1 displays this analytic process.

A general configuration for the reference system was developed utilizing a mix of generic equipment from a variety of military sources. The equipment configuration for the baseline system was predetermined through RPV project office and contractor documentation. GFE for reference and baseline equipment requirements was developed from Army sources. CFE was derived primarily from Army and contractor Logistics Support Analysis (LSA) data.

FIGURE 3.3.2-1
SYSTEMS ANALYSIS



Primary requirements for the selection of other weapon platforms to serve as a RPV equipment sources related to their fulfilling a specific functional requirement and their sensitivity to analysis through suitable R&M data. The type of R&M data, in order of preference, utilized for this equipment analysis were (1) field, (2) test, (3) design specifications, and (4) contractor projections.

The justification for use of non-Army systems/subsystems, (i.e., Air Force/Naval aircraft and/or ships equipment) was based on the availability of quantitative and qualitative historical information resident in the maintenance and material management data collection systems. This use of non-Army equipment was based not only on a lack of comparable Army equipment but upon the limited availability of mature RAM data within the Army. In some instances, mature technology was resident in another service's equipment inventory. In other cases, significant RAM data voids were readily apparent due to the lack of an Army centralized maintenance data reporting system similar to the Navy's Maintenance and Material Management (3-M) System or the Air Force's (AFM 66-1) Maintenance Data Collection (MDC) System.

3.3.3 RAM Data Analysis

Corrective maintenance (CM) workloads were developed for the reference and baseline systems using RAM data obtained from Army, Navy and contractor sources. CM manhours for subsystems selected from Army equipment were obtained from the following data sources; sample data collection efforts (SDCs), development, operational and production test results, independent evaluation reports, military equipment specifications, and LSA documents. CM manhours, when judged valid, for Navy system components were derived solely from field data reported through the Navy's 3-M data system. This information is disseminated by either the Navy Maintenance Support Office (NAMSO) or the Navy Weapons Quality Engineering Center (WQEC). Contractor-projected CM manhours, when judged valid, were used for reference equipment systems for which CM maintenance data was not available from service sources. Table 3.3.3-1 depicts the applicable reference and baseline CM and PM source documentation with related equipment.

The following is a list of assumptions utilized to assign CM maintenance workloads to reference and baseline subsystems:

- CM hours were normalized to reflect CM manhours per maintenance task for each equipment/system.

- Whenever manhours per task could not be defined, equipment CM was expressed via a mean time to repair (MTTR) rate, i.e., clock hours per maintenance action.

- Whenever possible, viable reference CM data were sought to provide a substantiating maintainability benchmark for comparative purposes.

Preventive maintenance (PM) workloads were developed for the reference and baseline systems using data obtained from service and contractor sources. PM intervals and associated

Table 3.3.3-1 RPV Baseline and Reference Systems R&M Sources

ARMY: Subject	Source	Type	Equipment
TACOM RAM-D Summaries			
• Sample Data Collections	Field	CM & PM	M880/890 1 1/4-ton truck series
	Field	CM & PM	M813 5-ton cargo truck
• Development Test/	Test	CM & PM	M939 5-ton truck series
Operational Test	Test	CM & PM	Simplified test equipment/internal combustion engine
• Initial Production Test	Test	CM & PM	M200A1 2 1/2-ton trailer chassis
TSARCOM			
• Sample Data Collection	Field	CM & PM	MEP-005A 30 KW generator set
TECOM			
• Independent Evaluation Report	Test	CM	M939 5-ton truck series
Technical Manuals			
• Preventative Maintenance Checks and Services Tables	Specification	PM	Multiple types
• Maintenance Allocation Charts	Specification	CM & PM	Multiple types
Lubrication Orders	Specification	PM	Vehicular types

Table 3.3.3-1 (continued)

Subject	Source	Type	Equipment
NAVY:			
Aviation 3M Maintenance Reporting System	Field	CM	Multiple types
Ship Maintenance Data System	Field	CM	Operator consoles
Aviation Maintenance Requirements Cards	Specification	PM	Multiple types
CONTRACTOR:			
LSAR Records	Predicted	CM & PM	CFE types
FMECA Studies	Predicted	CM	CFE types
Maintainability Reports	Predicted	CM & PM	CFE types
Design Reviews	Specifications	CM	CFE types

manhours for system selected Army equipment were primarily obtained from the servicing specifications in Lubrication Orders and from Preventive Maintenance Checks and Services (PMCS) tables and Maintenance Allocation Charts published in Army Technical Manuals (TMs) (both operational and organizational types). Additional Army PM sources were found in technical studies and new equipment specifications. PM requirements for system components selected from Navy equipment were obtained from Navy source documents such as Maintenance Requirements Cards (MRCs) and Maintenance Index Pages (MIPs). Contractor PM was also extracted from various LSA documents made available through the RPV Project Office.

The definition of preventive maintenance varies over a range of source documents and maintenance philosophies. Certain assumptions were necessary to normalize the data and establish a common base for distribution of PM manhours. Following is a list of assumptions used to assign PM manhours applicable to the systems/subsystems of the RPV equipment:

- Daily and weekly PM requirements are performed by driver, operator and/or crewmen.

- Monthly, quarterly, semiannual, annual and biennual PM requirements are accomplished by organizational maintenance personnel.

- Of the twelve maintenance or repair functions cited on Maintenance Allocation Charts, the service functions were solely allocated to PM manhours. The remaining functions were deemed to normally fall within corrective maintenance (CM) categories.

- Elapsed times cited on Maintenance Allocation Charts were assumed to exclude make-ready/put-away time as a portion of the total time allocated to perform the required maintenance function.

3.3.3.1 RPV Government Furnished Equipment

- Trucks

Each of the RPV ground subsystems require a wheeled vehicle, either of the 5-ton or 1 and 1/4-ton variety. Both truck models utilized for the reference and baseline systems were essentially derived from two basic classes: the M809 5-ton series and its product improved model the M939 series, and the M880/890, 1 and 1/4-ton series. The specific truck models of the reference system were the M811 cab/chassis and the M814 dropside cargo version in the 5-ton category, and the M882 cargo type in the 1 and 1/4-ton category. The M811 was the wheeled carrier for the RPV launcher and recovery subsystems while the M814 represented the carrier for the RPV ground control station, maintenance shelter and air vehicle handler. A standard unmodified M814 cargo model was found suitable for the RPV cargo vehicle. The M882 1 and 1/4-ton model represented the prime mover vehicle for both the reference and baseline systems.

The M939 5-ton truck series was used in the baseline system in place of the M809 series due to its projected availability at the Initial Operational Capability (IOC) date for the RPV system. The M942 and 927 versions were selected as being comparable to the M811 and 814 5-ton models, respectively. The primary design improvements of these M939 series trucks encompassed the automatic transmission and air brakes; while minor changes involved the tires, battery box, exhaust system, cab, hood and cab mounts. Additionally one of the RPV section's M814/M927 trucks was configured with a standard recovery winch.

Maintenance workload data in the form of R&M information was available on the M809 5-ton truck series to support its use for the reference system. The M813 cargo truck of this series had undergone a sample data collection (SDC) effort and field R&M data was utilized from this source. Because of the recent development of the M939 5-ton truck series, only developmental test RAM information was available on these vehicles. Consequently, prudent judgment should be exercised when comparing this RAM data with the field-derived data of the M813. The results of the comparative analysis on the various 5-ton truck models showed approximately a 2:1 improvement for the M939 series versus the M809 series through a reduction of corrective maintenance (CM) requirements. Analysis of the Lubrication Orders and Technical Manuals associated with these vehicles revealed that no significant difference in preventive maintenance (PM) workload existed between the M809 and its product improved version, the M939.

The CM workload data on the M882 1 and 1/4-ton truck was derived from an on-going Army SDC effort covering the M880/890 series. The M880/890 truck series' technical and service documents subsequently provided the PM requirements for the M882 cargo truck. In comparison to the RPV 5-ton vehicles, the 1 and 1/4-ton prime mover vehicle required approximately fifty percent less CM and PM manhours to operate.

o Trailers

The RPV section required three chassis-type trailers to carry two mobile generator sets and one remote ground terminal (RGT) set. The trailer units used for the reference and baseline systems were two sizes: a 3/4-ton capacity M116A1 model and a 2 and 1/2-ton capacity M200A1 model. The M116 is used with the RGT and towed by the M882 prime mover, while the M200 trailer units carry the RPV 30KW generators and mate with the RPV section's 5-ton trucks.

R&M data was available on the M200A1 trailer from its initial production test and, because of this trailer's structural similarity with the M116A1, the M200 CM data was determined to be also representative of the M116 trailers. A study of the respective trailer Technical Manuals and Lubrication Orders showed the PM workloads of both these trailer models were essentially the same. Therefore, the total maintenance requirements of both type trailer models were considered equivalent.

o Electrical Generators

Electrical power generation for the RPV section, both baseline and reference systems, is performed by two generator series, the MEP-005A and the MEP-015A. The MEP-005A is a 30 KW diesel generator unit and when mated with the M200A1 trailer chassis is designated the PU-406 generator set. The two units of this model support the RPV ground control station and maintenance shelter. The MEP-015A is a 1.5KW skid mounted, gas generator unit. The two units of this model used in conjunction with the remote ground terminal subsystem and transported by the M882 prime mover vehicle.

Suitable R&M data were extant through a current SDC program on several generator sets, one of which was the MEP-005A. The SDC provided the CM requirements for the 30KW generator and, lacking any comparable data on the 1.5KW generator unit, the 30KW CM workload was scaled to represent the smaller MEP-015A version. An analysis of applicable Lubrication Orders and Technical Manuals produced the required PM workload on both these generator sets.

- Communications

For analytic reasons, the RPV section's communications sets were treated as a separate entity. Communications equipment was aggregated by its functional requirements. Thus, the RPV communications suite is functionally composed of external voice units-vehicular and portable; external data units, teletype and digital; internal voice units, telephones; and external speech security units.

The external voice equipment found in the RPV section are the VHF-FM radio sets, AN/VRC-46 (vehicular) and AN/PRC-68 (portable). Of the section's four VRC-46 sets, three are resident in the Ground Control Station (GCS), with the fourth located in the M882 prime mover. The TSEC/KY-57 COMSEC sets are utilized for secure voice capability with the VRC-46 radios. Four of these units are assigned to the

GCS and one to the M882 prime mover. The OE-254/GRC antenna unit is used in conjunction with the VRC-46 radios in the GCS to extend their communications range. The six PRC-68 portable radios are allocated to six of the vehicles in the RPV section, with the exception of the cargo vehicle.

The external data units consist of one AN/UGC-74C teletypewriter set and one AN/PSG-2A digital message device. Both of these units are located with the GCS subsystem. The seven TA-312/PT hand held telephone sets are assigned to each of the RPV section vehicles to provide an internal voice communications capability.

The maintenance workload of the RPV communications equipment was derived from Army and Navy sources. CM requirements were generated from Navy field data on comparable electronic equipment resident in aviation and shipboard hardware. The scope and clarity of the historical data in the Navy's maintenance data collection system allowed this data source to serve as an accurate CM benchmark for electronics equipment. In using this field R&M information, the Navy's organizational and intermediate maintenance levels were equated to the Army's crew and organizational, and direct support maintenance levels, respectively. The operating environments of Navy ship and airborne platforms were considered sufficiently hostile to accurately simulate the operating conditions of the RPV system. Army technical manuals associated with the various communications equipment were used to develop the PM workloads for these sets.

o Command and Control

The RPV system's command and control equipment consists of the three GCS control and display consoles and the data link terminals dedicated to the modular integrated communications and navigation system (MICNS). The MICNS system, AN/USQ-86, is composed of several units, including: the airborne data terminal (OW-94) unit configured for the air vehicle; a ground data terminal (OW-96) unit collocated with the M116 trailer; the initializer control unit in the launcher subsystem; and the interface data terminal unit integrated with the ground control station. MICNS is designated as Army GFE but, because it is undergoing development, other fielded GFE was used with the RPV reference and baseline systems to determine viable CM workload data.

The maintenance workload of the MICNS system was adapted from functionally similar Naval aircraft electronic equipment. The CM requirements were found in Navy 3-M field data on comparable components in several aircraft types. An example of this type electronics is the selection of the AN/ASW-27 digitial data communications set as representative of the OW-94 airborne data terminal. This digital communications set is the airborne portion of a Navy data link system utilized to transfer critical orders between a surface control station and aircraft.

The CM maintenance requirements for the GCS operator consoles were also developed from Navy 3-M field data on a comparable shipboard console, the OJ-194. This unit is used with the Combat Direction System (CDS) which acts as an integrating system between ships and other tactical units such as aircraft.

o Environmental Control

The RPV system environmental control equipment was comprised of the modular collection protection equipment (MCPE) on the GCS and the air conditioning units used with the GCS and maintenance shelter. An aircraft pressurization system with the associated air conditioning components was identified as a source of reference system configuration and R&M information. The supporting maintenance workload data was available from Navy 3-M.

o Data Processing

A central processing unit similar to the one in the GCS was identified on board a sophisticated communications aircraft in use by the Navy. This unit, the AN/UYK-45, functions as the tactical message processor for this aircraft's communications suite. The source for this computer's CM manhours was Navy 3-M field data.

o Aircraft Components

Aircraft type components are utilized to configure the air vehicle subsystem. For the purpose of the study, these equipment were considered miniaturized versions of actual aircraft components. This assumption allowed the engineering analysis to determine representative CM workload values from Navy 3-M data associated with aviation hardware.

3.3.3.2 RPV Contractor Furnished Equipment

The RPV system's contractor furnished equipment (CFE) was primarily derived from the contractor's LSA candidate and task function list and the associated Army LSA-02 records. The LSA candidate and task function list provided configuration CFE data and also defined related maintenance tasks by level of maintenance. The LSA-02 record, a personnel and skill summary, complemented this information by integrating the projected maintenance manhours and frequency of occurrence with each proposed maintenance task. The study's engineering analysis incorporated major tasks not included in the LSA-02 records which were identified on the LSA candidate and task function list.

The CFE maintenance workloads were utilized to support the baseline system's CFE and in instances of RPV-unique equipment, for the reference system's CFE. The use of CFE must be tempered with the fact that contractor R&M values for workload projection, when used in their entirety, are sometimes representative of only a portion of the actual corrective maintenance requirements. The CFE equipment utilized for the reference system were primarily resident in the launcher and recovery subsystems plus any RPV peculiar ground support equipment.

3.3.3.3 R&M Analysis Products

This section details the PM and CM workload contributions of the major subsystems and equipment generated by an RPV section. These total maintenance requirements, under an ideal operational scenario, are depicted in summary format in Table 3.3.3-2. Direct support, along with crew and organizational maintenance requirements, for one RPV section are included in the values displayed. Direct support PM was, however, considered to be negligible for RPV equipment.

Several of the RPV end items have both CFE and GFE contributing to their maintenance workload totals. An example is the remote ground terminal which has a CFE end-item also has a major GFE assembly, a 3/4-ton trailer. The diesel generator sets are primarily GFE, being comprised of a 30KW generator mated with a 2 and 1/2 - ton trailer. The RPV section's vehicular and communications GFE are assigned by end items in accordance with the Army's Basis of Issue Plans (BOIP) for the RPV. All Army basic issue items for ease of workload identification are aggregated in a separate category.

Table 3.3.3-2 shows a 21 percent increase in maintenance workload requirements between an RPV reference system primarily consisting of fielded military equipment and an RPV baseline system composed of a mix of Army GFE and CFE subsystems. The principal difference in the reference and baseline maintenance workloads was due to corrective maintenance (CM) requirements.

A major factor in this CM workload disparity is that the bulk of unscheduled field maintenance is included for GFE subsystems, while failure-driven maintenance only is associated with CFE workload projections. Therefore, with the reference system having a higher ratio of GFE, a subsequent increase in reference CM requirements is experienced.

TABLE 3.3.3-2 RPV SECTION MAINTENANCE WORKLOAD DISTRIBUTION

END ITEM	REFERENCE MMH/MO**			BASELINE MMH/MO**		
	CM	PM	TOTAL	CM	PM	TOTAL
PRIME MOVER (M882)	14.04	56.66	70.70	14.04	56.66	70.70
REMOTE GROUND TERMINAL*	7.97	4.99	12.96	0.25	4.99	5.24
DIESEL GENERATOR SET (2)*	20.62	35.26	55.88	20.62	35.26	55.88
GROUND CONTROL STATION*	100.71	60.74	161.45	67.20	60.74	127.94
LAUNCHER SUBSYSTEM*	65.70	111.99	177.69	31.74	111.99	143.73
RECOVERY SUBSYSTEM*	76.53	77.79	154.32	32.24	77.79	110.03
AIR VEHICLE HANDLER*	83.91	55.33	139.24	38.66	55.33	93.99
MAINTENANCE SHELTER*	19.45	115.77	135.22	10.11	115.77	125.88
CARGO VEHICLE*	30.97	40.58	71.55	14.21	40.58	54.79
AIR VEHICLE	60.87	105.61	166.48	4.77	105.61	110.38
BASIC ISSUE EQPT.	9.64	5.75	15.39	9.64	5.75	15.39
TOTAL WORKLOAD	490.41	674.44	1164.85	243.48	674.44	917.92

*Includes Subsystem and Vehicle Maintenance Requirements

** Maintenance manhours per month under ideal scenario for crew, organizational, and direct support maintenance levels.

The basic GFE workload values are presented in Table 3.3.3-3 in maintenance ratio (MR) format for ease of extrapolation and use. These MRs include GFE preventive and corrective maintenance values common to both the baseline and reference systems. In addition, reference system GFE identified as representative of baseline system CFE for workload purposes are also included.

Table 3.3.3-3 RPV Government Furnished Equipment
By Maintenance Manhours [1] per Operating Hour

Type GFE	Reference System				Baseline System			
	Model(s)	ORG	DS	Combined	Model(s)	ORG	DS	Combined
VEHICLES								
5-Ton Truck	M811&814	1.833	0.449	2.282	M942&927	1.520	0.165	1.685
1¼-Ton Truck	M882	0.807	0.014	0.821	M882	0.807	0.014	0.821
2½-Ton Trailer	M200	0.410	0.001	0.411	M200	0.410	0.001	0.411
3/4-Ton Trailer	M116	0.410	0.001	0.411	M116	0.410	0.001	0.411
POWER GENERATORS								
30KW Generator	MEP-005A	0.048	0.016	0.064	MEP-005A	0.048	0.016	0.064
1.5KW Generator	MEP-015A	0.024	0.005	0.029	MEP-015A	0.024	0.005	0.029
COMMUNICATIONS								
VHF-FM Radios	VRC-46	0.001	0.003	0.004	VRC-46	0.001	0.003	0.004
	PRC-68	0.003	0.001	0.004	PRC-68	0.003	0.001	0.004
Telephone Set	TA-312	0.002	0.003	0.005	TA-312	0.002	0.003	0.005
Headset	H-182	0.000	0.002	0.002	H-182	0.000	0.002	0.002
Comsec Unit	KY-57	0.001	0.002	0.003	KY-57	0.001	0.002	0.003
Teletype	UGC-74	0.008	0.022	0.030	-			
Digital Message	PSG-2A	0.020	0.005	0.025	PSG-2A	0.020	0.005	0.025
Antenna	OE-254	0.000	0.001	0.001	OE-254	0.000	0.001	0.001

Table 3.3.3-3 (continued)

Type GFE	Reference System Model(s)	Reference System ORG	Reference System DS	Reference System Combined	Baseline System Model(s)	Baseline System ORG	Baseline System DS	Baseline System Combined
COMMAND&CONTROL								
Data Terminals	ASW-27	0.005	0.000	0.005	-			
	AS2719& APN-159	0.004	0.017	0.021	-			
	CV3225& PP7042	0.007	0.029	0.036	-			
Control & Display Consoles	OJ-194	0.018	0.004	0.022	-			
DATA HANDLING								
Central Processor	UYK-45	0.001	0.004	0.005	-			
ENVIRONMENTAL								
Air Conditioning & Positive Pressure	MCPE	0.004	0.017	0.021	MCPE	0.004	0.017	0.021
AIRCRAFT								
Air Frame Assembly	-	0.006	0.002	0.008	-			
Engine Module	-	0.033	0.031	0.064	-			
Flight Control Electronics	-	0.001	0.002	0.003	-			
Attitude Reference Assembly	-	0.001	0.003	0.004	-			
Airspeed/Altitude Sensors	-	0.002	0.002	0.004	-			

Table 3.3.3-3 (continued)

	Reference System				Baseline System			
Type GFE	Model(s)	ORG	DS	Combined	Model(s)	ORG	DS	Combined
AIRCRAFT cont'd.								
NIR Source	-	0.001	0.000	0.001	-			
Mission Payload	AXX-1& AAS-33A	0.060	0.143	0.203	-			

1 Maintenance Manhours Include Both CM & PM.

SECTION 4 - DETERMINE MANPOWER REQUIREMENTS

4.1 OVERVIEW

Manpower Requirements Analysis (MRA) of the HARDMAN Methodology provides estimates of the manpower levels associated with an emerging weapon system design such as the RPV. MRA identifies the numbers and specialty skill codes for system operator, maintainer and support personnel requirements from the crew to the direct support level. These manning requirements provide quantitative and qualitative inputs to the training, personnel, impact and tradeoff analysis steps of the methodology.

In order to estimate RPV system manpower requirements, system functional requirements must be defined in terms of system workload. Raw workload data collected to support the manpower analysis was obtained from several sources: (1) data already collected and residing in the CDB, such as mission and support scenarios, (2) results of Army field demonstrations, (3) reliability and maintainability data, (4) task and job analyses, and (5) manpower factors and standards as defined in Army Regulations. Workload data are refined, normalized, and formatted into general system task/event networks from which baseline and reference system workload could then be calculated. Resulting workload estimates for the baseline and reference systems were then placed in the appropriate manpower determination model to calculate manpower requirements. Outputs of this analysis were the quantitative and qualitative manpower requirements

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(i.e., numbers of people, their MOS, skill level and ASI) necessary to operate and maintain the system.

4.2 INITIAL INFORMATION AND ASSUMPTIONS

Manpower analysis of the RPV weapon system was influenced by the following key factors or constraints:

- System Configuration
- Force Structure
- Maintenance Concept
- Organizational and Operational Concept
- Skill and Skill Level Capabilities
- Manpower Workload Capacity

System configuration for the reference and baseline RPV equipment used in the analysis are discussed in Section 3.3.2 and consisted of the following subsystems:

- Ground Control Station (GCS)
- Air Vehicle (AV)
- Handling and Cargo Vehicles
- Launcher Subsystem (LS)
- Recovery Subsystem (RS)
- Maintenance Shelter (MS)
- Power Generation Equipment
- Remote Ground Terminal (RGT)

Force Structure

RPV force structure assumptions are shown in Table 4.2-1. The smallest unit analyzed to determine manpower requirements was the RPV section. Section manpower was then aggregated at the platoon level and again for the total Army RPV platoon inventory. The RPV platoon headquarters (HQ) element and equipment were not included in the manpower requirements analysis. However, the platoon headquarters positions were included for the personnel requirements analysis.

Table 4.2-1
RPV Force Structure

Level	Requirements	
	RPV Sections	Platoon HQ's
Platoon	4	1
Army (14 RPV Platoons)	56	14

Maintenance Concept

The maintenance concept for RPV equipment as outlined in the Organizational and Operational (O&O) Concept Plan calls for a 4/4 maintenance schema (i.e., four levels of maintenance for all ground equipment as well as the AV and mission payload equipment). Additionally, there is heavy reliance on module/unit replacement at the organizational level rather than piece-part repair. The RPV aviation-related maintenance concept differs from a normal 3-level concept (aviation unit maintenance (AVUM), aviation intermediate maintenance (AVIM), and depot level maintenance). Effect of this change in maintenance concept was to redistribute aviation related workload at the organizational, direct support and general support levels.

Skill and Skill Level Capabilities

Army grade and skill level criteria as outlined in the Enlisted Career Management Field (ECMF) and Military Occupational Specialties (MOS) Manual (AR 611-201) were applied to the RPV system to determine workload assignment. This was accomplished by comparing task requirements against stated skill and skill level capabilities for the appropriate MOS. In the case of RPV operators and maintainers, the definition of section positions and tentative associated grade and skill levels was outlined in the RPV Organizational and Operational (O&O) Concept Plan. These O&O grade and skill assumptions were subjected to minor modification by comparison with similar capabilities assigned to existing skills of AR 611-201 to determine the lowest skill level and grade capable of performing the workload specified. Table 4.2-2 is a summary of RPV section MOS skill levels and paygrades by identified position. There was down-grading of paygrades for Air Vehicle and Mission Payload Operators. This is the result of manpower assignment of workload to the lowest skill level and paygrade trained to accomplish the necessary task functions. Consideration of the degree of maturity/ experience required and supervision exercised over the position was also considered.

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Table 4.2-2

RPV Section Skill Levels and Paygrades

Paygrade	Skill Level/ASI	Title
WO	-	RPV Technician (Section Commander)
E-6	3	RPV Section Chief
E-5	2	Launch and Recovery Chief
E-5	2	Senior Air Vehicle Operator
E-5	2/P9	RPV Mechanic
E-4	1	Senior Mission Payload Operator
E-4	1/P9	RPV Mechanic
E-4	1	Air Vehicle Operator
E-3	1	Mission Payload Operator
E-4/E-3/E-2	1	RPV Crewman
E-4	1	Wheeled Vehicle and Power Generator Mechanic

Operational and maintenance workloads resulted from combining a Mission Event Profile with information from engineering analysis for each system as shown in Figure 4.2-1. This Mission Event Profile was constructed by using information from the RPV O&O plan and scenario information provided by the RPV Project Office. Engineering analysis outputs, consisting of reliability, maintainability, performance and operation information, were used to develop the set of maintenance tasks and associated manpower required to perform all RPV system functions. Using the Mission Event Profile as a basis, a generic task taxonomy was then created to determine all tasks required within an event/task group. This taxonomy is found in Appendix B.2.

A product of the Mission Event Profile development was a matrix-based scenario model for use in the DRC-developed Interactive Manpower Aggregation and Estimation Simulation (IMAGES) program. The IMAGES programs, used for determining manpower, were loaded with mission requirements, task times and system performance information. As output, it provided operational and maintenance workload. IMAGES is explained in greater detail in Section 4.3.

Manpower Workload Capacity

An explanation of workload capacity determination is also necessary. Figure 4.2-2 displays the basic Manpower Authorization Criteria (MACRIT) equation used to determine system manpower requirements at both a general level and with the specific data element inputs required by Army Regulation (AR) 570-2, Manpower and Equipment Control Organization, and Equipment Authorization Tables: Personnel-

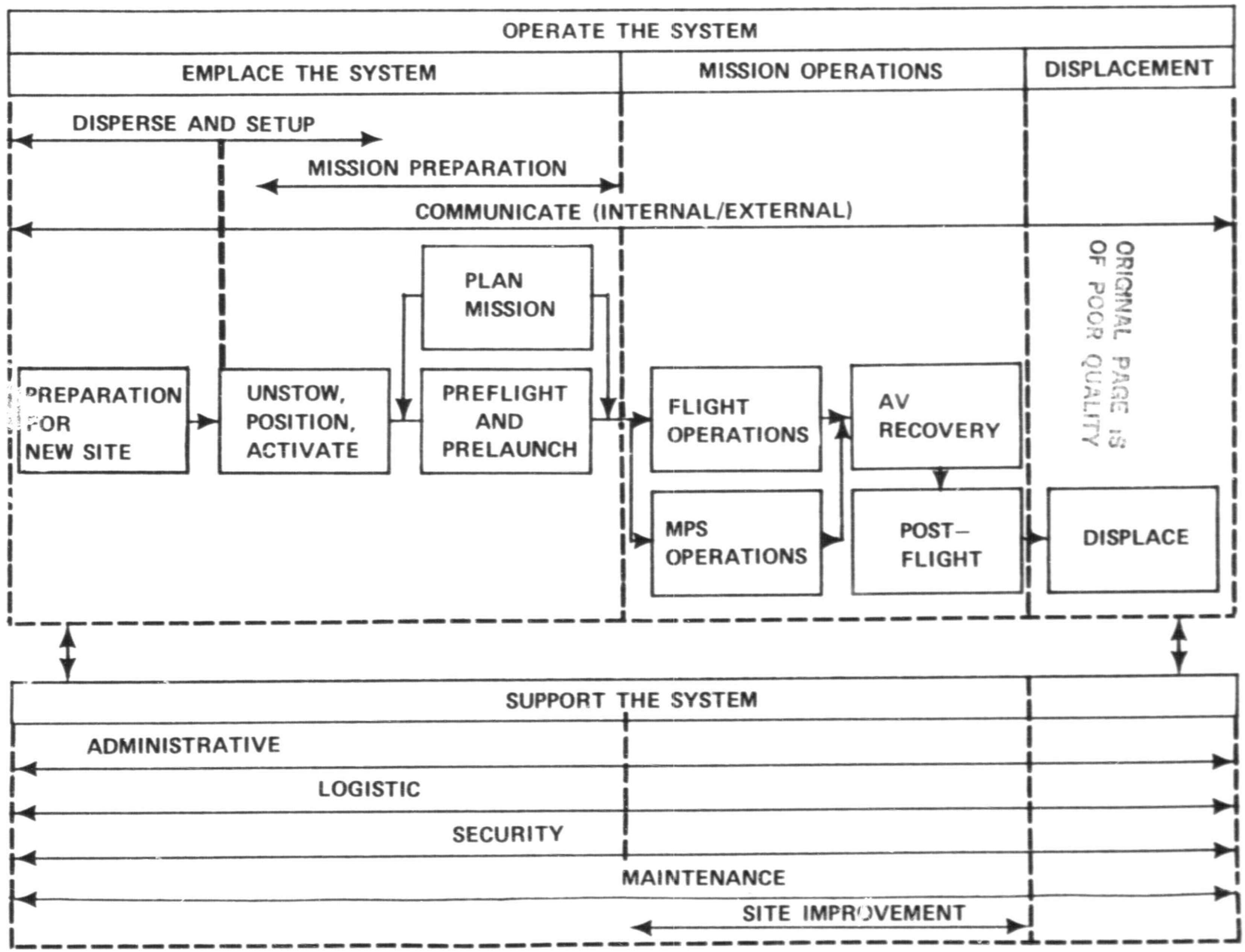
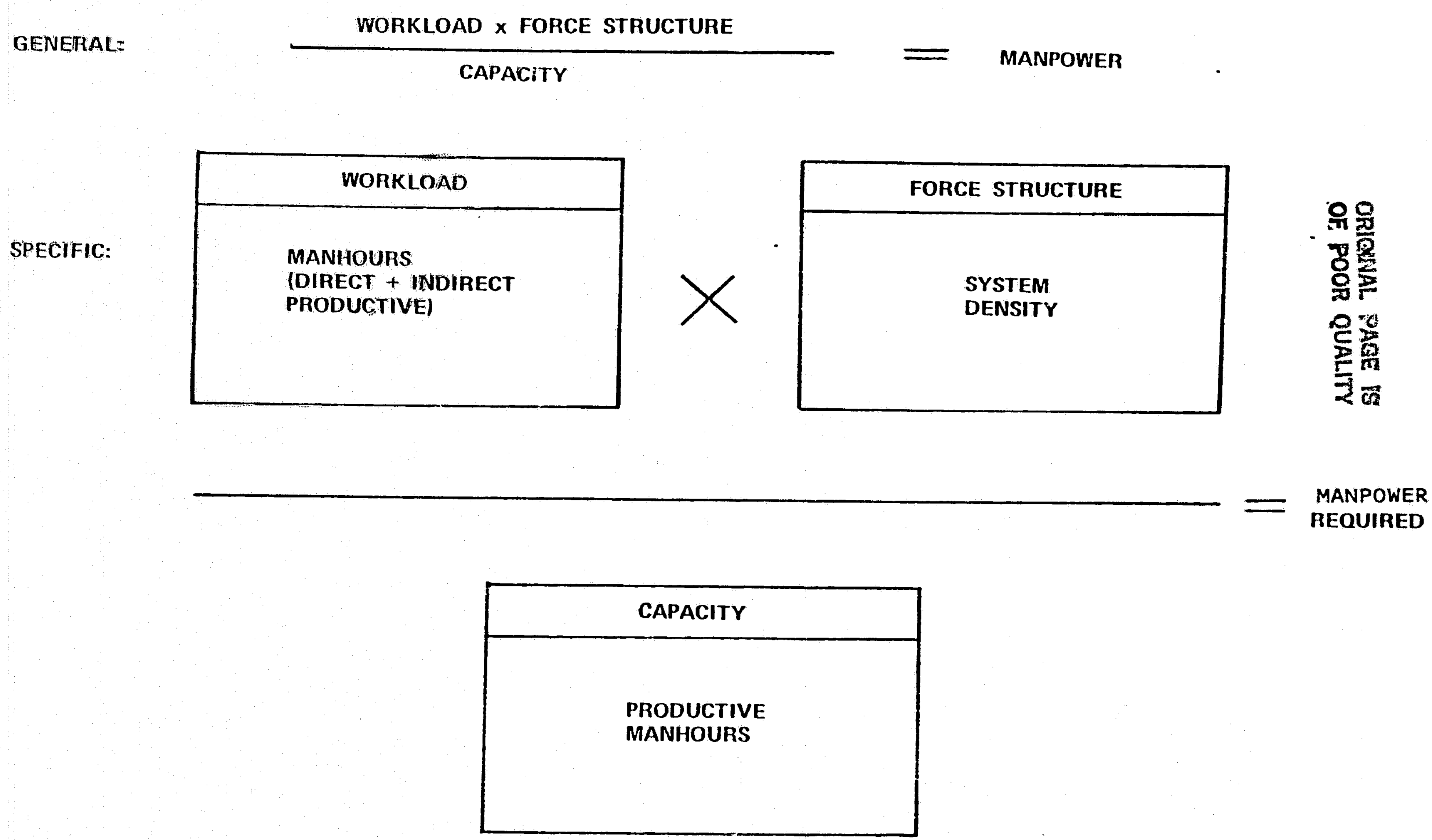


Figure 4.2-1 Mission Event Profile

Figure 4.2-2 Basic MACRIT Equation



MACRIT section. For the RPV system, modifications to standard MACRIT procedures were necessary because RPV section operations, although keyed to a 12 hour operational duty cycle, do not conform to shift work schedule as defined in MACRIT. These modifications, accomplished with information provided by the U.S. Army Logistics Center, Ft. Lee, Virginia, provided a more realistic estimate of productive capacity for personnel who operate and maintain the components of the RPV section. Maintenance manpower capacity at the direct support level was computed using standard MACRIT values found in Chapter 2 of AR 570-2. Productive capacities for RPV section personnel and direct support maintenance personnel are shown in Table 4.2-3. The maintenance manhours per week in this table were multiplied by 4.345 to convert to manhours per month for use by IMAGES' programs.

Determination of the productive capacity of the individuals in an RPV section was accomplished by constructing a work/task network based on mission requirements. For the purposes of this study, a seven day period, as specified in the O&O plan, was used to calculate a standard workweek. Using MACRIT as a guide, non-productive hours associated with sleeping, messing and personal needs, were factored out of time available for work. This decision was consistent with MACRIT methodology although these needs are not specifically addressed by MACRIT. The unit movement allowance, which includes tactical deployment, is considered by MACRIT as a percentage of the total workweek. However, the time to perform tactical movement is such a large and variable percentage of RPV section workload that using the MACRIT unit movement allowance would lead to a false indication of actual workload. Thus, to resolve this

Table 4.2-3

STANDARD WORK WEEK

1. RPV Section

a. Analysis of Available Hours

Total Hours Available (24x7)	168.00
Less: Sleep (7x7)	49.00
Messing (40 min. x 3x7)	14.00
Personal Needs (3x7)	21.00
Hours available for Productive Work	84.00/wk

b. Productive Capacity

Available Hours	84.00/wk
Less: MACRIT unit movement allowance (as discussed in Section 4.2)	00.00
	84.00hr/wk

2. Direct Support (DS) Maintenance

a. Analysis of Available Hours

Total hours available (1 shift)	84.00
Less: Standard MACRIT factors (as discussed in Section 4.2)	20.16
Hours available for Productive Work	63.84/wk

b. Productive Capacity

Available Hours	63.84/wk
Allowance (Caterory I TOE) (as discussed in Section 4.2)	15.92
Productive Capacity Available	47.92 hr/wk

problem, time associated with performing movement was classified as workload and not a percentage allowance.

Direct support (DS) maintenance manpower capacity calculations agreed with MACRIT methodology; therefore, standard unit movement MACRIT allowances from Section 2-7 of Army Regulation 570-2 combined as shown in Table 4.2-3 were used to determine productive capability available for each DS maintainer position. The standard allowances considered by current MACRIT methodology were Security, Kitchen Police, Work Details, Messing, Casualties, and Personnel Needs. At the division level, unit movement Category I TOE applies and was selected to represent that high degree of mobility. At this level, excessive mobility can impact adversely on the ability to perform maintenance actions.

4.3 THE INTERACTIVE MANPOWER AGGREGATION AND ESTIMATION SIMULATION (IMAGES) MODEL.

Once the individual section and direct support workload capacities were defined, available manpower requirements simulation models were reviewed. It was decided that the IMAGES model, with minor modifications, offered the most flexibility and best format for RPV manpower analysis. IMAGES is an interactive computer model, which has two purposes: (1) determine required manhours per task based on frequency per year as calculated from key parameters such as reliability, maintainability and scenario data, and (2) aggregate individual task workload to determine manhours by skill, skill level and paygrade.

Workload data, in the form of required tasks, time to accomplish, and required skill level are aggregated, based upon system activity levels. These activity levels are derived from system characteristics such as reliability, scenario data including system operation time, and support data such as level of repair. The resultant output is required manhours per month by skill level for a system/subsystem. IMAGES capability to develop aggregated manpower directly from system characteristics and activity levels permits its use in sensitivity analysis, supportability and risk assessments, and tradeoff analysis as well as manpower estimation.

Inputs which IMAGES requires are:

- O&O scenario (see Appendix B.3) and maintenance concept data such as number of flights, AV operating hours, weather, site displacement frequency and level of repair location.
- Task data such as skill, skill level and time to accomplish the task.
- Productivity allowances (see Table 4.2-3).
- Reliability and maintainability factors derived from the engineering portion of the system analysis.

Through modeling equations and task relations to skill, skill level and manhours per task, the four input categories above are used by IMAGES to determine workload. IMAGES modeling equations tailored to the RPV were used to determine task frequency for operational manning based on tactical scenario and R&M factors characteristic of each equipment.

Outputs which IMAGES produces are Manhours Per Month sorted by:

- o Activity
- o Major workload category
- o Task
- o Sub-task
- o Skill
- o Skill level
- o Paygrade

An example of an IMAGES output[1] is shown in Figure 4.3-1.

---

[1] A key to the abbreviations and coding used in the data files is contained in Appendix B.1.

Figure 4.3-1   EXAMPLE OF IMAGES OUTPUT

```
****************************************************************************************************************************
                    MANHOUR LOADING REPORT

    *** (RPV -- REFERENCE 002 RELIABILITY FILE)                    ***MMRB002
    *** RPV SEC REFERENCE (MMH) * RELIABILITY SORT ** 30 NOV. 1982 *** MMH
****************************************************************************************************************************
RELIABILITY BASELINE FILE=RPV11/IMAO/MMRB002  (ITERATION NUMBER IS 002.)
DATA FILE=RPV11/IMAO/MMLD202  (ITERATION NUMBER IS 202.)
DATA SELECTED --
WORKUNIT=ALL
 ACTIVITY=ALL
 WORKLOAD CATEGORY=ALL
 TASKS (NEXT LINE, SEPARATED BY DOLLAR SIGNS)
ALL           $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
 SUBTASK=ALL
 SKILL=ALL                  SKILL LEVEL=ALL                 SECONDARY SKILL=ALL
----------------------------------------------------------------------------------------------------------------------------
REQUESTED ORDER OF SORT IS --
 ACTIVITY           <------- (MAJOR SORT KEY)
 SKILL              <-------
 SECONDARY SKILL    <-------
----------------------------------------------------------------------------------------------------------------------------
<---ACTIVITY--><-WORKLOAD-CT-><-----TASK-----><---SUBTASK--->SK S-L 2S(--WORK-UNIT--> <-FREQ/YR-> <-FREQ/MO-> <MMH/TASK-> <-MMH/MO-->
----------------------------------------------------------------------------------------------------------------------------

C   MAIN 1     PM RS         SVC            POST MOVE   X3 13T10  E2K1.3.2.2.3.1       365.00       30.30       0.33       10.00

      TOTAL SECONDARY SKILL- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -          10.00

C   MAIN 1     PM VH         TEST           2 ROTGEN       13T10  E3K1.3.4.3.1.1.2     365.00       30.30       0.11        3.33

      TOTAL SECONDARY SKILL- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -           3.33

C   MAIN 1     PM GCS        INSP           GCS DOOR       13T10  E4  XODAAR            52.00        4.32       0.01        0.04

C   MAIN 1     PM GCS        SVC            AIR BAFFLE     13T10  E4  XODAA?AH          12.00        1.00       0.32        0.32

C   MAIN 1     PM GCS        TEST           CHECK GCS      13T10  E4  XOD              365.00       30.30       0.22        6.67

C   MAIN 1     PM GCS        TEST           GCS DOOR       13T10  E4  XODAAR            12.00        1.00       0.11        0.11

C   MAIN 1     PM LS         SVC            LAUNCH SYS DY  13T10  E4  OB               365.00       30.30       2.10       63.63

C   MAIN 1     PM RS         SVC            RECOV SYS DY   13T10  E4  OC               365.00       30.30       1.05       31.82

      TOTAL SECONDARY SKILL- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -         102.59

   TOTAL SKILL- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -         115.92

C   MAIN 1     PM VH         INSP           30KW GEN       63B10  E4  GGS              365.00       30.30       0.14        4.24

C   MAIN 1     PM VH         SVC            START GEN 1    63B10  E4K1.3.4.3.1.1.2     365.00       30.30       0.11        3.33

C   MAIN 1     PM VH         SVC            START GEN 2    63B10  E4D1.6.3.2.1         365.00       30.30       0.07        2.12

C   MAIN 1     PM VH         TEST           RUN GEN 2      63B10  E4D1.6.3.2.1         365.00       30.30       0.04        1.21

      TOTAL SECONDARY SKILL- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -          10.90

   TOTAL SKILL- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -          10.90

C   MAIN 1     PM MS         SVC            PERS CBR    X13 XXXXX  E21.7.6.2             52.00        4.32       0.91        3.93

C   MAIN 1     PM VH         TEST           RUN GEN 2      XXXXX  E2D1.6.3.2.1         365.00       30.30       0.04        1.21
```

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4.4 APPLICATION OF IMAGES TO THE RPV SECTION

Workload Determination

Completing the RPV systems analysis and developing the appropriate manpower model were only the initial steps in determining manpower requirements. The next step in the manpower requirements determination phase was identifying workload categories for tasks performed in satisfying mission events. The generic task taxonomy located in Appendix B.2 provided the basic task list. Workload categories noted in this listing were defined as follows:

- Operational Manning (OM) Workload required to fulfill mission capabilities of launch, recover, communicate, movement, emplacement, operate and displacement.

- Preventive Maintenance (PM) Workload required to maintain equipment or material in an operating condition. The associated tasks may be time or event driven but not caused by equipment failure.

- Corrective Maintenance (CM) Workload required to restore equipment or material to an operating condition after failure.

- Indirect Labor (INDL) Workload required to perform administration, supervision, supply, security and all other functions which may be assigned to the RPV but not specifically included in OM, PM or CM.

For the first category of workload, operational manning (OM) or required manhours per task was determined by using Army field demonstration data for government furnished equipment and contractor time estimates for those systems provided by the contractor. For example, appropriate Army field demonstration data was extrapolated to estimate task times in securing the GCS camouflage. For the few OM tasks for which time to accomplish was not covered by Army field demonstrations, data was determined through use of the operational audit (OP-AUDIT) technique. OP-AUDIT is the technique of estimating values (in this case task time) through interviewing/reviewing knowledgeable sources.

Maintenance values for PM/CM were obtained from review of MACRIT maintenance data, DT/OT tests, contractor provided logistics support analysis (LSA) information and engineering analysis. INDL task man-hours were primarily scenario driven. Those remaining tasks not covered by specific documentation had their time-to-accomplish determined by OP-AUDIT. Section manpower requirements could then be determined using the equation:

$$\frac{\text{Workload}}{\text{Workweek}} = \frac{\text{OM+PM+CM+INDL}}{84} = \text{Manpower}$$

The use of workweeks (defined in Section 4.2) and assumptions made concerning the scenario (Appendix B.3) permitted calculation of RPV section manpower requirements for workload aggregation into the various crew positions. Included in workload aggregation were the considerations of:

- Numbers of personnel required for each task and the requirements to perform simultaneous tasks (i.e., the 3 operators needed to conduct flight operations cannot be operating the recovery vehicle).

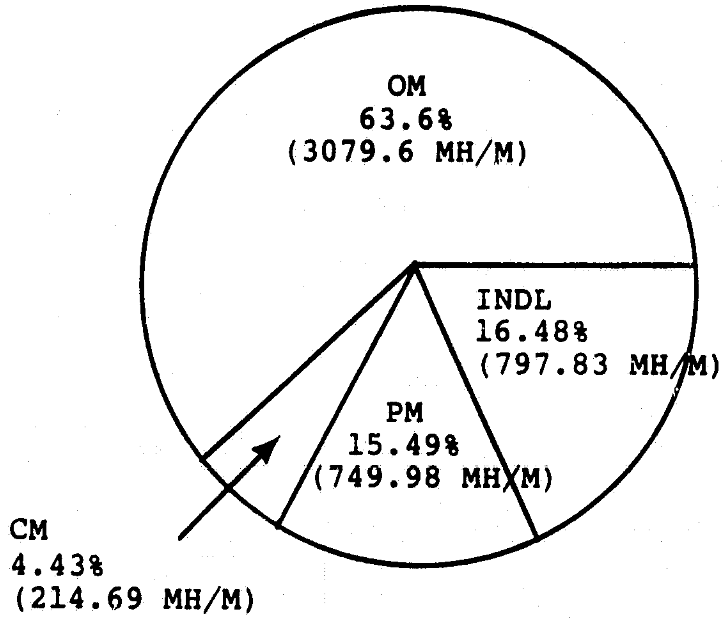
- Manpower quality (MOS/Skill Level/ASI) and quantity (i.e., number of crew needed to recover an AV) for each task.

Manpower Determination

Development of RPV section manpower for the reference and baseline systems began by obtaining the OM and INDL workload for the O&O and the sustained scenario models. The O&O scenario was defined from the O&O concept and is considered an ideal situation. The sustained operations scenario represents the normally expected RPV operating environment as stated in the O&O concept but modified for degraded weather and AV losses. Crew/organizational level maintenance (PM and CM) for each system configuration was developed by identifying system components requiring maintenance to be performed by section personnel. The RPV section workload aggregated through this process is shown in Figure 4.4-1. Detailed workload compiled by task is presented in Appendix B.5. This workload data was then reformatted by skill level and grade within IMAGES to examine its effect on workload distribution as shown in Table 4.4-1.

Figure 4.4-1 RPV Section Workload Distribution

REFERENCE - O&O SCENARIO



REFERENCE - SUSTAINED SCENARIO

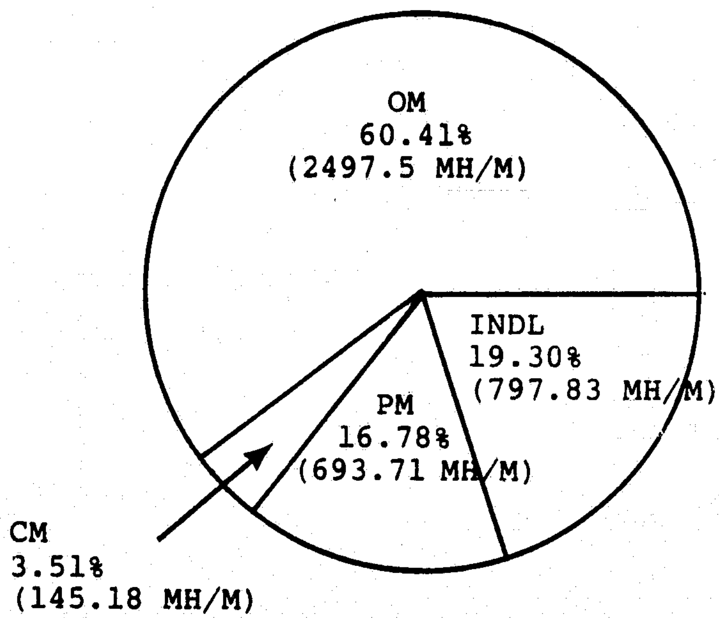
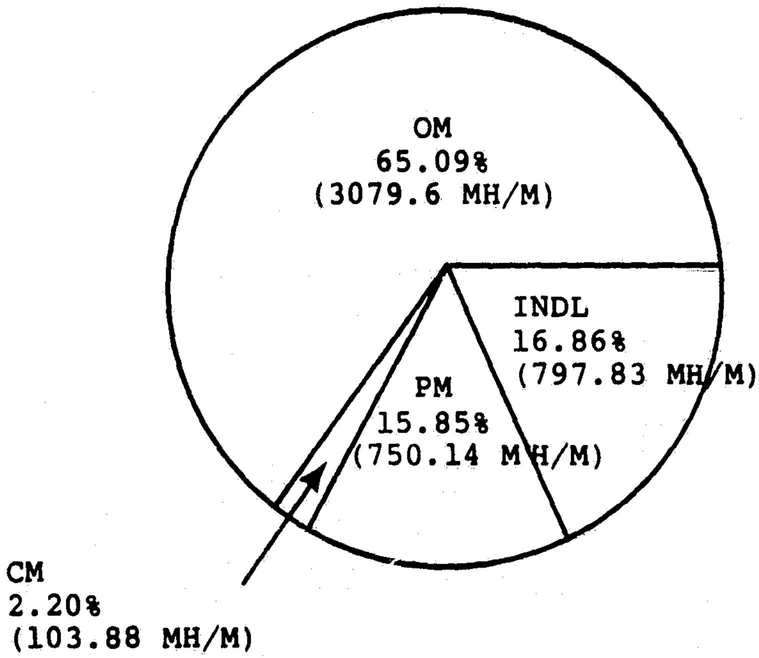


Figure 4.4-1 RPV Section Workload Distribution (continued)

BASELINE - O&O SCENARIO



BASELINE - SUSTAINED

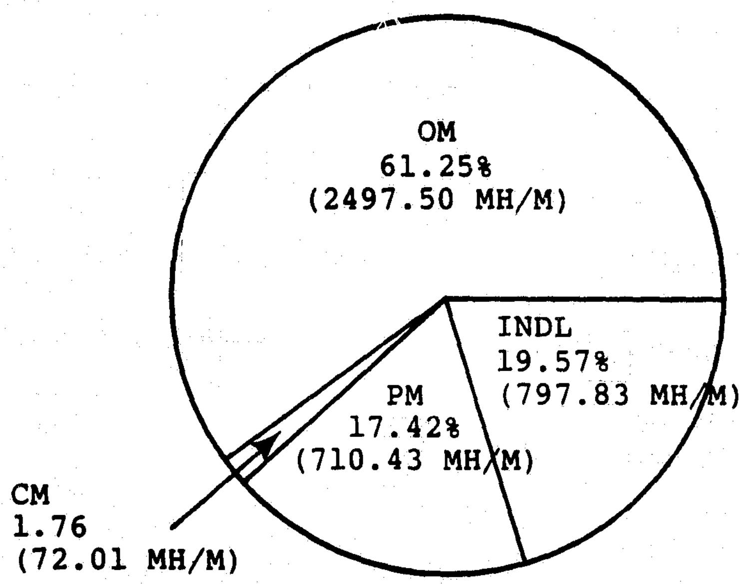


Table 4.4-1

RPV Section Workload Distribution (MH/Month)

MOS/SI/PAYGRADE		WORKLOAD CATEGORY	REFERENCE O & O	REFERENCE SUSTAINED	BASELINE O & O	BASELINE SUSTAINED
211B		OM	-	-	-	-
		PM	-	-	-	-
		CM				
		INDL	42.35	42.35	42.35	42.35
13T30	E6	OM	447.91	287.98	447.91	287.98
		PM	-	-	-	-
		CM				
		INDL	64.36	64.36	64.36	64.36
13T20	E5	OM	55.44	34.11	55.44	34.11
		PM	2.73	2.73	2.73	2.73
		CM	0.16	0.14	0.16	0.14
		INDL	4.82	4.82	4.82	4.82
13T20P9	E5	OM	-	-	-	-
		PM	17.73	9.60	18.64	10.51
		CM	19.32	11.35	9.40	5.09
		INDL	2.16	2.16	2.16	2.16
13T10	E4	OM	334.17	202.66	334.17	202.66
		PM	152.46	152.46	152.46	152.46
		CM	6.06	4.07	4.19	2.92
		INDL	2.16	2.16	2.16	2.16
13T10P9	E4	OM	45.45	45.45	45.45	45.45
		PM	110.88	99.58	110.41	99.58
		CM	13.70	9.81	16.57	12.66
		INDL	-	-	-	-
31V10	E4	OM	-	-	-	-
		PM	-	-	N/A	N/A
		CM	13.02	11.54	-	-
		INDL	-	-	-	-

Table 4.4-1 (Continued)

MOS/SI/PAYGRADE		WORKLOAD CATEGORY	REFERENCE O & O	REFERENCE SUSTAINED	BASELINE O & O	BASELINE SUSTAINED
63 10	E4	OM	10.61	10.61	10.61	10.61
		PM	93.06	93.06	93.06	93.06
		CM	155.75	104.47	71.29	49.56
		INDL	-	-	-	-
13T10	E3	OM	966.39	759.80	966.39	759.80
		PM	39.45	24.88	39.45	24.88
		CM	1.28	0.87	.64	.55
		INDL	18.79	18.79	18.79	18.79
13T10	E2	OM	116.04	93.63	116.04	93.63
		PM	29.19	23.40	28.91	22.73
		CM	5.40	2.93	1.63	1.09
		INDL	-	-	-	-
XXXX	E4	OM	6.06	6.06	6.06	6.06
		PM	-	-	-	-
		CM	-	-	-	-
		INDL	-	-	-	-
XXXX	E3	OM	30.30	30.30	30.30	30.30
		PM	-	-	-	-
		CM	-	-	-	-
		INDL	-	-	-	-
XXXX	E2	OM	1067.23	1026.90	1067.23	1026.90
		PM	304.48	304.48	304.48	304.48
		CM	-	-	-	-
		INDL	663.19	663.19	663.19	663.19
TOTAL		OM	3079.60	2497.50	3079.60	2497.50
		PM	749.98	693.71	750.14	710.43
		CM	214.69	145.18	103.88	72.01
		INDL	797.83	797.83	797.83	797.83
GRAND TOTAL			4842.10	4134.22	4731.45	4077.77

Using the results of Table 4.4-1, along with applicable scenario factors (i.e., operations sequence, number of crew per task), RPV section workload was distributed among the grade levels to efficiently and fully fill each position's workload capacity thereby determining the minimum manpower requirements. The results of this process are shown in Table 4.4-2.

The tabulated results of this manpower requirements analysis are listed by MOS, ASI and paygrade for the RPV section, platoon and Army totals in the following tables:

- Table 4.4-3 - Baseline, O&O Concept
- Table 4.4-4 - Baseline, Sustained Concept
- Table 4.4-5 - Reference, O&O Concept
- Table 4.4-6 - Reference, Sustained Concept

A detailed explanation of the O&O Concept and Sustained Operations scenario addressed by this report is contained in Appendix B.3.

The manpower results noted are considered idealistic in that no allowance was made for fatigue, working environment conditions, and task interruption when addressing OM and INDL tasks that are unconstrained by time-limits. For example, times to set up camouflage, drive the launcher to its launch site or write a report are not constrained by some time limit. Operator time for a three hour flight, on the other hand, is limited to three hours, and no more.

Table 4.4-2 AGGREGATED MONTHLY WORKLOAD ALLOCATED BY CREW POSITION

POSITION	WORKLOAD CATEGORY	REFERENCE O&O	REFERENCE SUSTAINED	BASELINE O&O	BASELINE SUSTAINED
Section Leader (WO)	OM	233.32*	156.61*	258.32*	172.61*
	PM	-	-	-	-
	CM	-	-	-	-
	INDL	42.35	42.35	42.35	42.35
		275.67	198.96	300.67	214.96
Section Chief (13T10), E6	OM	264.59	206.37	269.59	206.37
	PM	-		-	-
	CM	-		-	-
	INDL	64.36	64.36	64.36	64.36
		328.95	270.73	333.95	270.73
Senior Mission Payload Operator	OM	277.33*	239.32*	287.33*	223.32*
(13T10), E4	PM	46.45	62.86	46.44	79.61
	CM	3.03	2.03	1.16	0.88
	INDL	2.16	22.16*	2.16	22.16*
		328.97	326.37	337.09	325.97
Senior Air Vehicle Operator	OM	312.55*	224.60*	322.55*	224.60*
(13T10), E5	PM	2.73	32.73	2.73	32.73
	CM	0.16	0.14	0.16	0.14
	INDL	4.82	64.82**	9.82**	64.82**
		320.26	322.29	335.26	322.29
Mission Payload Operator	OM	303.67	252.81**	307.67	307.67**
(13T10), E3	PM	3.33	28.28*	3.33	28.28*
	CM	0.38	0.38	0.38	0.38
	INDL	18.79	38.79**	23.79	38.79**
		326.17	320.26	335.17	375.12

Table 4.4-2 (continued)

POSITION	WORKLOAD CATEGORY	REFERENCE O&O	REFERENCE SUSTAINED	BASELINE O&O	BASELINE SUSTAINED
Air Vehicle Operator (13T10), E4	OM	237.84	182.73	247.84	182.73
	PM	56.00	82.85	56.00	82.85
	CM	3.03	2.04	3.03	4.89
	INDL	30.00***	60.00***	35.00***	60.00***
		326.87	327.62	341.87	330.47
RPV Mechanic (13T20P9), E5	OM	135.45**	140.45**	150.45**	155.45**
	PM	97.73**	119.60**	103.69**	120.51**
	CM	19.32	11.35	9.34	5.09
	INDL	72.16**	52.16	75.16**	52.16
		324.66	323.56	338.64	333.21
RPV Mechanic (13T10P9), E4	OM	100.00***	100.00***	110.00***	100.00***
	PM	110.88**	119.58**	110.41**	119.58**
	CM	13.70	9.81	16.54	12.66
	INDL	100.00***	100.00***	100.00***	100.00***
		324.58	329.39	336.95	332.[illegible]
Launch & Recovery Team Chief (13T20), E5	OM	230.74**	180.02*	245.74**	180.02*
	PM	70.00*	80.00*	70.00*	80.00*
	CM	-	-	-	-
	INDL	20.00***	60.00***	20.00***	60.00***
		320.74	320.02	335.74	320.02
RPV Crewman (13T10), E3/E2	OM	854.03	608.98**	851.04	733.98**
	PM	151.10**	9.48***	160.32	8.81***
	CM	6.30	3.42 [I]	2.81	1.58*
	INDL	303.19***	123.19***	383.19	238.19***
		1314.62[I]	745.07[II]	1397.36[I]	982.56[I]

Table 4.4-2 (continued)

POSITION	WORKLOAD CATEGORY	REFERENCE O&O	REFERENCE SUSTAINED	BASELINE O&O	BASELINE SUSTAINED
Power Generator & Wheeled Vehicle Mechanic (63B10)E4					
	OM	30.61**	55.61**	115.61**	55.61**
	PM	143.07	143.33	145.06	163.06
	CM	155.75	104.47	71.29	49.56
	INDL	-	20.00***	-	50.00***
		329.43	323.41	331.96	323.23
Communications Equipment Repairman (31V10) (Reference Section) E4 Only					
	OM	190.00***	140.00***		
	PM	20.00***	20.00***	N/A	N/A
	CM	13.02	11.54		
	INDL	100.00***	150.00***		
		323.02	321.54		

Note: * Greater than 50% of workload shown comes from lower skill level of paygrade.

** Greater than 50% of workload shown comes from unspecified MOS work.

*** Entire workload shown comes from unspecified MOS work.

I Workload for four positions (13T10 E3-2, 13T10 E2-2).

II Workload for three positions (1eT10 E3-2, 13T10 E2-1).

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TABLE 4.4-3

MANPOWER REQUIREMENTS, BASELINE SYSTEM

O&O CONCEPT*

MOS	ASI	PAYGRADE	RPV SECTION	RPV PLATOON	ARMY TOTAL
211B		WO	1	4	56
13T30		E6	1	4	56
13T20		E5	2	8	112
13T10		E4	2	8	112
13T10		E3	3	12	168
13T10		E2	2	8	112
13T20	P9	E5	1	4	56
13T10	P9	E4	1	4	56
63B10		E4	1	4	56
TOTAL			14	56	784

* RPV Platoon Headquarters Requirements are not included in this table.

Table 4.4-4

MANPOWER REQUIREMENTS, BASELINE SYSTEM

SUSTAINED CONCEPT *

MOS	ASI	PAYGRADE	RPV SECTION	RPV PLATOON	ARMY TOTAL
211B		WO	1	4	56
13T30		E6	1	4	56
13T20		E5	2	8	112
13T10		E4	2	8	112
13T10		E3	3	12	168
13T10		E2	1	4	56
13T20	P9	E5	1	4	56
13T10	P9	E4	1	4	56
63B		E4	1	4	56
TOTAL			13	52	728*

* RPV Platoon Headquarters Requirements are not included in this table.

Table 4.4-5

MANPOWER REQUIREMENTS, REFERENCE SYSTEM
O&O CONCEPT *

MOS	ASI	PAYGRADE	RPV SECTION	RPV PLATOON	ARMY TOTAL
211B		WO	1	4	56
13T30		E6	1	4	56
13T20		E5	2	8	112
13T10		E4	2	8	112
13T10		E3	3	12	168
13T10		E2	2	8	112
13T10	P9	E5	1	4	56
13T10	P9	E4	1	4	56
31V10		E4	1	4	56
63B10		E4	1	4	56
TOTAL			15	60	840

* RPV Platoon Headquarters Requirements are not included in this table.

Table 4.4-6

MANPOWER REQUIREMENTS, REFERENCE SYSTEM

SUSTAINED CONCEPT *

MOS	ASI	PAYGRADE	RPV SECTION	RPV PLATOON	ARMY TOTAL
211B		WO	1	4	56
13T30		E6	1	4	56
13T20		E5	2	8	112
13T10		E4	2	8	112
13T10		E3	3	12	168
13T10		E2	1	4	56
13T20	P9	E5	1	4	56
13T10	P9	E4	1	4	56
31V10		E4	1	4	56
63B10		E4	1	4	56
TOTAL			14	56	784

* RPV Platoon Headquarters Requirements are not included in this table.

Fatigue factors, environment, unavoidable delay and interruption are not addressed by MACRIT and therefore are not normally considered in Army manpower analyses. However, for the RPV section working conditions, application of Navy or Air Force manpower methodologies (OPNAVINST 5310.14, OPNAVINST 5310.19, AF REG 25-5, Vol II) would permit a combined adjustment factor for the above items of 17-20 percent. This amounts to between 400 and 500 manhours for the sustained scenario and 450-550 manhours for the O&O scenario. These adjustments would fully load all positions shown in Table 4.4-2 and potentially add one to two positions depending on the capability to allocate additional workload to existing positions. Position workload was specifically limited to about 90 percent of capacity because of these potential adjustment factors. This value was based on the consideration that each position's workload consists of approximately 50 percent unconstrained operational manning and indirect labor.

Sensitivity analysis of RPV baseline manpower requirements for two additional operating scenarios (Surge and Reduced Tempo Operations) was conducted to obtain manpower sensitivity to scenario changes. These two additional scenarios were considered only for a manpower requirements briefing presented at the RPV Project Office in September, 1982. Surge operations incorporated high tempo flight operations and the frequent site movements and AV losses expected in intense combat operations. Reduced tempo operations represent conditions expected when the section would be in a divisional reserve status. Table 4.4-7 was used to present the results of these baseline manpower analyses.

Table 4.4-7

MANPOWER REQUIREMENTS

Surge Operations

MOS	ASI	WO	E6	E5	E4	E3	E2	TOTAL
211B		1						1
13T30			1					1
13T20				2				2
13T20	P9			1				1
13T10					2	3	2	7
13T10	P9				1			1
63B10					1			1
UNSPEC							1	1
TOTAL		1	1	3	4	3	3	15

Reduced Tempo

MOS	ASI	WO	E6	E5	E4	E3	E2	TOTAL
211B		1						1
13T30			1					1
13T20				2				2
13T20	P9			1				1
13T10					1	2	1	4
13T10	P9				1			1
63B10					1			1
UNSPEC								
TOTAL		1	1	3	3	2	1	11

Factors impacting baseline RPV manpower requirements were subsequently examined in detail. Using idealistic OM and INDL conditions (i.e., no fatigue, lost productive time, nor military administrative diversions), 13 positions will be required to satisfy RPV operational and maintenance manpower requirements (sustained operation scenario). With the exception of the Warrant Officer, all positions are filled to approximately 90 percent of workload capacity (without considering fatigue, productivity and delay allowances), thereby leaving little excess capability for the section's manpower to absorb added workload. Factors which could cause this percentage to increase are:

- o Inclusion of OM and INDL non-productivity factors similar to the MACRIT factor for maintenance.

- o Use of equipment reliability and mean time to repair values based on actual field experience rather than those inherent engineering reliability and repair times based on highly skilled and technically proficient maintainers. This factor is examined further in an impact analysis sensitivity check in Section 7.5.

- o Increasing the number or frequency of section displacements/flights. For example, adding one section displacement cycle increases baseline section manpower requirements by 46.8 manhours for a fully set up site. If the requirements to displace the site and set it up increased from 7 to 8 times per week, workload would increase by 203.6 manhours/month. Note: This increases both

MOS specific and non-specific workload the equivalent of 0.48 positions.

- Adding one 3 hour AV mission per day would increase monthly workload by 275-280 manhours (0.76 positions) for the sustained scenario and 400-405 manhours (1.10 positions) for the O&O scenario.

Timeline analysis of the 13 man emplacement/displacement requirements (Appendix B.4) for good weather/daylight conditions indicate the crew should be able to meet the 60 minute emplacement requirements provided adequate previous preparation is made to properly brief personnel and load the section vehicles. Under no conditions can the 13 man crew meet the 30 minute displacement requirement. (Appendix B.4, Tables B.4-2 to B.4-4). Examination of the operational manning (OM) workload on Table 4.4-8 shows the functions of emplacement/displacement drive considerable manpower, with the majority of this workload (68 percent) requiring no specific MOS and skill level to accomplish. This labor requirement, where possible, has been distributed to unfilled MOS skill level positions. The distribution was made based on timeline analysis of workload associated with specific tasks.

High Drivers of Workload

Tables 4.4-8 and 4.4-9 show the three "high drivers" in each workload category; OM and INDL, PM and CM respectively, for the baseline and reference equipment systems based upon the O&O and sustained operating scenarios. These tables show

Table 4.4-8 Workload High Drivers (MH/Month)

Workload Category	Ranking	Reference O&O	Reference Sustained	Baseline O&O	Baseline Sustained
OM	1	AVOPS Control 818.01	Displacement 503.88	AVOPS Control 818.01	Displacement 503.88
	2	Displacement 503.88	AVOPS Control 470.34	Displacement 503.88	AVOPS Control 470.34
	3a	Site Improvement 437.75	Site Improvement 437.75	Site Improvement 437.75	Site Improvement 437.75
	3b	Site Set Up (initial) 437.61	Site Set Up (initial) 437.61	Site Set Up (initial) 437.61	Site Set Up (initial) 437.61
INDL	1	Patrols * 466.62	Patrols * 466.62	Patrols * 466.62	Patrols * 466.62
	2	Resupply 125.50	Resupply 125.50	Resupply 125.50	Resupply 125.50
	3	Pers Supervision** 80.07	Pers Supervision** 80.07	Pers Supervision** 80.07	Pers Supervision ** 80.07

NOTE: * This is an internal site fire and equipment security patrol for unmanned equipments after normal operating hours.

** Includes only WO/E6 personnel administration/counciling workload.

Table 4.4-9 Workload High Drivers (MH/Month)

Workload Category	Ranking	Reference O&O	Reference Sustained	Baseline O&O	Baseline Sustained
PM	1	Wheeled * Vehicles 361.52	Wheeled * Vehicles 361.52	Wheeled * Vehicles 361.52	Wheeled * Vehicles 361.52
	2	Air ** Vehicle 105.61	GCS *** 87.40	Air ** Vehicle 105.61	GCS *** 87.40
	3	GCS *** 87.40	Maintenance Shelter 75.41	GCS *** 87.40	Maintenance Shelter 75.41
CM	1	Wheeled * Vehicles 160.33	Wheeled * Vehicles 107.33	Wheeled * Vehicles 72.86	Wheeled * Vehicles 50.65
	2	GCS *** 39.46	GCS *** 29.00	GCS *** 22.44	GCS *** 16.55
	3	Air Vehicle 8.08	Air Vehicle 4.65	Air Vehicle 4.09	Air Vehicle 2.44

Note: * Wheeled vehicles PM/CM does not include maintenance for carried RPV subsystems/equipments.

** Approximately 70% of this PM is associated with AV prelaunch preparation and is normally performed outside the maintenance shelter.

*** Includes associated Ground Support Equipments.

that, among other things, the Maintenance Shelter (MS) system (used to support AV test and that maintenance not directly related to launch preparation) drives very little wartime manpower. Table 4.4-9 points out that wheeled vehicle maintenance is the high driver of maintenance manpower.

Regarding AV flight mission planning, the requirement to plan a 30 waypoint mission will completely utilize the 60 minutes allowed for emplacement (assuming that the crew has been keeping their situation maps/overlays updated and the mission being planned requires only "updating" type workload). Initial mission planning should take approximately 20 minutes, with specific waypoint analysis another 28 minutes. Specific waypoint analysis time is based on an assumed time of three minutes for the first waypoint analysis and subsequent analyses times reduced using a 70 percent learning curve. This learning curve choice was selected because of expected high experience level of the warrant officer or section chief doing the mission planning.

4.5 APPLICATION OF IMAGES TO RPV DIRECT SUPPORT (DS) MAINTENANCE

Development of DS level maintenance manpower requirements required definition of DS maintenance workload but considered no operational tasks. The workload category of corrective maintenance (CM) was the only category utilized for this level. The standard MACRIT workweek developed in Section 4.2 for DS was used to derive the equation for DS level manpower.

Workload data, developed by the analysis process previously described in Section 4.4, were used in computing direct support maintenance workload for the reference and baseline systems. These workload data were then aggregated by MOS and a productivity allowance of 40 percent was added. This factor is consistent with MACRIT productivity allowances and is considered to be a valid estimate given the expected operating environment associated with forward-deployed direct support maintenance units. Results of this aggregation are shown as the Direct Support Manpower requirements in Tables 4.5-1 and 4.5-2 for the baseline and reference systems, respectively. These tables show that most MOS positions for RPV DS level maintainers are driven by small workload totals.

Because RPV DS level manpower requirements were driven by existing MOS's, the staffing tables contained in AR 611-201 were used to determine most paygrade and skill level requirements. Table 4.5-3 depicts the listing of deviations from the approved staffing tables of AR 611-201 along with a synopsis of the supporting rationale to justify the selected RPV staffing.

In Summary

- o Thirteen positions are the minimum required by the RPV section to satisfy all functional requirements specified in the modified O&O Concept, Sustained Operations. Fourteen positions are required to man an RPV section using the unmodified O&O Concept.

Table 4.5-1 Direct Support Maintenance Manpower Baseline System

MOS	PAYGRADE	Monthly Man-Hours O&O	Monthly Man-Hours SUSTAINED	RPV Platoon O&O	RPV Platoon SUSTAINED	Army Total O&O	Army Total SUSTAINED
26L	E5	0.11	0.06	1	1	14	14
31E	E4	80.76	63.27	1	1	14	14
31J	E4	12.82	12.82	1	1	14	14
31S	E4	26.38	26.38	1	1	14	14
34Y	E5	5.64*	3.93*	1	1	14	14
35E	E5	0.17	0.17	1	1	14	14
35H	E5	9.26*	12.64	1	1	14	14
36H	E4	14.59	14.59	1	1	14	14
41B	E4	14.70	19.41	1	1	14	14
41C	E4	0.46	0.46	1	1	14	14
43M	E4	1.39	1.39	1	1	14	14
44B	E5	19.08*	16.93*	1	1	14	14
45B	E4	1.38	1.38	1	1	14	14
52C	E5	37.16*	36.58*	1	1	14	14
52D	E4	62.60*	54.65*	1	1	14	14
63G	E4	49.93*	32.60*	1	1	14	14
63J	E4	0.58	0.34	1	1	14	14
63W	E3	200.17	-	1	-	14	-
63W	E5	9.47	135.83*	1	1	14	14
	Total	546.65	433.43	19	18	266	252

* Includes workload from a lower skill level within the same MOS.

Table 4.5-2 Direct Support Maintenance Manpower Reference System

		MONTHLY MANHOURS		RPV PLATOON		ARMY TOTAL	
MOS	PAYGRADE	O&O	SUSTAINED	O&O	SUSTAINED	O&O	SUSTAINED
26L	E5	31.50*	21.43*	1	1	14	14
26T	E4	50.32	26.94	1	1	14	14
31E	E4	100.30	77.69	1	1	14	14
31J	E4	60.73	60.73	1	1	14	14
31S	E4	26.38	26.38	1	1	14	14
34Y	E5	34.36*	24.98*	1	1	14	14
35E	E5	7.81*	4.50*	1	1	14	14
35H	E5	9.26*	12.64*	1	1	14	14
36H	E4	14.59	14.59	1	1	14	14
41B	E4	14.70	19.41	1	1	14	14
41C	E4	0.46	0.46	1	1	14	14
43M	E4	1.39	1.39	1	1	14	14
44B	E5	18.33	16.51	1	1	14	14
45B	E4	1.38	1.38	1	1	14	14
45G	E4	158.48*	91.11*	1	1	14	14
52C	E5	52.98*	52.40*	1	1	14	14
52D	E5	71.95*	60.03*	1	1	14	14
63G	E5	126.85*	80.57*	1	1	14	14
63J	E4	0.81	0.48	1	1	14	14
63W	E3	208.22	208.22	1	1	14	14
63W	E5	203.23*	58.82*	1	1	14	14
		1,194.03	860.66	21	21	294	294

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* Includes workload from a lower skill level within the same MOS.

Table 4.5-3 Direct Support Maintenance Staffing Deviations

MOS	STAFFING TABLE PAYGRADE	RECOMMENDED PAYGRADE	DISCUSSION
26L	E4	E5	Repair of the MICNS Microwave assembly requires training enhanced by technical experience of an E5 (AR 611-201, p. 3-29-11.)
34Y	E4	E5	Repair and test of the GCS computer/signal processing unit requires training enhanced by technical experience of an E5. Workload is caused by 2-8 mh/mo of E5 maintenance. (AR 611-201, p. 3-74-33.)
35E	E4	E5	This skill level is required by 0.17 mh/mo of work associated with the repair and replacement of the Air vehicles signal cable. (AR 611-201, p. 3-29-57.)
35H	E4	E5	Staffing table for the 35H Calibration Specialists is at variance with the workload skill requirements when a system workload quantity is unsufficient for more than one position. Since workload associated with test and repair of the vehicle (STE/ICE test equipment (2.80 mh/mo) exists the skill level 2 maintenance specialist was chosen. (AR 611-201, p. 3-29-59.)
44B	E4	E5	Alignment of using structural assemblies and repair of fuselage requires a skill level 2 metal worker as described in the associated duties section of MOS 44B p. 3-63-7 of AR 611-201.

Table 4.5-3 (continued)

MOS	STAFFING TABLE PAYGRADE	RECOMMENDED PAYGRADE	DISCUSSION
52C	E5	E5	Technical inspection of the MCPE after repair at the Direct Support level requires skill level 2 (AR 611-201 page 3-62013). Since insufficient workload exists for more than one position to support the RPV Platoon all 52C workload was aggregated into the senior skill level required.
63G	E4	E5	The MOS duty description of AR 611-201, p. 3-63-27 assigned independent trouble shooting and diagnoses of electrical systems to skill level 2 which by staffing standards would not exist until three positions are required. The RPV Platoon generates insufficient workload for three staffed positions therefore position assignment was made to accommodate the highest skill level workload requirement.
63W	E3/E4	E3/E5	Same rational for assignment of the 63G20 E5 applies to the assignment of the assignment of the 63W20 E5. (AR 611-201, p. 3-63-21.)

- The RPV section can emplace a minimum operations configuration for AV launch and mission control of a 30 waypoint mission in 60 minutes.

- A 13 man RPV section requires 54 minutes to displace an RPV section from a minimum operations configuration.

SECTION 5 - DETERMINE TRAINING RESOURCE REQUIREMENTS

5.1 OVERVIEW

This section describes the results of the RPV Training Resource Requirements Analysis (TRRA) and outlines the general procedures that were employed in this analysis. A more detailed discussion of the procedures employed in a Training Resource Requirements Analysis is contained in the ARI Technical Report on the application of HARDMAN to the Division Support Weapon System (DSWS).[1]

5.2 OBJECTIVES AND ASSUMPTIONS

Like the other steps in the HARDMAN methodology, the TRRA is tailored to meet the requirements of each study. This tailoring is based on the purpose and scope of the effort and the availability of data to support the analysis. The purposes of the RPV analysis are discussed in Section 1 of this report. These objectives were further refined into the following TRRA objectives.

- o Identify a baseline training pipeline which will support section manning and operation by:

---

1. Application of the HARDMAN Methodology to the Division Support Weapon System (DSWS), ARI Technical Report (Volume 2), in publication.

a) Assessing the baseline training pipelines' ability to support the acquisition of the job proficiencies required to operate and maintain the system.

b) Identifying course content and length.

c) Identifying instructor requirements.

- Identify the entry level resident training requirements for the maintainers of the Remotely Piloted Vehicle through the direct support level of maintenance, by:

  a) Identifying courses impacted.

  b) Identifying course content and length.

  c) Identifying instructor requirements.

These objectives support the primary purpose of the HARDMAN methodology which is to influence design during the early phases of the system acquisition process. Additionally, the TRRA provides early estimates of training requirements to training developers and supports the development of the Individual and Collective Training Plan (ICTP). Application of the TRRA is designed to lay the foundation for achieving these objectives, but is not designed or intended to answer all of the early training estimation questions related to RPV.

Two types of TRRA's can be conducted: general and detailed. In a general TRRA, only very general task and skill information is collected; in a detailed TRRA more specific task data, at the task element level, are collected and analyzed. The general TRRA produces quicker results, requires less extensive analysis, and, thus, can be easily applied during the earliest phases of the acquisition process. However, the general TRRA does have some disadvantages. Its general scope and focus make it less appropriate for detailed tradeoffs of instructional methods and media. Also, the general type of task data it utilizes makes it less appropriate for many of the procedures which have been developed for the Instructional Systems Development (ISD) process. The detailed TRRA, on the other hand, is designed to be applied later in the acquisition process, when detailed tradeoffs of instructional methods and media are required, and more time, resources and task data are available for extensive analyses.

A general TRRA was conducted in this effort. This type of analysis was selected for the following reasons:

- The general analysis was commensurate with the overall study and TRRA objectives.

- RPV is still in the early phases of the acquisition process and a detailed ICTP has not been completed.

- Neither the time nor resources were available to conduct a detailed TRRA.

The following assumptions helped to further define the general scope and focus of the TRRA.

- Estimates in the TRRA are based on the best available data, and projections are made from the existing subsystem, courses, etc., which most closely meet the functional requirements of the proposed system.

- The scope of the RPV study does not address the manpower, personnel and training requirements of the platoon headquarters.

- Training resources are estimated for the "steady-state" or average value year where the "steady-state" year is defined as the first year in which the Army training system is producing replacement training only (that is, all systems have been deployed and training is focused on filling personnel positions vacated through attrition and promotion).

- Training associated with the operational test and evaluation of the proposed system and training associated with the initial fielding of the system (e.g., new equipment training) are not estimated.

- Development and acquisition costs associated with training products are not estimated.

- All established training is assumed to be adequately meeting existing system performance requirements.

- It is assumed that the 13T would attend basic training prior to attending the XXX-13T10 course. Basic training requirements are not estimated.

- The RPV warrant officer is not intended to be a maintenance technician. His primary responsibility is supervision of the tactical employment of the RPV system.

- Training resources to support supervised on-the-job training (SOJT), collective training, and advanced technical training other than for operators are not identified.

- Skill proficiency and retention of tasks trained in RPV courses is assumed to be adequately provided by the unit's SOJT and collective training programs; therefore, no review of the tasks trained in previous courses in the training pipeline is included in RPV-specific courses.

5.3 TRAINING RESOURCE REQUIREMENTS ANALYSIS (TRRA)

All of the major steps in a general Training Resource Requirements Analysis (TRRA) were conducted for RPV; however, the following constraints affected the analysis:

- Time - This is the first time that the HARDMAN methodology has been applied to an Army system in the validation phase of the Weapon System

Acquisition Process (WSAP). The analysis was planned and conducted in a two month period based on the assumption that the LSA and other data would be available. It was assumed that this data was detailed, well-organized, and included the entire RPV system. In fact, the detailed data included limited contractor furnished equipment information, and was difficult to analyze.

- Data - Many of the existing Army training materials that were requested to support the RPV application were late in arriving and some of the materials requested were never received. This resulted in much data being obtained by telephone.

- RPV Predecessor - This is the first HARDMAN application for which there was no predecessor system. This resulted in additional analysis being required to identify comparable equipment for training estimation and, in turn, more analysis to identify the actual training.

5.3.1 Format Existing Data and Develop TRRA Worksheets

Inputs for the TRRA consisted of the system requirements, functions, scenario data, manpower task assignments, and equipment lists. This information was provided by the two previous steps in the analysis. The subsequent step, Personnel Requirements Analysis, exchanges information with the Training Resource Requirements Analysis in an interactive fashion by taking the MOS identified during the TRRA and providing the numbers of personnel who must be trained for the MOS. In addition, specific training related data are collected for the TRRA.

Worksheets were developed to record the relationship between RPV equipment, existing comparable equipment and existing courses of instruction (See Appendix C1). These worksheets are divided into two sets: one set to plan and document the analysis of system operation and the other to plan and document the analysis of system maintenance. This division was made because the requirements for system operator tasks are mission-based via the systems functional requirements. The equipment used by the operator to perform the system function is a means to this end. In comparison, maintenance task requirements are the result of equipment design and technology, hence, equipment design is an inherent component of maintenance tasks, rather than ancillary as in operator tasks.

5.3.2 MOS Assignment and Course Selection

The next step is the assignment of functions and equipment to MOS. Some of the considerations involved are:

- Which MOS works on and is now receiving training in similar skills and knowledges.
- Which MOS works on similar systems.
- The branch of service of the existing MOS.
- The units the existing MOS is assigned to.

- Historical precedent.

- Impacts on soldier career progression rates.

- The workload requirements or equipment density.

Table 5.3.2-1 shows the RPV MOSs selected for the reference and baseline systems. Comparability analysis was used to identify or match MOS to function and equipment. In general, an MOS was selected on the basis that training was already being provided on similar skills and knowledges. In the case of the RPV Crewmember (13T), RPV Mechanic (ASIP9), and RPV Technican (211B), the decision was made based on the planned RPV MOS structure. Initial MOS assignments were modified as the analysis progressed based on the information developed during subsequent analysis. Several potential problem areas have been identified related to MOS assignment which are discussed in the next section. All of the MOS assignments made for the RPV are reported in Appendix C.2. These MOSs are inputs to Manpower Requirements Analysis.

5.3.3 Develop Reference and Baseline Courses

Once the MOS has been determined, the existing courses of instruction associated with the MOS are identified. These courses are identified by consulting (1) DA Pam 351-4 US Army Formal Schools Catalog, (2) DA Pam 351-9 EPMS Master Training Plan, or (3) the school with proponency for the MOS. Table 5.3.3-1 summarizes the RPV technical courses of instruction.

Table 5.3.2-1 Summary of RPV MOS and ASI

MOS	CMF	Skill Level	Title (with abbreviation)
13T	13	1-3	Remotely Piloted Vehicle Crewmember (RPV Crewmember)
13TP9	13	1-2	Remotely Piloted Vehicle Mechanic (RPV Mech)
26L	29	1-3	Tactical Microwave System Repairer (Tac Mwave Sys Rep)
26T	84	1-3	Radio/Television Systems Specialist (Rdo/TV Sys Sp)
31E	29	1-3	Field Radio Repairer (*)
31J	29	1-3	Teletypewriter Repairer (Teletypewriter Rep)
31S	29	1-3	Field General COMSEC Repairer (Field Gen COMSEC Rep)
31V	31	1-3	Tactical Communications Systems Operator/ Mechanic (Tac Comm Sys Op/Mech)
34Y	74	1-3	Field Artillery Computer Repairer (FA Computer Rep)
35E	29	1-3	Special Electronics Devices Repairer (Sp Elec Devices Rep)
35H	29	1-3	Calibration Specialist (*)
36H	29	1-3	Dial/Manual Central Office Repairer (Dial/Man Cen Ofc Rep)
41B	81	1-2	Topographic Instrument Repair Specialist (Topo Inst Rep Sp)
41C	63	1-3	Fire Control Instrument Repairer (FC Instrument Rep)
43M	76	1-3	Fabric Repair Specialist (Fabric Repair Sp)
44B	63	1-2	Metal Worker (*)
44E	63	3	Machinist (*)
45B	63	1-2	Small Arms Repairer (*)
45G	63	1-3	Fire Control Systems Repairer (FC Systems Rep)
45K	63	3	Tank Turret Repairer (*)
52C	63	1-3	Utilities Equipment Repairer (Utilities Equip Rep)
52D	63	1-3	Power Generation Equipment Repairer (Pwr Gen Equip Rep)

Table 5.3.2-1 (continued)

MOS	CMF	Skill Level	Title (with abbreviation)
63B	63	1-3	Light Wheel Vehicle/Power Generation Mechanic (Lt WVeh & Pwr Gen Mech)
63G	63	1-2	Fuel and Electrical Systems Repairer (Fuel & Elec Sys Rep)
63H	63	3	Track Vehicle Repairer (Track Veh Rep)
63J	63	1-3	Quartermaster and Chemical Equipment Repairer (QM & Chem Equip Rep)
63W	63	1-2	Wheel Vehicle Repairer (Wveh Rep)
82D	81	3	Topographic Surveyor (*)
211BO	-	-	Remotely Piloted Vehicle Technician (RPV Tech)

* Indicates no abbreviation

Table 5.3.3-1 Summary of RPV Technical Courses of Instruction

MOS	Skill Level 1	Skill Level 2	Skill Level 3
13T	XXX-13T10 XXX-13TP9	None	XXX-13T30
26L	101-26L10	None	None
26T	G3ABR30435	None	None
31E	101-31E10	None	None
31J	113-31J10	None	None
31S	160-31S10	None	None
31V	101-31V10	None	101-31V30
34Y	041-34Y10	None	None
35E	198-35E10	198-35E20	None
35H	G3ABR3240-003	G3AZR32470-000	198-35H30
36H	622-36H10	None	None
41B	670-41B10	None	None
41C	670-41C10	None	None
43M	760-43M10	None	None
44B	704-44B10	None	702-44E30
45B	641-45B10	None	643-45K30
45G	113-45G10	None	None
52C	662-52C10	662-52C20	None
52D	662-52D10	662-52D20	None
63B	610-63B10	None	610-63B30
63G	610-63G10	None	611-63H30
63J	690-63J10	None	690-63J30
63W	610-63W10	None	611-63H30

211B0 Warrant Officer Course: XX-211B

The proposed RPV-specific courses are shown in Table 5.3.3-2. This proposed training course pipeline represents a possible plan for providing training and is based on the present career progression plans for the RPV section personnel. It is this training configuration that was followed in estimating the RPV operator and organizational maintenance training requirements. At this point, the reference and baseline courses were developed. The programs of instruction for the courses impacted by RPV were examined to identify equipment/subject matter areas taught in each course. The reference system courses were developed first. The RPV task requirements were compared with those taught in the existing courses; course modules were added or modified to reflect the differences. In the case of the RPV-specific courses where there were no predecessor courses, totally new courses had to be constructed. These were in two cases modeled after existing courses. The 13T30 Basic Training Course (BTC) was developed in part on the 13C30 BTC (TACFIRE Operations Specialist), while the 13TP9 was developed in part on the 34Y10 course (Field Artillery Repairer).

Assignment of training to reference courses by skill level was based on the skill levels identified in the Manpower Requirements Analysis, tasks and duty positions contained in the Training Aids and Devices Study, Revision to Part 1, Embedded Simulation, and the RPV Organizational and Operational (O&O) concept. Once the reference training courses were configured, the baseline courses were constructed from the reference courses based on the RPV system configuration as found in the RPV Organizational and Operational (O&O) concept. As shown in Table 5.3.3-3, a total of nine courses were developed or modified to reflect the reference equipment, then seven of these courses were

Table 5.3.3-2 Proposed Training Course Pipeline

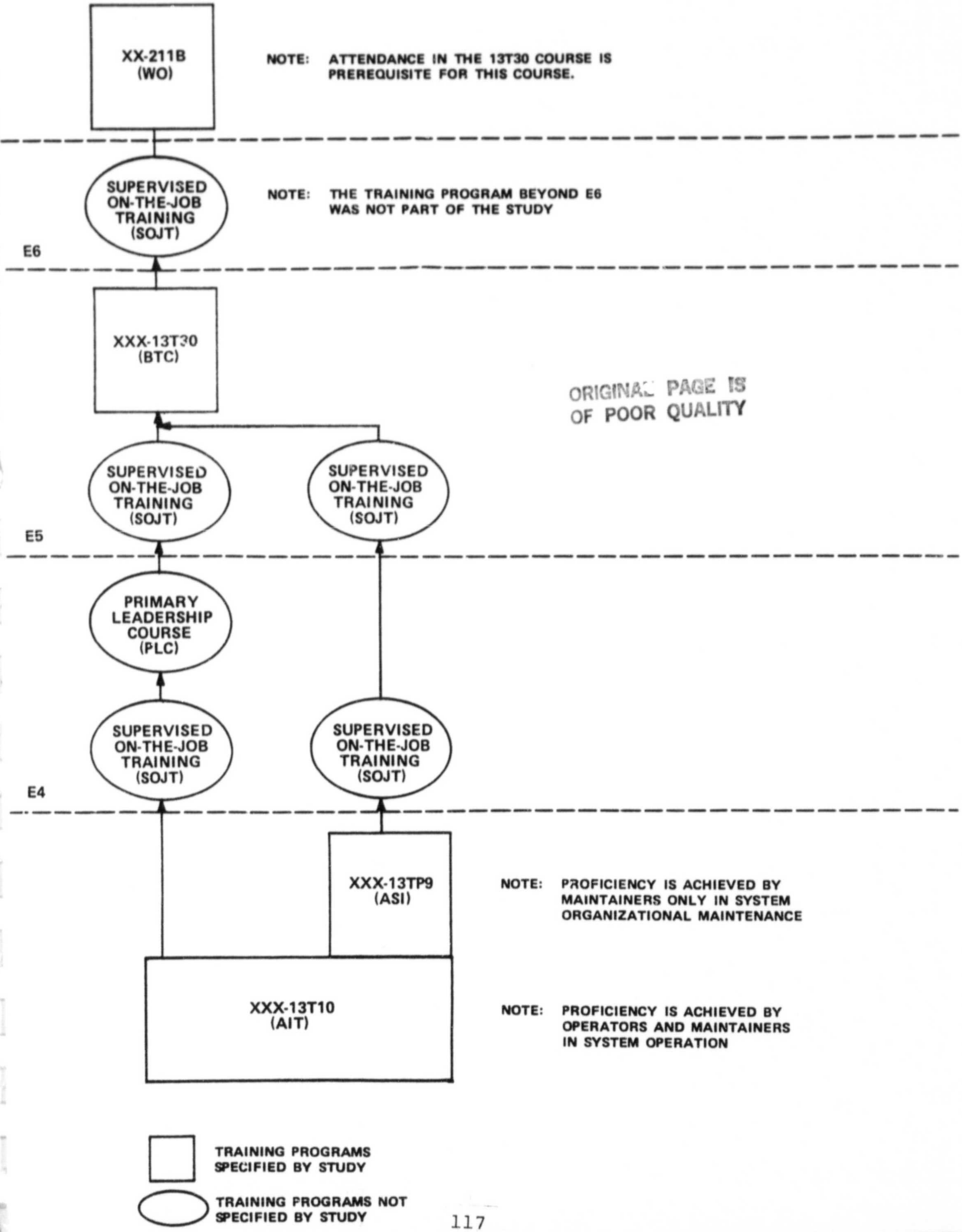

Table 5.3.3-3 New and Modified Courses by System

MOS	Course Number	Course Title	Reference	Baseline
13T	XXX-13T10	RPV Crewmember	1	10
	XXX-13TP9	RPV Mech	2	11
	XXX-13T30	RPV BTC	3	12
26L	101-26L10	Tac Mwave Sys Rep	4	13
26T	G3ABR30435	Radio/TV Sys Rep	NC	--
31E	101-31E10	Field Radio Repairer	5	10
31J	113-31J10	Teletypewriter Rep	NC	NC
31S	160-31S10	Field Gen COMSEC Rep	NC	NC
31V	101-31V10	Tac Comm Op/Mech	6	6
34Y	041-34Y10	FA Computer Rep	7	15
35E	198-35E10	Sp Elec Devices Rep	8	NC
35H	G3ABR3240-003	Calibration Specialist	NC	NC
36H	622-36H10	Dial/Man Cen Ofc Rep	NC	NC
41B	670-41B10	Topo Inst Rep Sp.	NC	NC
41C	670-41C10	FC Instrument Rep	NC	NC
43M	760-43M10	Fabric Repair Sp.	NC	NC
44B	704-44B10	Metal Worker	NC	NC
45B	641-45B10	Small Arms Repairer	NC	NC
45G	113-45G10	FC Systems Rep	NC	--
52C	662-52C10	Utilities Equip Rep	NC	NC
52D	662-52D10	Pwr Gen Equip Rep	NC	NC
63B	610-63B10	Lt WVeh & Pwr Gen Mech	NC	NC
63G	610-63G10	Fuel and Elec Sys Rep	NC	NC
63J	690-63J10	QM & Chem Equip Rep	NC	NC
63W	610-63W10	Wveh Rep	NC	16
211BO	XX-211B	RPV Tech	9	9

NC No change from existing course

-- No course required for system

modified to reflect differences between the reference and baseline systems. Table 5.3.3-4 shows the effects of these differences on course lengths in man-days.

Table 5.3.3-5 provides a more detailed breakdown of the topics and times contained in the three RPV reference and baseline operator courses. Table 5.3.3-6 highlights the course topic and training time differences between the two systems and provides a brief rationale for the differences. The RPV Technician course is not included in this table as there were no differences identified in the course between the reference and baseline systems.

A significant finding in skill level and grade differences is shown in Table 5.3.3-7. A substantial portion of all three baseline operator courses was derived from existing courses which are at higher grade level. Because of these high skill requirements and low grade authorizations, system performance requirements may not be achieved.

The limited analytical power achieved by the application of a general TRRA is illustrated by these grade differences since it is difficult to determine if the skills and knowledges required of the higher grades are the same as those which will be required by the RPV operators. Therefore, a detailed TRRA which assesses task and skill and knowledge differences may be required in order to determine the accuracy of these projections. In any case, further study and consideration should be given to resolving these differences and reassessing the proposed grade structure.

Table 5.3.3-4 RPV Course Impacts

MOS	Course	Reference	Baseline
13T	XXX-13T10	New 47.5 M.D.	New 51.0 M.D.
	XXX-13TP9	New 63.1 M.D.	New 42.1 M.D.
	XXX-13T30	New 32.3 M.D.	New 27.2 M.D.
26L	101-26L10	Added 17.0 M.D.	Added 4.7 M.D.
26T	G3ABR20435	NC	--
31E	101-31E10	Added 5.8 M.D.	Added 3.1 M.D.
31J	113-31J10	NC	NC
31S	160-31S10	NC	NC
31V	101-31V10	Added 4.2 M.D.	Added 4.2 M.D.
	101-31V30	NC	NC
34Y	041-34Y10	Added 18.9 M.D.	Added 1.5 M.D.
35E	198-35E10	Added 18.5 M.D.	NC
	198-35E20	NC	NC
35H	G3ABR3240-003	NC	NC
	G3AZR32470-000	NC	NC
	198-35H30	NC	NC
36H	622-36H10	NC	NC
41B	670-41B10	NC	NC
41C	670-41C10	NC	NC
43M	760-43M10	NC	NC
44B	704-44B10	NC	NC
	702-44E30	NC	NC
45B	641-45B10	NC	NC
	643-45K30	NC	NC
45G	113-45G10	NC	--
52C	662-52C10	NC	NC
	662-52C20	NC	NC
52D	662-52D10	NC	NC
	662-52D20	NC	NC
63B	610-63B10	NC	NC
	610-63B30	NC	NC
63G	610-63G10	NC	NC
	611-63H30	NC	NC
63J	690-63J10	NC	NC
	690-63J30	NC	NC
63W	610-63W10	NC	Added 3.6 M.D.
	611-63H30	NC	NC
211BO	XX-211B	New 30.7 M.D.	New 30.7 M.D.

NC- No change from existing course   M.D. Man-Days

-- No course required for system

Table 5.3.3-5

Operator Course Topics and Training Times

Course: XXX-13T10

REFERENCE		BASELINE	
Annex and Topic	Hours	Annex and Topic	Hours
A. System Introduction Technical Manual Introduction	4.3	A. Same	4.3
B. Launch Vehicle, Recovery Vehicle, Handling Vehicle and System Emplacement Operations	56.0	B. Same	56.0
C. Communication/COMSEC Procedures	55.4	C. Same	55.4
D. Plotting/Charting/ Map Reading Procedures	47.5	D. Same	47.5
E. Navigation Display Panel Operations	8.2	E. Same	2.0
F. Ground Data Terminal Control and Display Operations	9.2	F. Same	9.2
G. Air Vehicle Command and Display Console Operations	73.8	G. Same	73.8
H. Mission Payload Command and Display Console Operations (Including Target Identification)	115.0	H. Same	115.0
I. Organizational/ Crew Maintenance	10.4	I. Same	10.4
		J. Weather (MET)	6.5

Table 5.3.3-5 (continued)

End of: XXX-13T30 (BTC)

REFERENCE			BASELINE		
	Annex and Topic	Hours		Annex and Topic	Hours
L.	FA Communications Systems	1.7	J.	Same	1.7
M.	IM-93/IM-174/PD	1.5	K.	Same	1.5

-------------------- Course: XX-211B --------------------

REFERENCE			BASELINE		
	Annex and Topic	Hours		Annex and Topic	Hours
A.	Leadership	22.1	A.	Same	22.1
B.	Supply	28.6	B.	Same	28.6
C.	Maintenance	36.2	C.	Same	36.2
D.	Emergency Destruction	0.9	D.	Same	0.9
E.	Air Ground Navigation Review	26.9	E.	Same	26.9
F.	Mission Planning	71.0	F.	Same	71.0
G.	Target ID and Calls for Fire	44.6	G.	Same	44.6
H.	Field Artillery Communications	6.8	H.	Same	6.8
I.	NBC Operations	8.5	I.	Same	8.5

Table 5.3.3-5 (continued)

END OF: XXX - 13T10

REFERENCE Annex and Topic	Hours	BASELINE Annex and Topic	Hours
		K. Survey	10.5
		L. Digital Message Device Operation	5.1
		M. Processor Start-up and Data Entry	12.0
------------------ Course: XXX-13T30 (BTC) ----------------------			
A. Leadership	21.9	A. Same	21.9
B. Weather (MET)	29.5	B. Same	14.0
C. Navigation	13.1	C. Same	13.1
D. Intelligence	10.9	D. Same	10.9
E. Field Artillery and RPV Missions/Tactics	24.4	E. Same	24.4
F. Fire Support/ Tactics	85.3	F. Same	85.3
G. Processor Start-Up and Data Entry	9.2	None	
H. Digital Message Device Operation	5.1	None	
I. Target ID/Calls NOTE: For fire the Digital Message Device will be used during this instruction	32.0	G. None NOTE: The Digital Message Device will be used during the instruction	32.0
J. Survey	20.9	H. Same	10.4
K. Convoy Route Planning		I. Same	2.5

Table 5.3.3-6

Operator Course Topic and Training Time Changes

Course: XXX-13T10

	Annex/Topic	Reference Hours	Baseline Hours	Reason
E.	Navigation Display Panel Operation	8.2	2.0	This instruction was taken from the TACFIRE digital plotter map and included operation of the TACFIRE system to plot data. The operation of this plotter in the context of the system's operation is subsummed in the subsequent annexes of instruction.
J.	Weather (MET)	0	6.5	Section V (Training) of the O & O concept identifies this as required training.
K.	Artillery Survey	0	10.5	
L.	Digital Message Device Operation	0	5.1	
M.	Processor Data Start-Up and Data Entry	0	12.0	This instruction will familiarize the student with the operation of this major subsystem in the BCS.
	Course: XXX-13T30			
B.	Weather (MET)	29.5	14.0	In the baseline training pipeline, training is provided in the XXX-13T 10 Course. This training is provided to support mission planning.
G.	Processor Start-Up and Data Entry	9.2	0	In the baseline training pipeline, this training is provided in the XXX-13T10 Course.

Table 5.3.3-6 (Continued)

H.	Digital Message Device (DMD) Operation	4.2	0	
J.	Survey	20.9	10.4	In the baseline training pipeline, training is provided in the XXX-13T10 Course. This training is provided to enable site survey for emplacement.

Table 5.3.3-7

Reference to Baseline Skill/Grade Differences

Course Topic/ Equipment	Reference Training Source with Grade	Baseline Course Assignment	RPV Grade
AV Recovery, AN/PVS-5 Night Vision Goggles	Officer/WO Rotary Wing Aviator Course 2C-15A/2C-100B-B (Officer/WO)	XXX-13T10	E1-E4
Plotting and Charting Aircraft Routes		o	o
Navigation Display Panel Operation	TACFIRE Operations Specialist 13C (BTC) (E6)	o	E4
Ground Data Terminal Control and Display Operations		o	o
RPV Aerodynamics	OV-1 Instructor Pilot Course 2B-F5 (Officer/WO)	o	o
AV Command Display Console Operation	Officer/WO Rotary Wing Aviator Course 2C-15A/2C-100B-B (Officer/WO)	o	o
Target Identification	Image Interpreter PTC 242-96D20 (E5) Officer/Wo Rotary Wing Aviator Course 2C-15A/2C-100B-B (Officer/WO)	o	o
Aerial Adjustment of Artillery		o	o
Target Ranging Laser Designation	Field Artillery Officer Basic 2-6-C20-13E (Officer)	o	o

o Same as above

Table 5.3.3-7 (Continued)

Course Topic/Equipment	Reference Training Source with Grade	Baseline Course Assignment	RPV Grade
Leadership	Field Artillery Cannon NCO Advanced Course 0-13-C42 (E7)	XXX-13T30	E6
Flight Planning/Weather	Officer/WO Rotary Wing Aviator Course 2C-15A/2C-100B-B (Officer/WO)	o	o
Flight Planning/Navigation		o	o
Flight Planning Field Artillery Missions, Tactics, and Fire Support Resources	Field Artillery Cannon NCO Advanced Course 0-13-C42 (E7)	o	o
Digital Message Device Operation	Field Artillery Officer Basic 2-6-C2D-13E (Officer)	o	o
Target Identification/ Calls for Fire		o	o
System Emplacement, Survey Operations	Field Artillery Cannon NCO Advanced Course 0-13-C42 (E7)	o	o
Plan Convoy Route and Emplacement		o	o
Leadership	Field Artillery Officer Basic 2-6-C20-13E (Officer)	XX-211B	Warrant Officer
Training Management (Unit)		o	o
Logistics Management Supply/Maintenance		o	o
Navigation		o	o
Mission Planning		o	o
Target Identification and Calls for Fire		o	o
Communications		o	o
NBC Operations		o	o

o Same as above

Table 5.3.3-8 shows the impacts of the various design configurations on maintenance training. The total course length for the reference 13TP9 course of 63.1 man-days (12.6 weeks) represents a substantial amount of organizational maintenance training. The course length for the baseline 13TP9 course (42.1 man-days) was based solely on engineering and training judgement. Virtually all systems fielded in the Army at this time do not contain automated test equipment (ATE) or built-in test (BIT) equipment. The result was that comparability analysis could not be used to assess this RPV design parameter. Based on the collective experience of the DRC engineering analysts and the training analysts, it was estimated that approximately 30% of the troubleshooting training contained in the reference course could be eliminated if some form of reliable, automatic fault isolation capability was installed in the contractor furnished equipment. However, it must be noted that this projection is based on the assumption that the test capability will be dependable and will achieve the 95% fault isolation planned. A number of developmental and recently fielded Army systems with BIT are known by DRC analysts to have not achieved their desired rate of fault isolation. Should this occur with RPV, alternate troubleshooting training as found in the reference training course would be required. In either case, sufficient training will exist to justify the requirement for an RPV-specific organizational maintenance MOS.

The direct support (DS) maintenance requirements identified for the reference system in Table 5.3.3-8 and summarized in Table 5.3.3-4, represents DS maintenance that was identified for comparably fielded equipment chosen for training estimation. The total of all new projected DS maintenance

Table 5.3.3-8 Design Impacts on Maintenance Training

Course: XXX-13TP9 (Reference)

LCN	Equipment Name	Additional Hours
OAAM,OAAMAB	Propulsion System, Engine Module	6.0
OAAH,OAAX	Airspeed and Altitude (A&A) Sensors	4.0
OAAJ	Attitude Reference Assembly	11.0
OAAL,OASA,OAEA	Flight Control Electronic Package, Control Actuators	25.0
OAALAB	Central Processing Unit (CPU) Module Assembly	30.0
OAAWAF	Airborne Data Terminal (ADT)	35.7
OEAAB,OEAAD	Television Camera, Main Optics Assembly	6.0
OEAAC,OEAAE	Laser System	3.0
OEAAF-OEBAA	Mission Payload System Assemblies	13.0
	AIR VEHICLE SUBTOTAL	133.7
OAS	Handling Crane	2.0
OAL,OAT	AV Recovery Harness, AV Container	.9
	AIR VEHICLE HANDLER SUBTOTAL	2.9
ODAA3	Radiac Meters	2.0
ODAA3AE	Power Monitor	3.0
ODAC2	Video Reconstruction Unit	5.0
ODAC3	Master Interface Unit (MIU)	6.7
ODADA,ODAEA, ODAFA	Video Monitor	5.0
ODADG	Ground Data Terminal Control Display	2.0
ODADH	AV Control & Display Assembly	4.0
ODAEH	Mission Payload Control & Display Assembly	4.0
ODAFH	Mission Commander's Control & Display Assembly	4.5
ODAFK	Video Recorder Assembly	2.0
ODAGB	Teleprinter Assembly AN/UGC-74	2.0
ODAJ	Navigation Display Unit	4.0
ODALAAA	Computer/Signal Processor Rack Code Assembly	3.4
ODALBAA	Main Computer	33.6

Table 5.3.3-8 (continued)

LCN	Equipment Name	Additional Hours
ODALD	Interface Unit	6.7
OD6	Training Interface Unit, Imagery Simulator	28.2
OD7	Portable Data Entry Device	1.0
	GROUND CONTROL STATION SUBTOTAL	117.1
OBB	Initializer Assembly	16.1
OBC	Launcher Assembly	32.0
OBCAAAF	Launcher Control Panel	2.0
OBD	Launcher Command Module	1.0
	LAUNCHER SUBSYSTEM SUBTOTAL	51.1
OGQ	AV Fault Isolator	15.0
OGR	Nitrogen Purge Set	4.2
XWL6,XWL7	Multimeters	1.7
	MAINTENANCE SHELTER SUBTOTAL	20.9
OCA	Recovery Assembly	7.0
OCB	Recovery Guidance Assembly	5.0
	RECOVERY SUBSYSTEM SUBTOTAL	12.0
MRGT	Antenna	7.0
MRGT1	Remote Ground Terminal Electronics	38.0
	REMOTE GROUND TERMINAL SUBTOTAL	45.0

General Subject Areas:

Course Introduction, Components, Familiarization, Initialization, System Programs, Review, Preventive Maintenance, Manuals, System Troubleshooting, Etc.	92.8

Table 5.3.3-8 (continued)

Course: 101-26L10 (Reference)

LCN	Equipment Name	Additional Hours
ODAC3	Master Interface Unit	14.3
OBB	Initializer Assembly	37.8 *
MRGT	RGT Antenna	21.0
MRGT1	Remote Ground Terminal Electronics	63.0
	TOTAL	136.1

* Baseline Course

Course: 101-31E10 (Reference)

ODAB8,ODAB9	Communications Mode Selector Control	24.5 *
ODADE,ODAEE,ODAFE	Communications Panel Assembly	22.0
	TOTAL	46.5

* Baseline Course

Course: 101-31V10 (Reference & Baseline)

ODAB1	Radio Set AN/PRC-68	6.0
ODAB3	Digital Message Device AN/PSG-2A	12.2
ODAB8,ODAB9	Communications Mode Selector Control	8.0
ODADE,ODAEE,ODAFE	Communications Panel Assembly	7.0
	TOTAL	33.2

Table 5.3.3-8 (continued)

Course: 041-34Y10 (Reference)

LCN	Equipment Name	Additional Hours
OAALAB	Central Processing Unit Module Assembly	51.0
ODADG	Ground Data Terminal Control Display	3.0
ODADH	AV Control & Display Assembly	8.0
ODAEH	Mission Payload Control & Display Assembly	6.0
ODAFH	Mission Commander's Control & Display Assembly	10.2
ODAJ	Navigation Display Unit	12.0 *
ODALBAA	Main Computer	47.2
ODALD	Interface Unit	13.8
	TOTAL	151.2

* Baseline Course

Course: 198-35E10 (Reference)

OAAJ	Attitude Reference Assembly	64.0
OEAAF-OEBAA	Mission Payload System Assemblies	84.0
	TOTAL	148.0

Course: 610-63W10 (Baseline)

OCB	Recovery Guidance Assembly	29.0

training for the reference system amounts to 60.2 man-days (12.0 weeks). This does not include the RPV maintenance requirements that were assigned to existing DS maintainers who were deemed to require no additional training due to the existence of previously attained skills and knowledge. However, the baseline system requires only 12.9 man-days (2.6 weeks) of additional DS maintenance training. This significant difference is due to the small amount of maintenance being assigned to the direct support category of maintenance in the logistics support analysis (LSA).

The shifting of DS maintenance workload to the general support (GS) and depot maintenance levels has two implications. First, a much higher number of line replaceable units (LRU's) and other maintenance repair spares will have to be maintained in the inventory, as the repair process will probably take longer. Secondly, very little training savings will be achieved as virtually all DS and GS maintainers attend the same courses. Preliminary studies underway within the Army to combine the DS and GS categories of maintenance into one, would also negate any savings achieved by having maintenance performed at the GS level.

The difference of 47.3 man-days of DS maintenance training from the reference to the baseline systems, is a hidden "cost" with the baseline system. Personnel will obviously have to be trained at either the GS or depot level to repair these subsystems. The creation of a DS/GS maintenance MOS may be required, but any such decision, as with a possible organizational maintenance MOS, involves a complicated set of personnel and training factors that would need to be studied.

The success of the present RPV training program, as illustrated in Table 5.3.3-2, will depend to a large degree on the supervised on-the-job training (SOJT) program. The availability of the RPV equipment, training interface unit, and training time, the required proficiency of the unit, the cross training of maintainers to operators, and the skill development of junior system operators will have to be carefully coordinated within a section. This is further complicated by the complex nature of team performance during the conduct of a flight mission. A well-defined structure of formal training, MOS proficiency certification, and supervised unit training will be required. As the XXX-13T10 course is now configured, the majority of the training will be on Ground Control Station (GCS) operation. The graduate of this course is not likely to perform in this capacity until he is a senior E4 or a junior E5, 2 to 3 years after assignment to a unit. The training provided on GCS operation will have to be repeated when the soldier moves into the GCS, unless the SOJT program insures retention of these skills and knowledges. An alternative approach might be to concentrate XXX-13T10 training on Launcher Subsystem operations, Recovery Subsystem operations, Air Vehicle Handling operations, and vehicle driving. This would necessitate the development of a Primary Technical Course (PTC) at E5 that would be devoted to GCS operation.

5.4 IDENTIFICATION OF TRAINING RESOURCES

There are many different ways to measure the resources required for training. Training resources are estimated only for the system-specific courses. In the RPV study, the term "system-specific courses" is used to refer to (a) the

Advanced Individual Training (AIT) courses for all of the entry level MOS's associated with the operation and maintenance of the reference and baseline systems (b) the Noncommisioned Officer Education System (NCOES) courses provided RPV section supervisors, and, (c) the RPV warrant officer courses.

Two parameters were chosen to depict the training resource requirements for RPV:

- Training man-days - the length of time needed to train an individual in a course.

- Instructors - the number of instructors required to conduct a course of instruction (COI).

The selection of these parameters takes into consideration (1) the training data available for analysis, and (2) the level of meaningful training resource estimation needed to make decisions at this stage in the acquisition process. As the RPV system is further defined, subsequent iterations of the methodology allow for more detailed analyses of training resource requirements.

5.4.1 Determine Training Man-days

The number of man-days required for training was obtained from the program of instruction (POI) for those courses that did not change and from course modification worksheets for those courses that did. Appendix C.3.1 contains detailed breakdowns of training man-days by course and system for each MOS. Table 5.4.1-1 is a summary of the annual training

Table 5.4.1-1 Annual Training Man-Days

MOS	Course	Reference Sustained	Reference O&O	Baseline Sustained	Baseline O&O
13T	XXX-13T10	16,459	18,558	17,672	19,926
	XXX-13TP9	8,998	8,998	6,004	6,004
	XXX-13T30	1,809	1,809	1,523	1,523
26L	101-26L10	3,598	3,598	3,378	3,378
26T	G3ABR30435	821	821	0	0
31E	101-31E10	2,695	2,695	2,639	2,639
31J	113-31J10	1,375	1,375	1,375	1,375
31S	160-31S10	1,463	1,463	1,463	1,463
31V	101-31V10	4,108	4,108	0	0
34Y	041-34Y10	4,265	4,265	3,625	3,625
35E	198-35E10	3,385	3,385	2,808	2,808
35H	G3ABR3240-003	5,191	5,191	5,191	5,191
36H	622-36H10	3,249	3,249	3,249	3,249
41B	670-41B10	533	533	533	533
41C	670-41C10	1,986	1,986	1,986	1,986
43M	760-43M10	314	314	314	314
44B	704-44B10	1,421	1,421	1,421	1,421
45B	641-45B10	320	320	320	320
45G	113-45G10	2,362	2,362	0	0
52C	662-52C10	2,405	2,405	2,405	2,405
52D	662-52D10	884	884	884	884
63B	610-63B10	3,046	3,046	3,046	3,046
63G	610-63G10	2,470	2,470	1,243	1,243
63J	690-63J10	426	426	426	426
63W	610-63W10	2,550	2,550	2,703	2,703
	TOTALS	76,133	78,232	64,208	66,462

man-days requirements for RPV. The reference O&O system will have the largest total requirement for training time, while the baseline sustained system will have the least.

5.4.2 Determine Number of Instructors

Estimation of the number of instructors associated with the system-specific RPV courses was determined by applying the algorithm used in the Staffing Guide for U.S. Army Service Schools (DA Pam 570-558). Appendix C3.2 provides a detailed description of the procedures and data sources used in developing the instructor contact hours. The total annual instructor contact hours provide the basis upon which the number of instructor requirements is determined.

Table 5.4.2-1 is a listing by system and MOS of the annual instructor requirements for RPV. The overall range of instructor requirements varied from 63.5 for the baseline sustained system to 74.8 for the reference O&O system. Overall, the baseline system for both scenarios was less intensive in the use of training resources than the reference system under the same conditions.

Table 5.4.2-1 Annual Instructor Requirements

		Reference		Baseline	
MOS	Course	Sustained	O&O	Sustained	O&O
13T	XXX-13T10	14.5	16.3	15.4	17.4
	XXX-13TP9	8.2	8.2	8.2	8.2
	XXX-13T30	1.5	1.5	1.1	1.1
26L	101-26L10	2.5	2.5	2.3	2.3
26T	G3ABR30435	.8	.8	-	-
31E	101-31E10	1.9	1.9	1.8	1.8
31J	113-31J10	1.3	1.3	1.3	1.3
31S	160-31S10	2.0	2.0	2.0	2.0
31V	101-31V10	3.9	3.9	-	-
34Y	041-34Y10	8.2	8.2	7.6	7.6
35E	198-35E10	3.6	3.6	2.7	2.7
35H	G3ABR3240-003	2.6	2.6	2.6	2.6
36H	622-36H10	2.7	2.7	2.7	2.7
41B	670-41B10	.5	.5	.5	.5
41C	670-41C10	1.9	1.9	1.9	1.9
43M	760-43M10	.5	.5	.5	.5
44B	704-44B10	1.3	1.3	1.3	1.3
45B	641-45B10	.5	.5	.5	.5
45G	113-45G10	3.7	3.7	-	-
52C	662-52C10	2.6	2.6	2.6	2.6
52D	662-52D10	1.8	1.8	1.8	1.8
63B	610-63B10	2.7	2.7	2.7	2.7
63G	610-63G10	1.2	1.2	1.2	1.2
63J	690-63J10	.3	.3	.3	.3
63W	610-63W10	2.3	2.3	2.5	2.5
	TOTALS	73.0	74.8	63.5	65.5

SECTION 6 - DETERMINE PERSONNEL REQUIREMENTS

6.1 OVERVIEW

The following section is a description of the HARDMAN Personnel Requirements Analysis (PRA). The purpose of the PRA is to estimate the number of personnel needed to sustain any one set of system specific manpower requirements, typically those of a single Military Occupational Specialty (MOS). Its major output is the number of personnel which must be trained per year to support manpower requirements. Its secondary output is a personnel structure.

It is important to note the difference between manpower and personnel requirements. A manpower requirement is a statement of the necessary number of people, described by MOS and paygrade needed to directly perform a specific set of mission-oriented tasks for a particular weapon system. A manpower requirement is calculated based on the workload required for the tasks. A personnel requirement is an estimate of the number of people carried within the MOS and paygrade to offset various losses from the manpower requirement over a specified period of time. During the standard time period, one year, it is assumed that there are no changes to a manpower requirement ("steady-state"); hence the personnel requirement is due solely to the structural imperative of the personnel system.

Figure 6.1-1 illustrates the logic upon which the PRA is based, by showing two MOS's (A and B) at two grade levels (E1 and E2.) The PRA determines the size and structure of the personnel pipelines in steady state by estimating the losses that occur to a paygrade. Two main causes for MOS/paygrade losses are promotion and attrition. The definition of the promotion rate is the rate at which individuals advance from one paygrade to another. The attrition rate is the rate at which individuals leave a particular MOS/paygrade cell. Two types of attrition exist in the Army, MOS attrition (horizontal attrition) and Army attrition. Trainees, transients, holdees or students (TTHS) are actually non-active personnel and are classified as overhead. Individuals that fall into this category are not a direct loss to the Army or paygrade (since they may become active again), but a substantial loss to the operational force of that MOS/paygrade, therefore, they must be compensated for.

The Interactive Manpower-Personnel Assessment and Correlation Technology (IMPACT) Model was developed by DRC as a tool to determine personnel requirement given (1) manpower requirements; (2) promotion rates; (3) attrition rates; and (4) TTHS percentage. The IMPACT model calculates the quantities of personnel needed to sustain a required level in each of nine paygrades. Personnel must be promoted from below to fill replacements. For this reason, personnel requirements must be projected to allow for the growth necessary to satisfy current and future demands.

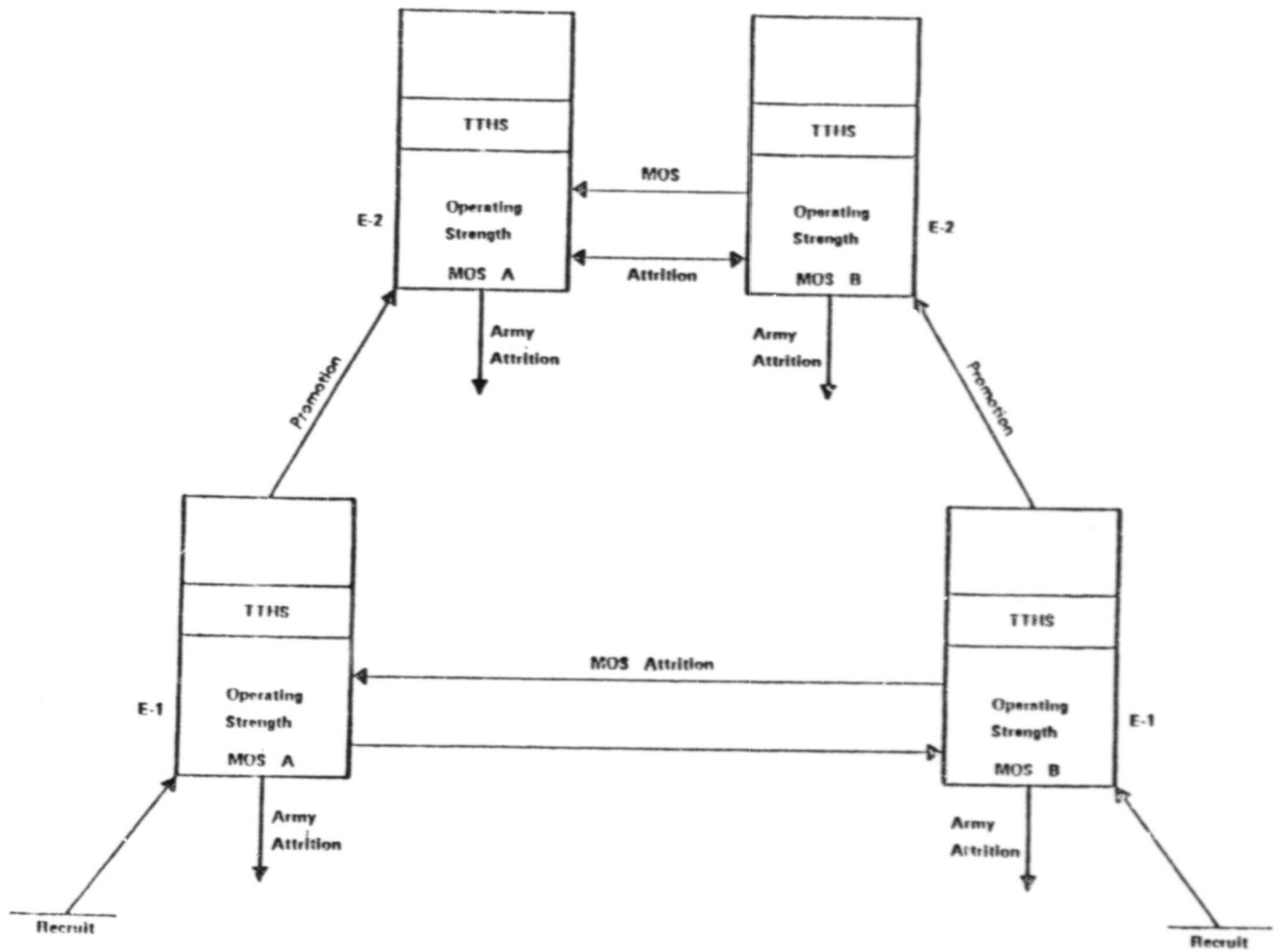

Figure 6.1-1 The Personnel Flow Diagram

6.2 THE INTERACTIVE MANPOWER-PERSONNEL ASSESSMENT AND CORRELATION TECHNOLOGY (IMPACT) MODEL

6.2.1 Assumptions

- The IMPACT model is currently a system-specific personnel model which is driven by steady-state manpower requirements. Because of this, it is assumed that manpower requirements are already filled, and therefore, the personnel requirements represent the quantities and qualities of personnel which it takes to sustain these already-filled manpower requirements.

- Historical rates are extracted and calculated from the Enlisted Master File (EMF), via the Defense Manpower Data Center (DMDC), for input to the IMPACT model. It is assumed that these input rates, or personnel flow rates, are accurate for their intended purpose.

6.2.2 Logic of the IMPACT Model

The IMPACT model was developed to determine personnel requirements. The concept which underlies the IMPACT model is the conservation of people. This means that the quantities of personnel which leave a particular paygrade must be replaced by personnel entering that paygrade. The IMPACT model determines the quantities of personnel needed in the personnel structure to support specified manpower requirements and to sustain itself so that the personnel structure can account for incurred losses. There are three input parameters to the IMPACT model. They represent reductions in the ability of a given total MOS/paygrade population to support its manpower requirement. These parameters are (1) promotion rates, (2) attrition rates, and (3) the percentage of the MOS/paygrade population in a trainee, transient, holdees, or student (TTHS) status at any given time. The IMPACT models's objective is to calculate the minimum amount of personnel needed at each level in the personnel structure. It is constrained so that each paygrade must support losses from the next higher paygrade, since replacements for these losses must be promoted from the paygrade below. The process will iterate several times before the optimal structure is established. Once each paygrade is able to support the paygrade above, as driven by manpower needs, the iteration process stops.

Personnel to be trained per year is the primary output parameter of the IMPACT Model. The quantities of personnel to be trained per year represent the flow through each paygrade due to yearly losses to the personnel structure and therefore, the flow through the training system. The parameter is split into the categories, (1) manpower losses per year, and (2) overhead losses per year. Manpower losses are losses given promotion, attrition, and application of the TTHS percentage to the manpower requirement. Overhead losses are losses to the personnel structure minus manpower requirements and manpower losses (see Table 6.2.2-1).

Steady-state personnel requirements of the personnel structure are the secondary output parameter of the IMPACT model. This parameter is used as a relative measure of the personnel requirements of one system as compared to those of

Table 6.2.2-1 IMPACT Output

Baseline O&O with Headquarters Requirements

MOS = 13T   RECRUITS PER YEAR =   390.7

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	213.6	0.	0.	390.7	0.	390.7
E-2	132.3	126.0	132.3	280.1	280.1	0.0
E-3	198.2	168.0	175.7	232.4	206.1	26.3
E-4	284.4	112.0	117.4	179.7	74.2	105.6
E-5	158.1	112.0	115.4	76.5	55.8	20.7
E-6	128.3	56.0	57.5	38.1	17.1	21.0
E-7	61.9	14.0	14.0	19.4	4.4	15.0

MOS = 13T

PAYGRADE	MANPOWER	ATTRITION	UPGRADE	TTHS
E-1	0.	0.518	1.311	0.
E-2	126.0	0.360	1.757	0.050
E-3	168.0	0.266	0.907	0.046
E-4	112.0	0.363	0.269	0.048
E-5	112.0	0.243	0.241	0.030
E-6	56.0	0.146	0.151	0.027
E-7	14.0	0.164	0.149	0.
E-8	-1.0	2.500	0.	0.
E-9	-1.0	0.	0.	0.

another system. Replacement for losses primarily occur by promoting from the lower paygrade. Therefore, if manpower requirements begin at an E-4 level, personnel are needed in lower paygrades to be promoted as manpower losses occur. These personnel requirements, over and above manpower requirements, are considered to be overhead supporting a particular weapon system, although they may potentially be used by another weapon system. A measure of the quantity and quality of the personnel structure provides an indication of how efficiently specific manpower requirements sustain themselves. For example, a structure of requirements which decreases as the paygrade spread increases (i.e., pyramidal structure) is more self-sustaining than the opposite situation. The example in Table 6.2.2-2 shows the impact on the personnel structure and personnel to be trained for two equal sets of manpower requirements with different grade distributions. The upper set illustrates that when the manpower requirements (column 3) for the E-2 and E-3 levels are aggregated at the E-3 level, a larger demand for personnel exists. Thus, as manpower demand calls for higher skill levels (paygrades), the structure becomes less self supporting.

6.3 APPLICATION TO RPV

6.3.1 Establish Personnel Portion of CDB

Due to the lack of Army historical data on the career history of individual MOS's (formal and on-the-job training), career paths were not examined. The purpose of studying career paths in detail, when feasible, is to differentiate among groups of individuals with different

Table 6.2.2-2 Comparative Personnel Structure Impacts

MOS = 13xx Recruits Per Year = 606.4

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	331.5	0.	0.	606.4	0.	606.4
E-2	205.3	0.	0.	434.6	0.	434.6
E-3	307.5	294.0	307.5	360.7	360.7	0.0
E-4	441.3	112.0	117.4	278.9	74.2	204.7
E-5	245.3	112.0	115.4	118.7	55.8	62.9
E-6	199.0	56.0	57.5	59.1	17.1	42.0
E-7	96.0	14.0	14.0	30.1	4.4	25.7

MOS = 13xx Recruits Per Year = 390.7

PAYGRADE	PERSONNEL REQUIREMENTS	UNADJUSTED MANPOWER	TTHS ADJUSTED MANPOWER	PERSONNEL TO BE TRAINED PER YR	MANPOWER LOSSES PER YR	OVERHEAD LOSSES PER YR
E-1	213.6	0.	0.	390.7	0.	390.7
E-2	132.3	126.0	132.3	280.1	280.1	0.0
E-3	198.2	168.0	175.7	232.4	206.1	26.3
E-4	284.4	112.0	117.4	179.7	74.2	105.6
E-5	158.1	112.0	115.4	76.5	55.8	20.7
E-6	128.3	56.0	57.5	38.1	17.1	21.0
E-7	61.9	14.0	14.0	19.4	4.4	15.0

patterns of school and career history, since these groups generate different personnel flow rates.

Two sources provided data which were generated by extracting elements from the EMF. The Defense Manpower Data Center (DMDC) was able to supply two of the input rates for IMPACT, promotion and attrition, as well as inventory information. DRC received in tape form the quarterly promotion and attrition rates for the years 1980 and 1981. The Chief of Personnel Operations (COPO) 45 Report was the source of the third input parameter: Trainees, Transients, Holdees and Students (TTHS). The TTHS data were obtained in microfiche form, by quarters, for the years 1980 and 1981 from the U.S. Army Military Personnel Center (MILPERCEN). Quarterly snapshots were taken over a two year period of current personnel status, beginning in December 1979.

6.3.2 Establish Personnel Pipeline Characteristics

DMDC supplied personnel flow characterics (attrition and promotion) by tracking individuals across successive quarters. The data were separated by MOS/paygrade. Promotion and attrition rates were calculated by tracking and counting individuals whose Active/Inactive indicator (code RSCD or EMF) was active. This code indicates if an individual is or is not chargeable to the active strength of the Army. If an individual's status code or MOS classification changed, this change was considered to be attrition to that particular MOS/paygrade. If an individual's paygrade increased, this was considered to be a promotion. Individuals who were part of the active Army but were either Trainees, Transients, Holdees, or Students, were classified as overhead. The COPO 45 Report supplied by MILPERCEN separated the active code into the operational force and TTHS. Quarterly rates were calculated for every MOS and paygrade. Weighted averages were taken for yearly rates since inventory levels vary across periods of time.

6.3.3 Calculate Personnel Requirements

Results of the IMPACT model for each of the Military Occupational Specialties (MOS's) considered in the RPV application are contained in Appendix D1. Tables 6.3.3-1 through 6.3.3-4 are summary charts of these results, depicting personnel requirements by MOS, by paygrade with and without headquarters requirements and the annual recruit rate, respectively.

Table 6.3.3-1 Personnel Requirements by MOS
(Includes Platoon Headquarters Requirements)

MOS	Reference Sustained	Reference O&O	Baseline Sustained	Baseline O&O
13T	1,043	1,177	1,043	1,177
13T*	989	991	989	991
13T P9	360	360	360	360
26L	59	59	59	59
26T	31	31	-	-
31E	44	44	44	44
31J	34	34	34	34
31S	51	51	51	51
31V	176	176	-	-
34Y	97	97	97	97
35E	90	90	90	90
35H	82	82	82	82
36H	42	42	42	42
41B	42	42	42	42
41C	44	44	44	44
43M	27	27	27	27
44B	69	69	69	69
45B	27	27	27	27
45G	47	47	-	-
52C	125	125	125	125
52D	46	46	46	46
63B	139	139	139	139
63G	111	111	49	49
63J	31	31	31	31
63W	115	115	115	115

* Does not include Platoon Headquarters 13T requirements.

Table 6.3.3-2 Personnel Requirements by Paygrade (Includes Platoon Headquarters Requirements)

Grade	Reference Sustained	Reference O&O	Baseline Sustained	Baseline O&O
E-1	590.6	614.8	518.3	542.5
E-2	408.9	423.9	355.4	370.4
E-3	572.5	595.0	499.0	521.5
E-4	874.4	906.6	771.4	803.6
E-5	314.3	332.2	300.3	318.2
E-6	113.7	128.3	113.7	128.3
E-7	54.9	61.9	54.9	61.9
E-8	-	-	-	-
E-9	-	-	-	-
Total	2,929.3	3,062.7	2,613.0	2,746.4

Table 6.3.3-3 Personnel Requirements by Paygrade

(Excludes Platoon Headquarters Requirements)

Grade	Reference Sustained	Reference O&O	Baseline Sustained	Baseline O&O
E-1	590.6	591.1	518.3	572.8
E-2	408.9	409.2	355.4	355.7
E-3	572.5	572.9	499.0	499.4
E-4	874.4	875.0	771.4	772.0
E-5	314.3	314.6	300.3	300.6
E-6	113.7	114.0	113.7	114.0
E-7	-	-	-	-
E-8	-	-	-	-
E-9	-	-	-	-
Total	2,874.4	2,876.8	2,558.1	2,614.5

Table 6.3.3-4 Recruiting Requirements

	Reference		Baseline	
MOS	Sustained	O&O	Sustained	O&O
13T	346.5	390.7	346.5	390.7
13T*	346.5	347.3	346.5	347.3
13T P9	142.6	142.6	142.6	142.6
26L	17.9	17.9	17.9	17.9
26T	10.8	10.8	-	-
31E	20.6	20.6	20.6	20.6
31J	12.5	12.5	12.5	12.5
31S	22.5	22.5	22.5	22.5
31V	75.8	75.8	-	-
34Y	36.8	36.8	36.8	36.8
35E	31.2	31.2	31.2	31.2
35H	29.0	29.0	29.0	29.0
36H	17.1	17.1	17.1	17.1
41B	21.3	21.3	21.3	21.3
41C	20.9	20.9	20.9	20.9
43M	9.5	9.5	9.5	9.5
44B	20.9	20.9	20.9	20.9
45B	8.2	8.2	8.2	8.2
45G	20.9	20.9	-	-
52C	42.2	42.2	42.2	42.2
52D	22.1	22.1	22.1	22.1
63B	54.4	54.4	54.4	54.4
63G	44.9	44.9	22.6	22.6
63J	11.2	11.2	11.2	11.2
63W	42.5	42.5	42.5	42.5

* Does Not Include Platoon Headquarters 13T Personnel

SECTION 7 - CONDUCT IMPACT ANALYSIS

7.1 OVERVIEW

In the HARDMAN Methodology, Impact Analysis determines the demand that an emerging system's personnel and training requirements will place upon the projected supply of personnel and training resources. The supply/demand comparison surfaces the system's "high drivers", i.e., those factors whether design, personnel or training policy, maintenance plan or scenario, which would cause consumption of a disproportionate share of the available resources. It is these high drivers which are often the focus of tradeoff analyses (step 6 of the HARDMAN Methodology).

The application of HARDMAN to RPV represents the first instance of Impact Analysis conducted on an Army system between Milestone I and Milestone II in the Weapon System Acquisition Process. The RPV study benefited from some preliminary investigations into Impact Analysis conducted in the course of other studies performed by DRC. These studies found that the key to an effective supply/demand comparison is the accurate projection of the likely supply of personnel and training resources at the time of an emerging system's deployment. Tools and techniques adequate to the task do not presently exist, or if the basic means are present (as in the Personnel Policy Project Model (P3M) mentioned below), their typically short horizon (1-3 years) is of little value when compared with average system development times (5-7 years). The short horizon coincides with the typical current year/budget year/program year orientation of the PPBS process; whether this constitutes a cause and effect relationship or merely coincidence one can only speculate.

Consequently, the current state of the Impact Analysis conducted for Army applications of HARDMAN can be described as rudimentary. However, this does not mean that meaningful results were not obtained. On the contrary, an effective Impact Analysis was conducted by taking advantage of a major, and not unreasonable, simplifying assumption: that RPV will in essence represent a complete addition to the Army's force structure (and hence manpower, personnel and training) requirements. In other words, no system presently deployed will be replaced by RPV. The reasonableness of this assumption stems from the Organizational and Operational Concept, which indicates that the Army completely lacks the capability which RPV represents, thus establishing the RPV system requirement. The utility of this major simplifying assumption is elaborated upon in the following sections, which describe training and personnel impacts, respectively.

7.2 TRAINING IMPACTS

For a determination of training impacts, the assumption that RPV will represent a complete addition implies that existing training resources will be, and will remain, completely committed to training presently being conducted. Thus, the RPV training resource requirements, or demands, determined in Section 5 are completely "unfunded," and consequently the impacts of these demands are the demands themselves. It remains only to rank order the training resource requirements (man-days and instructors) in descending order. The high drivers are those of the highest rank. The results of this ranking are displayed in Tables 7.2-1 and 7.2-2.

7.3 PERSONNEL IMPACTS

7.3.1 Process

A comparison of the personnel demands of a new system to available personnel resources can indicate three conditions: (1) a surplus of resources relative to demand, (2) a shortage of resources, or (3) projected resources are adequate to meet demand. In Impact Analysis, the first condition is called a surplus, the second a shortfall, and the third condition is referred to as neutral.

Two types of personnel data, authorizations and availability, were used to make supply/demand comparison. Authorizations are those manpower positions, or spaces, for which the Army has received (or must request) funding authority from the Congress. Thus authorizations constitute a statement of the Army's demand for manpower. Availability, on the other hand, is a statement of the personnel system's ability to fill the authorized positions with individuals. In any current year, availability is a statement of personnel inventory on-hand. In a future year, it is an estimate of future supply.

Table 7.2-1 Training Impacts: Man-Days

Rank Order	Reference				Baseline			
	Sustained		O&O		Sustained		O&O	
	MOS	Man-Days	MOS	Man-Days	MOS	Man-Days	MOS	Man-Days
1	13T	16,459	13T	18,558	13T	17,672	13T	19,926
2	13TP9	8,998	13TP9	8,998	13TP9	6,004	13TP9	6,004
3	35H	5,191	35H	5,191	35H	5,191	35H	5,191
4	34Y	4,265	34Y	4,265	34Y	3,625	34Y	3,625
5	31V	4,108	31V	4,108	26L	3,378	26L	3,378
6	26L	3,598	26L	3,598	36H	3,249	36H	3,249
7	35E	3,385	35E	3,385	63B	3,046	63B	3,046
8	36H	3,249	36H	3,249	35E	2,808	35E	2,808
9	63B	3,046	63B	3,046	63W	2,703	63W	2,703
10	31E	2,695	31E	2,695	31E	2,639	31E	2,639
11	63W	2,550	63W	2,550	52C	2,405	52C	2,405
12	63G	2,470	63G	2,470	41C	1,986	41C	1,986
13	52C	2,405	52C	2,405	13T30	1,523	13T30	1,523
14	45G	2,362	45G	2,362	31S	1,463	31S	1,463
15	41C	1,986	41C	1,986	44B	1,421	44B	1,421
16	13T30	1,809	13T30	1,809	31J	1,375	31J	1,375
17	31S	1,463	31S	1,463	63G	1,243	63G	1,243
18	44B	1,421	44B	1,421	52D	884	52D	884
19	31J	1,375	31J	1,375	41B	533	41B	533
20	52D	884	52D	884	63J	426	63J	426
21	26T	821	26T	821	45B	320	45B	320
22	41B	533	41B	533	43M	314	43M	314
23	63J	426	63J	426	-	-	-	-
24	45B	320	45B	320	-	-	-	-
25	43M	314	43M	314	-	-	-	-

Table 7.2-2 Training Impacts: Instructors

	REFERENCE				BASELINE			
	Sustained		O&O		Sustained		O&O	
Order	MOS	Instructors	MOS	Instructors	MOS	Instructors	MOS	Instructors
1	13T	14.5	13T	16.3	13T	15.4	13T	17.4
2	13TP9	8.2	13TP9	8.2	13TP9	8.2	13TP9	8.2
3	34Y	8.2	34Y	8.2	34Y	7.6	34Y	7.6
4	31V	3.9	31V	3.9	35E	2.7	35E	2.7
5	45G	3.7	45G	3.7	36H	2.7	36H	2.7
6	35E	3.6	35E	3.6	63B	2.7	63B	2.7
7	36H	2.7	36H	2.7	35H	2.6	35H	2.6
8	63B	2.7	63B	2.7	52C	2.6	52C	2.6
9	35H	2.6	35H	2.6	63W	2.5	63W	2.5
10	52C	2.6	52C	2.6	26L	2.3	26L	2.3
11	26L	2.5	26L	2.5	31S	2.0	31S	2.0
12	63W	2.3	63W	2.3	41C	1.9	41C	1.9
13	31S	2.0	31S	2.0	31E	1.8	31E	1.8
14	31E	1.9	31E	1.9	52D	1.8	52D	1.8
15	41C	1.9	41C	1.9	31J	1.3	31J	1.3
16	52D	1.8	52D	1.8	44B	1.3	44B	1.3
17	13T30	1.5	13T30	1.5	63G	1.2	63G	1.2
18	44B	1.3	44B	1.3	13T30	1.1	13T30	1.1
19	31J	1.3	31J	1.3	41B	.5	41B	.5
20	63G	1.2	63G	1.2	43M	.5	43M	.5
21	26T	.8	26T	.8	45B	.5	45B	.5
22	41B	.5	41B	.5	63J	.3	63J	.3
23	43M	.5	43M	.5	-	-	-	-
24	45B	.5	45B	.5	-	-	-	-
25	63J	.3	63J	.3	-	-	-	-

It must be noted that authorizations do not reflect the force structure required to satisfy the various missions with which the Army has been tasked. In peacetime, the Army chooses not to man (i.e., authorize) 100 percent of its units at 100 percent of their force structure requirement, in order to divert resources to other priority objectives. Consequently, authorizations are usually lower than requirements; stated another way, the manpower demand reflected by requirements is almost always higher than that reflected by authorizations. It is not possible to make an analysis of how an emerging system's manpower requirements impact on the total force structure requirements without knowing how the force structure requirement is allocated to the various systems and MOS's. This information was not available for the RPV study.

It was, however, possible to determine impact of RPV for a supply/demand comparison based on authorizations. RPV will represent a complete increase to present projections of both authorizations and availability, since it is also assumed that no systems will be replaced by RPV.[1] Therefore 100 percent of the RPV specific manpower (i.e., force structure) requirement will be added to present authorization. An availability ratio (AR) may now be calculated using the equation:

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[1] The new enlisted MOS required by RPV, 13TXX with ASIP9, RPV Crewmember and Mechanic, respectively, were assumed to impact upon, and therefore could be represented by, the existing MOS 15D. Their true availability ratios are zero, since these skills do not presently exist in the inventory. However, the impacts presented here represent the more realistic case, where RPV will draw its manpower from an existing pool such as the 15D MOS.

$$AR = \frac{\text{Availability}}{\text{Authorizations} + \text{RPV Manpower}}$$

where:

AR	<	1	=	Shortfall
AR	>	1	=	Surplus
AR	=	1	=	Neutral

Availability and authorization data, by MOS and paygrade, for fiscal year (FY) 1983 were provided from the Army's Personnel Policy Project Model (P3M). While subject to the short horizon problem mentioned earlier, the data were accepted as the "best estimate" on which to base near-term decisions regarding RPV. Further, the data were inflated to allow for the effect of the TTHS account. These figures had to be backed out using the TTHS percentages from the COPO 45 report used in Section 6. Thus the final equation was:

$$AR = \frac{(\text{Availability}) \times (1 - \%\ \text{TTHS})}{\text{Authorizations} \times (1 - \%\ \text{TTHS}) + \text{RPV Manpower}}$$

Adjusted availability and authorizations for the MOSs considered by the RPV study are displayed in Table 7.3-1. RPV manpower requirements are displayed in Table 7.3-2. Table 7.3-3 displays the Availability Ratio results. Referring to the 13T MOS in Table 7.3-3, as an example of how to interpret the given AR values, the 1.13 in column 2

Table 7.3-1 Adjusted Availability/Authorizations
FY 1984 Total MOS/Paygrade

MOS	Availability	Authorizations
13T	2,839.58	2,517.07
26L	926.62	763.04
26T	261.95	235.12
31E	1,634.74	1,605.29
31J	1,891.23	1,713.18
31S	631.69	747.19
31V	6,850.90	6,274.98
34Y	455.62	585.14
35E	529.07	527.37
35H	1,287.09	1,332.72
36H	1,586.42	1,339.13
41B	42.98	49.22
41C	555.32	523.85
43M	516.17	458.84
44B	1,436.45	1,540.48
45B	515.26	467.07
45G	320.74	356.30
52C	1,818.05	1,863.92
52D	3,271.35	3,143.56
63B	26,629.92	24,671.24
63G	877.69	821.35
63J	1,312.64	1,006.13
63W	4,126.45	3,386.56

Table 7.3-2 RPV Manpower Requirements

MOS	Reference Sustained	Reference O&O	Baseline Sustained	Baseline O&O
13T	532	588	532	588
13T P9	112	112	112	112
26L	14	14	14	14
26T	14	14	-	-
31E	14	14	14	14
31J	14	14	14	14
31S	14	14	14	14
31V	56	56	-	-
34Y	14	14	14	14
35E	14	14	14	14
35H	14	14	14	14
36H	14	14	14	14
41B	14	14	14	14
41C	14	14	14	14
43M	14	14	14	14
44B	14	14	14	14
45B	14	14	14	14
45G	14	14	-	-
52C	14	14	14	14
52D	14	14	14	14
63B	56	56	56	56
63G	14	14	14	14
63J	14	14	14	14
63W	28	28	14	28

Table 7.3-3 Availability Ratio Results

	Current FY 84 Projection	Reference Sustained		Reference O&O		Baseline Sustained		Baseline O&O	
13T	1.13	(.20)	0.90	(.22)	0.88	(.20)	0.90	(.22)	0.88
26L	1.21	(.02)	1.19	(.02)	1.19	(.02)	1.19	(.02)	1.19
26T	1.11	(.05)	1.05	(.05)	1.05	(.00)	1.11	(.00)	1.11
31E	1.02	(.01)	1.01	(.01)	1.01	(.01)	1.01	(.01)	1.01
31J	1.10	(.01)	1.09	(.01)	1.09	(.01)	1.09	(.01)	1.09
31S	0.85	(.02)	0.83	(.02)	0.83	(.02)	0.83	(.02)	0.83
31V	1.09	(.01)	1.08	(.01)	1.08	(.00)	1.09	(.00)	1.09
34Y	0.78	(.03)	0.76	(.03)	0.76	(.03)	0.76	(.03)	0.76
35E	1.00	(.02)	0.98	(.02)	0.98	(.02)	0.98	(.02)	0.98
35H	0.97	(.01)	0.96	(.01)	0.96	(.01)	0.96	(.01)	0.96
36H	1.18	(.01)	1.17	(.01)	1.17	(.01)	1.17	(.01)	1.17
41B	0.87	(.22)	0.68	(.22)	0.68	(.22)	0.68	(.22)	0.68
41C	1.06	(.03)	1.03	(.03)	1.03	(.03)	1.03	(.03)	1.03
43M	1.12	(.03)	1.09	(.03)	1.09	(.03)	1.09	(.03)	1.09
44B	0.93	(.01)	0.92	(.01)	0.92	(.01)	0.92	(.01)	0.92
45B	1.10	(.03)	1.07	(.03)	1.07	(.03)	1.07	(.03)	1.07
45G	0.90	(.03)	0.87	(.03)	0.87	(.00)	0.90	(.00)	0.90
52C	0.98	(.01)	0.97	(.01)	0.97	(.01)	0.97	(.01)	0.97
52D	1.04	(.00)	1.04	(.00)	1.04	(.00)	1.04	(.00)	1.04
63B	1.08	(.00)	1.08	(.00)	1.08	(.00)	1.08	(.00)	1.08
63G	1.07	(.02)	1.05	(.02)	1.05	(.02)	1.05	(.02)	1.05
63J	1.30	(.01)	1.29	(.01)	1.29	(.01)	1.29	(.01)	1.29
63W	1.22	(.01)	1.21	(.01)	1.21	(.01)	1.21	(.01)	1.21

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indicates that the potential source of the 13T MOS has a projected availability surplus over authorization for FY84 of 113 percent. The 0.90 in column 4 indicates that when the RPV demands for MOS 13T are placed on the personnel system, a 10 percent shortfall exists. The 0.20 in parenthesis for column 3 indicates that the AR demand in column 4 shows a load of 20 percent with respect to the column 2 FY84 AR projection. The following section describes the P3M model and how availability and authorization were defined.

7.3.2 The Personnel Policy Project Model (P3M).

The Personnel Policy Project Model (P3M) projects actual inventory or availability (supply) by MOS/paygrade. Inputs to P3M include a continuation rate which contains (1) reenlistment rates; (2) retirement rates (career or medical retirement); (3) miscellaneous rates (death, desertion, discharge); (4) attrition; (5) promotion and a feeder rate. DRC received 1983 availability rates which are a function of projected personnel policies for 1983. The above rates are sensitive to 1983 increases or decreases in Army internal variables, such as bonus levels. By changing bonus levels for MOS/paygrades, changes will occur in the continuation rates. For example, if a bonus is taken away, reenlistment rates will drop for that particular MOS/paygrade. If bonuses are increased, reenlistment rates will increase. This will be a linear function.

The objective of P3M is to index retention rates based on years of service. These rates are divided into three time zones within each paygrade; (1) first term personnel (1-6 years); (2) midservice personnel (6-10 years); and (3) career personnel (10 years and up). Rates would vary among first termers, mid-service, and career personnel. For example, career personnel would have higher retirement rates than first termers or mid-service personnel and first term personnel would have higher attrition and promotion rates than career personnel.

Authorizations are the quantity and type of people funded to fill manpower requirements (demand). The baseline for authorizations originates from the Personnel Structure and Composition System (PERSACS) which is a detailed summary of authorizations (requests) submitted by field organizations. The baseline is then adjusted according to the following internal changes projected to occur; (1) new equipment densities; (2) structure changes; (3) deployment schedules, and (4) the Quantitative and Qualitative Personnel Requirements Information (QQPRI) used to calculate total force system specific manpower requirements. All these changes are taken into consideration for new systems. Between the field requests and internal changes, the quantities of personnel to be funded through authorizations are projected.

7.4 MAINTENANCE IMPACTS

Table 7.4-1 presents an RPV section's maintenance workload by an end item's percent contribution to the total section maintenance requirements. It is rank-ordered to indicate system maintenance high drivers. These end items maintain a fairly uniform percentage distribution for both the reference and baseline systems. Of significance is that the RPV generic ground subsystem (launcher, recovery and GCS), when integrated with Army GFE as is the case here, drive the

Table 7.4-1 RPV Maintenance High Drivers By End Item

Rank Order	Reference System -	%	Baseline System -	%
01	Launcher Subsystem	15.3	Launcher Subsystem	15.7
02	Air Vehicle	14.3	Ground Control Station	14.0
03	Ground Control Station	13.9	Maintenance Shelter	13.8
04	Recovery Subsystem	13.3	Air Vehicle	12.1
05	Air Vehicle Handler	12.0	Recovery Subsystem	12.0
06	Maintenance Shelter	11.6	Air Vehicle Handler	10.3
07	Cargo Vehicle	6.2	Prime Mover, M882	7.7
08	Prime Mover, M882	6.1	Diesel Generator Set(2)	6.1
09	Diesel Generator Set(2)	4.8	Cargo Vehicle	6.0
10	Basic Issue Equipment	1.3	Basic Issue Equipment	1.7
11	Remote Ground Terminal	1.2	Remote Ground Terminal	0.6

greater maintenance requirements. The only RPV subsystem with a high maintenance workload percentage, when Army GFE is not a factor, is the air vehicle. The values chosen for GFE equipment reliability and maintainability are workload high drivers in respect to the CFE values.

7.5 SENSIVITY ANALYSIS

The question then arises as to whether the workload estimates for the CFE are high enough. The answer is "probably not", since the values are low and because they are predicated on inherent reliability and maintainability estimates without any allowance for field conditions.

This answer necessitates a sensitivity analysis to determine the effect that these reliabilty estimates can have on workload. As discussed in Section 4, and presented in the Figure 4.4-1 piechart, the following RPV Section's workload distribution values prevail for the baseline system under a sustained operation.

Type Workload	Manhours/Month	% Contribution
Operational Manning (OM)	2497.5	61.2
Indirect Labor (INDL)	797.8	19.6
Preventive Maintenance (PM)	710.4	17.4
Corrective Maintenance (CM)	72.0	1.8
TOTAL	4077.7	100.00

An analysis of the data for these piecharts indicates that the OM, INDL and PM workloads, although the major contributors, are not likely to be as sensitive to changes in reliability or maintainability parameters as they are to operational requirements. This leaves corrective maintenance (CM) as the choice for sensitivity analysis.

There are a number of key parameters which could be varied to influence this CM workload including fail rate, maintenance action rate, elapsed maintenance time to repair, number of men per task and quality factors, e.g., skill level. The product of maintenance action rate (or failure) and manhours required per repair over a given period of time constitutes CM workload. Therefore, CM maintenance manhours per month was chosen as the variable parameter, thereby encompassing everything except skill level.

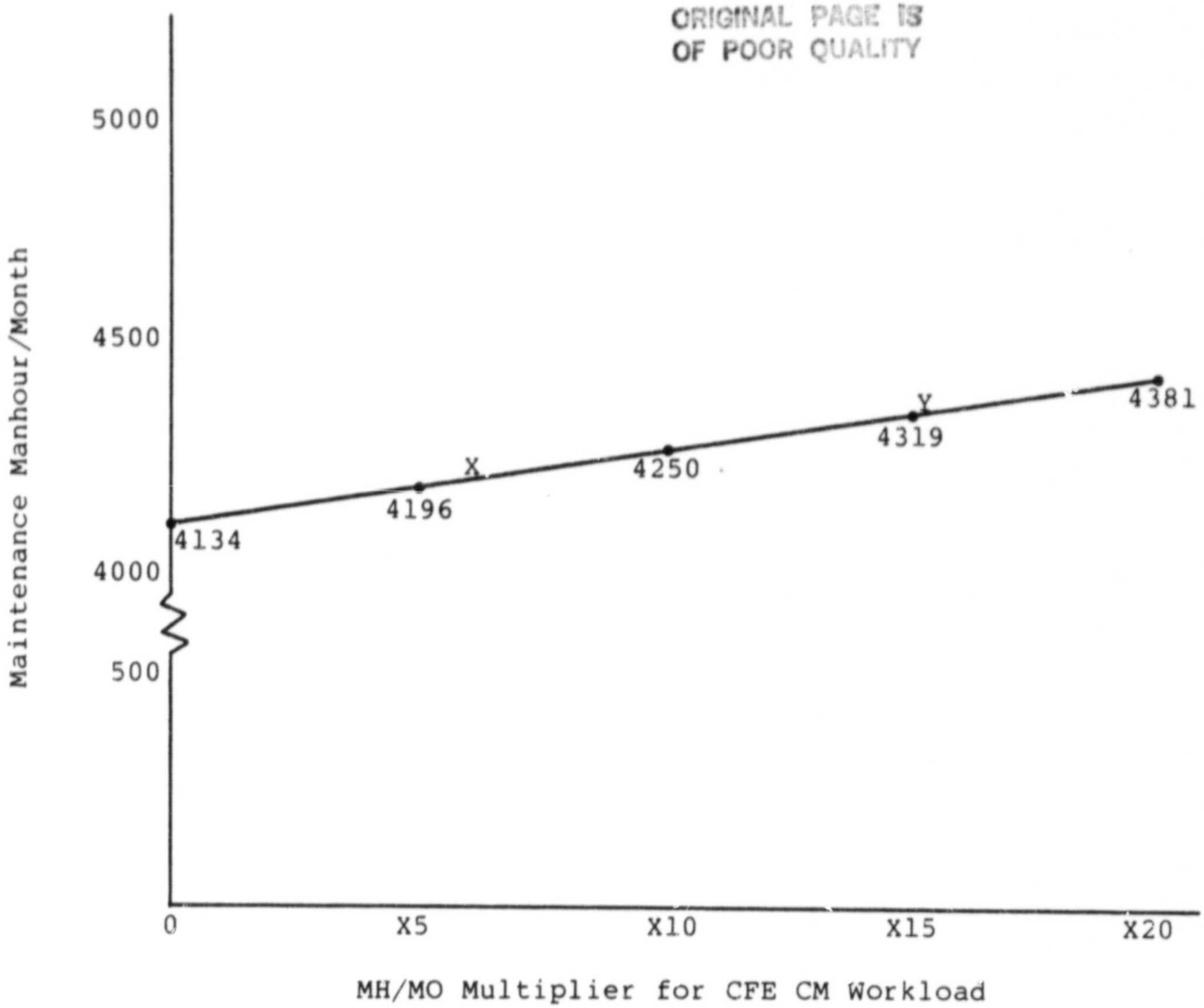
The CFE portion of the workload in manhours per month (MH/MO) was extracted from the sustained baseline data base as shown in Table 7.5-1. Maintenance manhours per month for an RPV section were then plotted against a linear increase in the CFE workload as shown in Figure 7.5-1. The point at which an increase in manhours will cause the enlisted positions to increase by one is 73.1 additional manhours (marked with an X on the plot). This is approximately six times the present CFE workload, yet still allows a 90% load factor for each enlisted position as previously discussed.

The warrant officer position could absorb an additional 113 manhours of labor before becoming 90 percent loaded as shown at point Y in Figure 7.5-1. From the quality factor aspects, the two 13T ASI P9 personnel positions together are capable of absorbing an additional 480 hours of CM per month

Table 7.5-1 Sustained Baseline CFE Workload Aggregation

Category	RPV Section (MH/MO)	DS Main (MH/MO)	Total (MH/MO)
CM AV	2.44	1.54	3.98
CM AVH	.13	.70	.83
CM GCS	8.49	30.14	38.63
CM LS	.43	3.41	3.84
CM MIC	.28	.06	.34
CM MS	.44	2.82	3.26
CM RS	.06	.93	.99
CM VH	.06	-	.06
	12.33	39.60	51.93

Figure 7.5-1 Corrective Maintenance Workload Sensitivity (RPV Section)



if they relinquish unspecified MOS workload to other positions. Additional maintenance workload accrued by poorer reliabilty would probably go to the P9. Therefore, the concern for the reliability estimates being low can make a difference of one position at the section level. This condition could be worsened by time to repair estimates being low. For example, a poor built in test (BIT) would cause an increase in the time it takes to fault isolate.

The previously noted six to one factor which generates the need for another section position is not difficult to attain. In fact, the reference system reflects a need for an additional section position. However, the likelihood of the R&M values being low by a factor of 30, the value it would take in order to generate the need for another position, is remote.

A similar analyses was directed to the DS level maintenance. Starting with the fact that it takes 208 hours of workload per month to generate a DS level position each MOS was assessed for their present workload. Then, the CFE portion of the present workload was identified. Finally, the multiplier (X) of the CFE manhours per month necessary to create a need for a new DS level position for a given MOS was obtained from the equation:

$$(X)\ \text{MH/MO} = \frac{208\ \text{MH/MO} - \text{Present MH/MO Load}}{\text{CFE Portion of Present Load}}$$

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The results of performing this calculation for the DS positions are shown in Table 7.5-2. Referring to the right hand column, it requires a manhour/month increase of eleven and fourteen times before a second 44B or 63W position respectively, would be generated. All other positions require considerable greater workload multiples to generate additional positions as noted in Table 7.5-2.

Table 7.5-2

DS Maintenance Sensitivity Analysis - Baseline Sustained

MOS	MMH/MO (Total)	MMH/MO (CFE) Total	POTENTIAL MH/MO MULTIPLIER
26L	.06	.06	3466
31E	52.66	8.14	19
31H	10.61		
31J	12.82		
31S	26.38		
34Y	3.93	3.49	58
35E	.10	.10	2079
35H	12.64		
36H	14.59		
41B	19.41		
41C	.46		
43M	1.39		
44B	16.93	16.93	11
45B	1.38		
52C	36.58	5.30	32
52D	54.65		
63G	32.60	.02	8770
63J	.34	.34	610
63W	135.83	5.16	14
	433.36	39.78	

SECTION 8 - TRADEOFF ANALYSIS

8.1 OVERVIEW

The HARDMAN Methodology has been designed to support equipment/human resource tradeoffs in the early stages of the Weapon System Acquisition Process (WSAP). These tradeoffs review design, personnel, training and logistics alternatives in order to formulate solutions to excessive human resource consumers.

Potential system tradeoffs are normally derived through impact analysis which is that step in the HARDMAN Methodology where the supportability of a baseline design, from a human resource perspective, is addressed. Each supportability issue normally generates a number of alternative solutions. The greater the number of alternatives explored, the greater the number of options provided to the Project Manager (PM).

In the case of the RPV, alternative tradeoff analyses were identified early in the application of the HARDMAN Methodology. In September 1982, a briefing was presented to the RPV Project Office detailing DRC's analysis work that had been accomplished from date of contract start (July, 1982). This briefing concentrated on the manpower requirements of the baseline RPV section deployed in an operational scenario provided by the Project Office. It was during this briefing that alternative manpower tradeoffs were identified and subsequently selected for investigation.

8.2 SELECTION OF PROPOSED TRADEOFFS

As previously discussed, alternative tradeoffs which would impact the manpower, personnel, and training resources of the RPV system were identified during the RPV Project Office briefing. Of the alternatives discussed at that time, the following three were selected for further investigation:

- Use of the M809 series versus the M939 series 5-ton Truck.
- Receipt of varying advance notification prior to section displacement.
- Manpower for internal section security requirements.

8.3 TRADEOFF ANALYSES

8.3.1 Use of M809 series Versus M939 series 5-ton Truck

Mounted on one 1 and 1/4 ton and six 5 ton cargo trucks, the RPV section is highly mobile. These vehicles serve as the prime movers for the organic equipment on the vehicle as well as the two generator trailers and the Remote Ground Terminal (RGT) trailer. All of these vehicles are maintained at the organizational level by the 63B10, Wheeled Vehicle Mechanic, with crew level support from the drivers. The series truck selected will, therefore, directly impact the total organizational maintenance workload for the wheeled vehicle mechanic.

M809 Series 5 ton Truck

One of the basic 5 ton cargo truck models presently in the Army inventory is designated the M809 series. This series truck, equipped with a standard transmission, has been in the Army's operational inventory for over 15 years. Because of its lengthy service record, substantial amounts of data regarding reliability, availability, and maintainabiltiy (RAM) are available.

M939 Series 5 ton Truck

In June 1982, the Army accepted delivery of the first production model of the M939 series 5 ton truck. This series vehicle is an enhanced version of the present M809 series truck and features an automatic transmission designed to provide greater reliability and maintainability.

Because production of the M939 series truck has just begun, no mature RAM data regarding operational employment is presently available. Data has been compiled from the operational/developmental testing (DT/OT) which the truck has undergone. It was this data that was used to support comparability analysis with the M809 series vehicle.

Results of Tradeoff

The present organizational and operational concept for the RPV system calls for the M939 series truck to be available and used at RPV system's Initial Operational Capability (IOC). Therefore, the RPV baseline system included the M942 and M927 version of the M939 series truck. However, because of concern that the RPV system might be deployed using the M809 series truck, a tradeoff analysis was conducted to determine the MPT impact of this alternative with the M811 and M814 models.

The major differences between the two series of trucks is the M809 series has a standard transmission while the M939 series has an automatic transmission. Additionally, numerous technological improvements have been made to the M939 series truck subsystems. As previously discussed, qualitative and quantitative amounts of mature RAM data are available for the M809 series. The M939 series, however, has accumulated only that maintenance data associated with operational and developmental testing.

A comparability analysis of these two truck systems produced the following results:

- Preventive maintenance (PM) for each series of truck is approximately the same, and has no adverse impact on manpower requirements (operator or maintainer).

- Corrective maintenance (CM), that unscheduled maintenance performed at the organizational level, differs significantly between the two series of trucks. Using the M939 series truck, sufficient workload was present at the organizational level to justify the single 63B10 position. If the M809 series truck is selected, the amount of 63B10 workload associated with CM increases by a factor of 2.46. This increase in workload, while significant in terms of maintenance manhours, does not, however, indicate that a second 63B10 be assigned to the section. It does however, detract from the amount of unspecified MOS workload which he can accept, thereby shifting this unspecified workload to the 13TXX MOS.

8.3.2 Receipt of Advance Notification Prior to Section Displacement

During the baseline manpower analysis conducted early in the RPV study, the initial requirement for an RPV section manned by thirteen personnel to displace in 30 minutes was found to be unrealistic. A tradeoff analysis was therefore conducted to determine the effect of receiving advance displacement notice prior to required moveout time.

In order for a section to properly displace, a number of factors must be considered. These include (1) selection of the next position, (2) determining routes to the new position, (3) a reconnaissance of that location if possible, and (4) estimation of flight mission profiles that can be flown from the new location. This planning information can be done separately or in conjunction with the physical preparation of the section's equipment for movement. Additionally, consideration must be given to air vehicle (AV) status at time of displacement notification. The AV could be performing a mission, it could have just been netted, or the section could be in a non-mission operation mode.

RPV section displacement time includes reconfiguring the system to move, proper equipment storage, and briefing the section for movement to the new site (including vehicle positioning upon arrival). Proper vehicle loading and a section briefing on new site positions could be eliminated in order to reduce displacement time. However, selection of this option would require at least an equal time increase upon arrival at the next location, thereby preventing attainment of the required 60 minute emplacement time. Sharing part of the proper loading and section briefing workload between emplacement and displacement is not considered a viable alternative. Time necessary to properly load and brief is simply not linearly additive. Therefore, the resultant time lost could adversly affect the section's actions whereby both emplacement and displacement functions could not meet their time requirements, assuming section manning remains at 13.

Displacement timeline analysis was conducted to determine time needed from time of displacement notification to completion of the displacement given three scenarios:

Scenario one:

> A site is in the minimum operational configuration with launcher in its hide site ready to be deployed and the air vehicle has just been recovered.

Scenario two:

> A site is fully improved and the air vehicle has just been recovered.

Scenario three:

A site is fully improved, all vehicles are at their hide sites ready to be deployed, and an air vehicle is in the air on an operational mission.

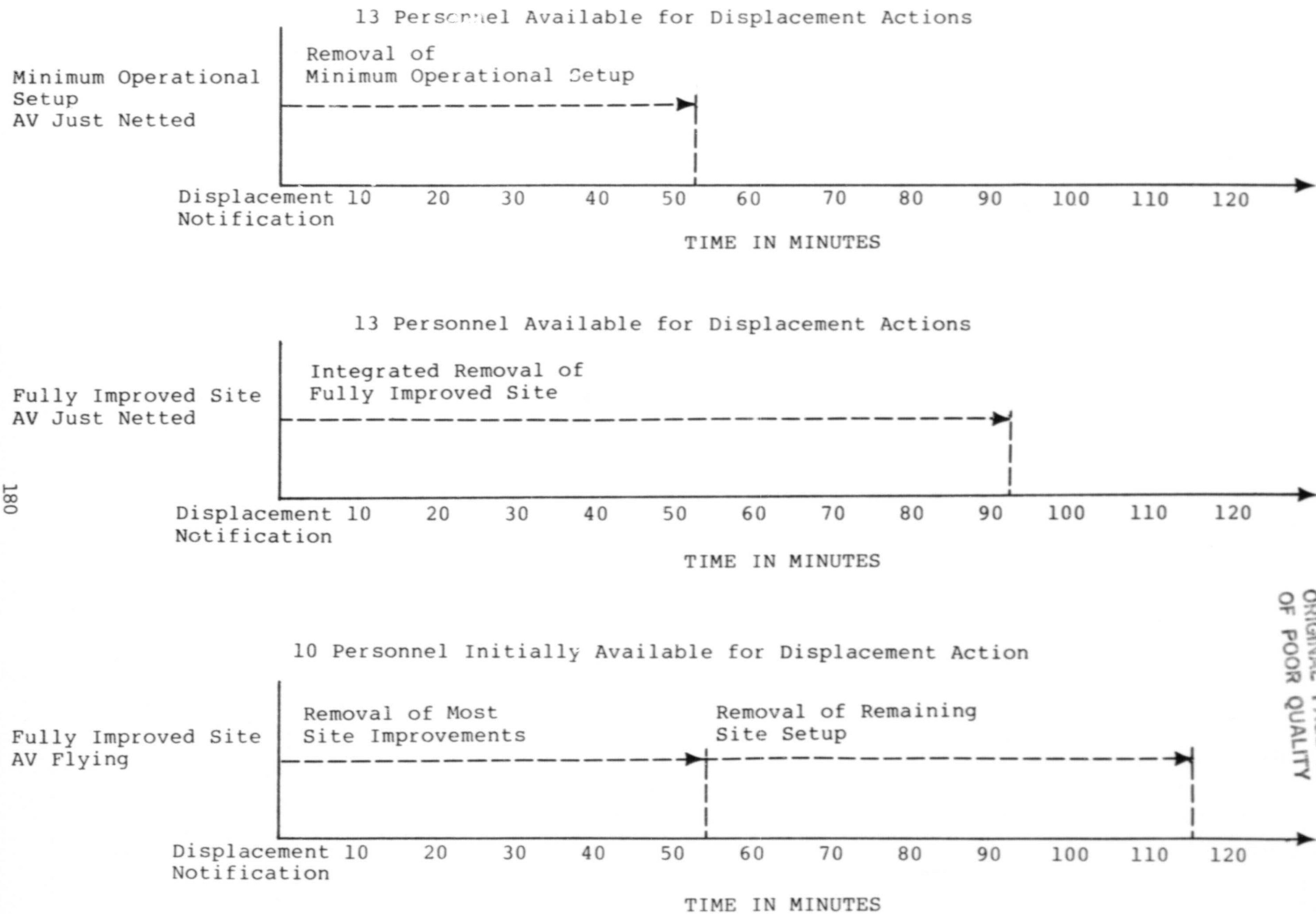
Figure 8.3.2-1 summarizes the displacement times given the three scenarios described above.

The first scenario can be considered the minimum site displacement time in that only the minimum equipment for flight operations has been put into service and all 13 section personnel are available to prepare this equipment for displacement. Ideal conditions and ideal personnel placement were assumed. In this case, it takes approximately 54 minutes to displace the system.

Given the second scenario, with all 13 personnel of the RPV section available to prepare equipment for displacement and the new RPV site selected and properly defined by higher authority, it will take 87-90 minutes to displace the 100% improved site. This time is considered an absolute minimum for displacing a 100% improved site. It does not, however, take into account fatigue, environmental factors (terrain, foul weather, combat hazard, etc.) and wasted motion/time. It also assumes personnel are properly placed to begin displacement tasks.

Scenario three represents a highly probable situation of a site being fully established, 100% improved when movement orders are received, and a flight mission in progress. Displacement preparations under these conditions take place in two phases:

Figure 8.3.2-1 Summary of Displacement Times



- o Displacement, stowage, and preparations for movement of all site improvements not essential for flight operations and recovery and,

- o Displacement, stowage and preparation of those minimum operationally-essential equipments after the AV has returned to the section site and been captured.

Based upon scenario analysis, the required time to displace increases significantly. This increase results from operational manning requirements to continue the air vehicle mission and prepare the recovery subsystem for an AV recovery while simultaneously preparing for the displacement. Only after completion of the operational tasks can all section personnel be devoted to the remaining preparation for displacement.

If an AV is flying at the time of displacement notification, operational personnel must continue the mission and then recover the air vehicle. The remaining RPV section personnel can begin to prepare the section for displacement. However, based on operational manpower requirements for the flight and recovery of the AV, only 40% of the total site setup (includes minimum operations and site improvement configurations) can actually be removed from a fully improved site. This 40% of the site can be removed in 60 minutes without impacting flight operations. The remaining 60% of the site can then be removed as part of the normal displacement preparation, assuming all thirteen personnel are now available. This would take an additional 54 minutes. Therefore, adding the normal displacement time required results in a total of 114-120 minutes required from time of notification, compared to 87-90 minutes for Scenario two.

Another view of the time requirements necessary to displace an operational section would indicate that for every 10% of site improvement above that minimum operational condition required to operate the air vehicle, it will take 5-6 minutes to prepare for movement (i.e., If the section is 50% improved and an AV is in the air, it will take 25-30 minutes to remove site improvements in addition to 54 minutes to complete preparation for displacement).

Detailed timelines of the three scenarios described above are contained in Appendix B4.

8.3.3 Internal Security

A tradeoff analysis was also performed to address the manpower requirements associated with RPV internal site security. The subject of site perimeter security and equipment security (inside and outside of the section perimeter) were the main issues, since neither of these two considerations were addressed in the Organizational and Operational Concept.

The deployed RPV section will occupy an area approximately 200 meters in diameter. The Remote Ground Terminal (RGT) will be located somewhere outside of the section perimeter. Security requirements for this vital communications link, therefore, are critical to section air operations. This is exacerbated if the RPV section is tactically deployed close to the forward edge of the battle area.

Various concepts of internal security for the RPV section were formulated. These ranged from a strong-point defensive position (offensive and defensive weapons, manned and unmanned positions, active and passive sensors), to a passive defense consisting only of unmanned sensors. The RPV Project Office decided that to satisfy essential security requirement of providing only a warning/alert with no offensive or defensive capability, a single-man fixed warning post would be on guard in the vicinity of the RGT 24 hours a day. Additionally, two single-man moving patrols would patrol the RPV section perimeter. Each patrol would cover about one-half of the perimeter, a distance of approximately 300 meters.

Based on the concept of employment for this security force, a manpower analysis determined that workload associated with internal security would drive a requirement for six (6) additional personnel in the RPV section. These positions could be of an unspecified MOS. However, because of operational requirements for the thirteen personnel presently projected to man the RPV section, <u>none</u> of this security function could be accomplished by them. Operational considerations (given a 12-hour operational scenario) as well as required MACRIT allowances, accounts for all of the section's available time. Thus, providing section perimeter security for the RGT guardpost from within RPV personnel resources would not be possible.

SECTION 9 - RESULTS

This section contains a discussion of the results derived from the application of the HARDMAN Methodology to the Army's Remotely Piloted Vehicle (RPV). Section 9.1 deals with the specific findings of the analysis. Section 9.2 contains the conclusions reached and their relevance to the objectives of the study. Recommendations for further action are contained in Section 9.3

9.1 FINDINGS

A summary of the MPT results is depicted in Table 9.1-1. For the most part, these are self-explanatory and have been discussed in greater detail in the preceding sections. In some cases, the detailed explanation and information is contained in the Appendices. This section will be devoted to relating only the most significant findings and/or those not fully addressed in the report.

As discussed in Section 4, manpower requirements are developed from four basic workload categories: operational, indirect labor, preventive and corrective maintenance. In applications of the HARDMAN Methodology it has been found that seemingly small variations in workload requirements sometime mask significant differences across alternative system concepts. This is due to the indivisibility of the required asset - - namely, a person. In other words, a system that requires only part of an individual's productive

C -2

TABLE 9.1-1 RPV SYSTEM SUMMARY

CATEGORY	REFERENCE SYSTEM SUSTAINED	REFERENCE SYSTEM O&O	BASELINE SYSTEM SUSTAINED	BASELINE SYSTEM O&O
Manpower				
Crew*	812	868	$\boxed{756}$	812
DS Maintenance	294	294	$\boxed{252}$	266
Personnel				
Number of MOS	24	24	$\boxed{21}$	$\boxed{21}$
Personnel Requirement*	2,932	3,066	$\boxed{2,616}$	2,750
Annual Recruit Rate	1,080	1,124	$\boxed{973}$	1,017
Training				
Annual Training Man-Days	76,133	78,232	$\boxed{64,208}$	66,462
Annual Instructor Requirement	73.0	74.8	$\boxed{63.5}$	65.5

* Includes enlisted requirements of the Platoon Headquarters

capacity must take all of that person, not just the portion it requires.

As an example, there is a likelihood that another position will be required in a section to offset the maintenance workload. This possibility manifested itself in the manpower, R&M sensitivity and training analyses as a result of qualitative requirements associated with potential increases in quantity of workload. In other words, higher predicted failure rates and longer times to diagnose and repair a fault will cause more 13T P9 workload. Additionally, the breadth of equipment types which the 13T P9 will support may demand consideration of assistance from another MOS, in particular MOS 31V, Tactical Communications Systems Operator/Mechanic.

The neglible amount of workload actually accomplished in the maintenance shelter (MS) given the RPV remove and replace maintenance philosophy does not seem to justify an MS for each section. Significant resource savings might be realized if wartime AV test and maintenance done in the maintenance shelter was moved to the DS level along with other MS functions that require sophisticated test equipment. This could lead to a lesser number of MS configurations and a possible reduction in 13TP9 position workload. Also, increased operational AV assets at the section level could then be realized, by replacing the semi-inert air vehicle with an operational unit.

The Sustained tempo of operations requires less workload than does the Organizational and Operational concept tempo because of AV losses and weather conditions curtailing flight time.

Operational manning (OM) is the high driver of manpower. Sixty-eight percent of this OM workload is non-MOS, non-skill level specific. Corrective maintenance (CM) drives the least manpower but will require a high quality of training particularly if BIT is not adequate for fault isolation.

The government furnished equipment (GFE) maintenance requirements were dictated by fielded equipment R&M values and accounted for the majority of the CM sustained scenario workload. For contractor furnished equipment (CFE) some predicted R&M values were used. However, the CM contributed less than four percent of the overall workload. A sensitivity analysis of the CFE workload indicated that either the fail rate or the mean time to repair would have to increase by a factor of six before another section position would be required. A factor of thirty is required before an additional maintenance position is needed. It is of interest to note that wheeled vehicles created the largest PM and CM workload.

The 13-man RPV section can emplace minimum equipment for AV launch and mission control of a 30 waypoint mission in 60 minutes. A 13-man RPV section requires 54 minutes to displace from a minimum operations configuration.

The 13T10 MOS availability ratio for the RPV system, which was predicated on a 15D MOS source, shows a ten percent personnel shortfall in FY 1984. The availability ratio is determined by dividing the predicted personnel availability by the manpower authorization plus RPV manpower requirements.

The RPV 13T MOS personnel structure indicates a larger demand at the E-4 and E-3 levels than is available from the inherent 13T E-2 and E-1 levels. This was in spite of accomplishing much of the non-skill level specific workload at the E-2 level; e.g., vehicle drivers. There are a number of potential solutions to this "hump" in the structure including (1) reinforcing the 13T MOS at the E-4 level with personnel cross trained from another MOS, (2) cross training with other systems so that a greater E-1 and E-2 pool would be available (i.e., create a secondary MOS), or (3) shift workload through system engineering analysis to incorporate a greater E-1 and E-2 requirement.

A total of nine new or modified courses will be needed for the new and modified MOSs for the reference system. Of the nine courses, seven were modified for the baseline system, and two other reference courses were deleted. The training for five existing maintenance MOSs must be modified to accommodate the RPV system. The new enlisted MOS (13T) with ASI (P9) will result in the requirement for at least three new courses of instruction. The new warrant officer MOS, 211B, will also require a new course of instruction.

The requirement exists for a system-specific organizational maintenance MOS (rather than an ASI P9) and a direct support maintenance MOS as well. A critical factor will be the ability of the BIT to perform to design specifications.

The type of training that will be required for the mission payload operators and air vehicle operators is in keeping with the duties required of the section commander and section chief. In most instances, this training is similar to that normally provided to senior NCO's and officers.

Thus the personnel selected for this training must possess the proper background, aptitude, and maturity. This fact, coupled with the expectation that 13T MOSs will not be using these skills for some time after reaching the field, may dictate a two step training program. The first level would center on those duties involving the operation of launcher, recovery, and AV handling systems and driver training. Then, based on aptitude and potential demonstrated during their SOJT program, personnel would be selected for advanced operator training.

9.2 CONCLUSIONS

The boxed figures in Table 9.1-1 highlights the most favorable result in each category. The baseline system, operating in the sustained scenario configuration, requires the least manpower, personnel and training assets. The primary reason for this is the weather degradation and air vehicle losses (battle and other) for the reference or baseline systems. However, it must be noted that the baseline system uses idealistic R&M values to arrive at workload estimates. These two reasons then (lesser operational demands and idealistic maintenance actions) reduce manpower requirements at the crew and direct support levels, thereby influencing the personnel required to sustain the total system.

Regarding the training requirements, the baseline system, regardless of scenario, was less intensive in the use of training resources than the reference system. The sustained baseline scenario required the fewest training resources in terms of training man-days and instructor requirements.

The identification of appropriate data sources, and the subsequent collection of required data, continue to be significant factors driving both the time and funds required for a HARDMAN application. Numerous problems in this regard were encountered in the RPV application in spite of the RPV Project Office's efforts. While not precluding effective analysis, the sometimes fragmented data that was available for the analysis makes the cost in time required higher than it should be for a single HARDMAN application. The question of data, and access to data, is one that must be addressed as initial considerations and on-going concerns. The attention of the Program Office is paramount to success, as was the case with the RPV analysis.

9.3 RECOMMENDATIONS

There are three general recommendations in this report. First, a manpower, personnel and training requirements analysis should be applied to the RPV baseline system operating under the sustained scenario, but operating 24 hours-a-day rather than 12 hours-a-day as assumed in this study. Incorporating a 24 hours-a-day operational tempo would add the dimension of alternative air vehicle payloads (e.g., Forward Looking Infrared (FLIR), electronic jammer,) and a more realistic wartime scenario to the analysis.

Second, a human resource requirements assessment of a RPV section deployed with operational elements (Ground Control Station and Remote Ground Terminal) forward and support elements (Launch Subsystem, Recovery Subsystem and associated handling and maintenance equipment) in a rear area should be conducted. The study identified the possibility that workload associated with maintenance actions at the section level could be incorporated, or shifted, into existing direct support positions, or better performed in a rear area. The proposed investigation should include the sensitivity analysis regarding the level at which operational and maintenance workload is performed.

Finally, the requirement may exist for a system-specific organizational maintenance MOS and a direct support maintenance MOS, or both. A critical factor for consideration will be the ability of the proposed built-in-test (BIT) equipment to perform to design specifications.

GLOSSARY OF ACRONYMS

AFM	Air Force Manual
AFREG	Air Force Regulation
AIT	Advanced Individual Training
AR	Army Regulation
AR	Availability Ratio
ASI	Additional Skill Indicator
ASARC	Army System Acquisition Review Council
AV	Air Vehicle
AVIM	Aviation Intermediate Maintenance
AVUM	Aviation Unit Maintenance
BIT	Built-in-test
BOIP	Basis of Issue Plan
BTC	Basic Training Course
CDB	Consolidated Data Base
CFE	Contractor Furnished Equipment
CM	Corrective Maintenance
COI	Course of Instruction
COPO	Chief of Personnel Operations
COTR	Contract Office Technical Representative
CSWS	Corps Support Weapon System
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DRC	Dynamics Research Corporation
DSWS	Division Support Weapon System
DS	Direct Support
DT/OT	Development Test/Operational Test
ECMF	Enlisted Career Management Field
EMF	Enlisted Master File

FLIR	Forward Looking Infrared
FMECA	Forward Modes Effects Criticality Analysis
FY	Fiscal Year
GCS	Ground Control Station
GFE	Government Furnished Equipment
HQ	Headquarters
IMAGES	Interactive Manpower Aggregation Estimation System
IMPACT	Interactive Manpower-Personnel Assessment and Correlation Technology
INDL	Indirect Labor
IOC	Initial Operational Capability
JPL	Joint Propulsion Laboratory
KW	Kilowatt
LCN	Logistic Control Number
LS	Launcher Subsystem
LSA	Logistic Support Analysis
LSAR	Logistic Support Analysis Record
MAA	Mission Area Analysis
MAC	Maintenance Allocation Chart
MACRIT	Manpower Authorization Criteria
MEP	Mission Event Profile
MH	Manhour
MILPERCEN	U.S. Army Military Personnel Center
MIP	Maintenance Index Pages
MOS	Military Occupational Specialty
MPT	Manpower Personnel and Training
MRA	Manpower Requirements Analysis
MRC	Maintenance Requirements Card
MTTR	Mean Time to Repair
MS	Maintenance Shelter
NAMSO	Navy Maintenance Support Office
NATO	North Atlantic Treaty Organization

NCOES	Non commissioned Officer Education System
NETP	New Equipment Training Plan
O&O	Organizational and Operational
OICTP	Outline of Individual and Collective Training Plan
OM	Operational Manning
OP-AUDIT	Operational Audit
OPNAVINST	Chief of Naval Operations Instruction
OT	Operational Test
PERSACS	Personnel Structure and Composition System
PM	Preventive Maintenance
PM	Project Manager
PMCS	Preventive Maintenance Checks and Services
POI	Program of Instruction
PRA	Personnel Requirements Analysis
p3M	Personnel Policy Project Model
QQPRI	Qualitative and Quantitative Personnel Requirements Information
RAM	Reliability, Availability, and Maintainability
R&M	Reliability and Maintainabilty
RGT	Remote Ground Terminal
ROC	Required Operational Capability
RPV	Remotely Piloted Vehicle
RS	Recovery Subsystem
SDC	Sample Data Collection
SOJT	Supervised On-the-Job Training
TM	Technical Manual
TRADOC	U.S. Army Training and Doctrine Command
TRRA	Training Resource Requirements Analysis
TTHS	Trainees, Transients, Holdees and Students
WQEC	Weapons Quality Engineering Center
WSAP	Weapon System Acqusition Process
3-M	Maintenance and Material Management

BIBLIOGRAPHY

The RPV bibliography contains only the study's major references i.e., those sources contributing directly to the various HARDMAN analyses, and is not intended to be an all inclusive listing of RPV-related documentation. A significant amount of the documentation reviewed and utilized to some degree in the study is therefore not part of the bibliography but is contained in the RPV's Consolidated Data Base (CDB). These data and information files are the central repository for all RPV data and are a ready reference and audit trail source.

Army RPV systems air vehicle critical design reviews. Lockheed, May 1982.

Army RPV system operational concept (functional baseline). LMSC - D732702, Lockheed, June 1980.

Aviation electronics configuration directory. U.S. Army Technical Bulletin No. 750, Washington, D.C., 28 Febuary 1975.

Barkley, J.A., HP-30 Launcher for aquila/reliability prediction/ estimate report. AAE, July 1980.

The chief of personnel operations (COPO) 45 report. MILPERCEN, Washington, D.C.

Col. Christensen, George, Schnebly, F. David, Aquila RPV system command and control. AIAA.

Contract work breakdown structure index and dictionary. U.S. Army RPV System - Vol. 6, LMSC-L037666D, Lockheed, September 1979.

Enlisted career management fields and military occupational specialties. Department of the Army, Army Regulation No. 611-201, C1B, Washington, D.C., 1 June, 1982.

EPMS master training plan. U.S. Army Pam351-9, Washington, D.C., June 1981.

GCS design overview informal technical review. LMCS-D780255, Lockheed, Febuary 1981.

GCS shelter critical design review. Lockheed, March 1980.

Generator (5,15,30 KW) SDC logistic analysis management semi-annual summary. COBRO, April 1982.

Government furnished property. U.S. Army RPV System-Vol.22, LMSC-L037666J, Lockheed, April 1982.

Hackathorn, Jack, Job task and skill analysis sheets. DRCPM-L.

HP-30 launcher assembly - table 3 - estimated corrective maintenance task times. AAE, February 1982.

Issues from system OTR. Lockheed, January 1982.

Kirschman, Richard H., Riser, Henry L., System assessment of the 30 kw/60hz generator set. TSARCOM system assessment #50, TSARCOM, September 1981.

Launcher subsystem failure modes, effects, and criticality analysis - revision. LMSC-D826217-A, Lockheed, February 1982.

Lim, William P., Paolini, Donald D., M880/890 series 1 1/4 ton truck SDC summary - part A. DA CIR 750-81-14, DARCOM, July 1982.

LMSC/AVRADCOM RAM/LOG coordination conference. November 1981.

Logistics support analysis record - LSA data for the HARDMAN simulation data base. LMSC-L037666C, U.S. Army, May 1982.

Logistic support analysis record-personnel skill summary-LSA-02. LMSC-L037666C, Lockheed, August 1982.

Logistic support analysis record - preliminary maintenance allocation summary. U.S. Army LSA-16, 12 July 1982.

Logistic support analysis record - special training device requirements. U.S. Army LSA-11, 2 July 1982.

Logistics support analysis report for the RPV system. LMSC-L037666C, U.S. Army, May 1982.

LSA candidate and task function list. Lockheed, July 1982.

LSA candidate and task function list. Lockheed, February 1982.

Manpower and equipment control organization, equipment authorization tables: personnel MACRIT section. Army regulation 570-2, 15 September 1978.

Manual of warrant officer military occupational specialties. U.S. Army Regulation No. 611-112, C4, Washington, D.C., 15 March 1980.

MICNS-CDR for RPV ADT. Harris, February 1982.

MICNS-CDR for RPV GDT. Harris, May 1982.

MICNS critical design review (CDR) for RPV ground data terminal (GDT) system design III. Harris, May 1982.

MICNS integrated logistic support management team (ILSMT) meeting presentation material. Harris, June 1982.

MICNS logistics support analysis record. CDRL item H004, Harris, June 1982.

MICNS-reliability prediction math and apportionment for RPV-ADT CDRL. Harris, April 1982.

MICNS-reliability prediction math and apportionment for the RPV-GDT CDRL. Harris, April 1982.

Military occupational classification structure development and amplification. U.S Army, Regulation 611-1, 27 April 1976.

Miller, V.T., Government test facilities requirement plan-operational requirement for the RPV system. LMSC-D780856B, Lockheed, February 1982.

Modular integrated communications and navigation system (MICNS). Harris, May 1979.

M813, 5-ton truck RAM summary. TACOM, September 1978.

M880/M890, 1 1/4 truck series RAM assessment study. TACOM, April 1980.

Ogles Jr., T.M., _U.S. Army RPV programs-logistics support analysis record (LSAR)-procedures manual_. LMSC-D732900, Lockheed, March 1980.

Paul, D., _Air vehicle subsystem failure modes, effects and criticality analyses (final report)_. LMSC-D826274, Lockheed, April 1982.

Paul, D., _Ground control station - ground data terminal failure modes effects and criticality analyses; revision B._ LMSC- D80129-B, Lockheed, March 1981.

Paul, D., _Ground control station-ground data terminal-failure modes, effects, and criticality analyses (revision C and C1)_. LMSC-D780129-C, C1 Lockheed, September 1981.

Personnel flow characteristics. Defense Manpower Data Center, Monterey, CA.

Personnel policy project model (P3M). MILPERCEN, Washington, D.C.

Personnel structure and composition system (PERSACS). U.S. Army Military Personnel Center, Alexandria, VA.

Poorman, D.C. , _Integrated logistics support plan_. LMSC-D863502, Lockheed, March 1982.

ORIGINAL PAGE IS
OF POOR QUALITY

Poorman, D.C., Training aids and devices study-revision to part I - embedded simulation. LMSC-L826628, ILS, 8 December 1981.

Radio and radar reference data. U.S. Army Field Manual No. 24-24, Washington, D.C., 20 May 1977.

Recovery subsystem- failure modes, effects, and criticality analysis. Lockheed, 26 March 1982.

Reliability, availability, maintainability, standardization, (RAMS). Lockheed, April 1980.

Request for Army demonstrations and results (observers notes). Lockheed, February 1982.

RPV program ILS status review. U.S. Army, March 1982.

Snow, Ken, Critical design review, maintenance shelter progress review GCS shelter, DTUPC. LMSC-5781079, Lockheed, June 1980.

Tacfire operations. U.S. Army FM/6-1, Washington, D.C., 28 September 1979.

Target acquisition/designation and serial reconnaissance system (TADARS) YMYM-1. U.S. Army, October 1980.

United States Army Training and Doctrine Command. Program of Instruction TRADOC Cir 351-12. 18 April 1980.

Updated and new basis of issure plans (BOIP) for the remotely piloted vehicle system (TADARS). U.S. Army, December 1981.

U.S. Army formal schools catalog. Department of the Army Pam 351-4, Washington, D.C., 1 January 1980.

U.S. Army RPV system preliminary design review splinter session, ground support equipment. LMSC-D732947, Lockheed, April 1980.