ARI Research Note 91-43

Handbook for Conducting Analysis of the Manpower, Personnel, and Training Elements for a MANPRINT Assessment

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April 1991

United States Army
Research Institute for the Behavioral and Social Sciences

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction of the Deputy Chief of Staff for Personnel

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Research accomplished under contract
for the Department of the Army

Allen Corporation of America

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS --
2a. SECURITY CLASSIFICATION AUTHORITY --	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE --	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) --	5. MONITORING ORGANIZATION REPORT NUMBER(S) ARI Research Note 91-43
6a. NAME OF PERFORMING ORGANIZATION Allen Corporation of America 6b. OFFICE SYMBOL (*If applicable*) --	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute Headquarters, U.S. Army Training and Doctrine Command
6c. ADDRESS (*City, State, and ZIP Code*) 209 Madison Street Alexandria, VA 22314	7b. ADDRESS (*City, State, and ZIP Code*) PERI-SM 5001 Eisenhower Avenue Alexandria, VA 22333-5600
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences 8b. OFFICE SYMBOL (*If applicable*) PERI-S	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER OPM Contract No. 85-75/W.O. Nos. 275-117 and 375-123 and OPM-90-02/W.O. No. 202-043
8c. ADDRESS (*City, State, and ZIP Code*) 5001 Eisenhower Avenue Alexandria, VA 22333-5600	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 63007A; PROJECT NO. 793; TASK NO. 125; WORK UNIT ACCESSION NO. C5

11. TITLE (*Include Security Classification*)
Handbook for Conducting Analysis of the Manpower, Personnel, and Training Elements for a MANPRINT Assessment

12. PERSONAL AUTHOR(S) Guerrier, Jose H.; Lowry, John C.; Jones, Robert E., Jr.; Guthrie, Jerry L.; Barber, Jacob L. (Allen Corp. of America); and Miles, John L., Jr. (ARI)

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (*Year, Month, Day*)	15. PAGE COUNT
Final	FROM 85/09 TO 87/10	1991, April	118

16. SUPPLEMENTARY NOTATION
Monitored by Headquarters, Training and Doctrine Command, Fort Monroe, Virginia 23651-5000.

17. COSATI CODES			18. SUBJECT TERMS (*Continue on reverse if necessary and identify by block number*)	
FIELD	GROUP	SUB-GROUP	MANPRINT	Personnel and training analysis
			Human factors engineering analysis	MANPRINT assessment
			Manpower	

19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

This handbook is a guide to the analysis of manpower, personnel, and training (MPT) topics as a part of a MANPRINT assessment. Some of the theory underlying Manpower and Personnel Integration (MANPRINT) and the technical and administrative steps in the MPT analysis are presented. The sequence of activities for conducting the MPT analysis, the rationale underlying those activities, and specific approaches to planning the MPT analysis are included. Also addressed are the topics of interviewing personnel and collecting data as well as sources of data relevant to MPT aspects of system performance. A format for the MPT analysis report is provided. The handbook is illustrated with examples from the MPT analyses of three materiel acquisition programs.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL John L. Miles, Jr.	22b. TELEPHONE (*Include Area Code*) (703) 274-8883 22c. OFFICE SYMBOL PERI-SM

DD Form 1473, JUN 86 *Previous editions are obsolete.*

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

PREFACE

HOW TO USE THIS HANDBOOK

The United States of America has never tried to match its potential adversaries soldier-for-soldier and weapon-for-weapon. Instead, our policy has consistently been to equip our citizen-soldiers with weapons and other materiel so effective that they would be provided with the winning edge on any battlefield. Clearly in order to achieve this policy objective, the effectiveness of new systems must be assessed.

Army Regulation (AR) 602-2, Manpower and Personnel Integration (MANPRINT) and AR 602-1, Human Factors Engineering Program, presently include requirements for conducting Human Factors Engineering Analysis (HFEA). The HFEA, which is required for each new system entering the materiel acquisition cycle, was recently renamed a "MANPRINT Assessment." Training and Doctrine Command (TRADOC) has been assigned lead role in providing the Manpower, Personnel, and Training (MPT) input to MANPRINT Assessments. This handbook is published to provide "how to do it" guidance for TRADOC personnel. The Army Human Engineering Laboratory has responsibility for human factors engineering input. That input is obtained through a Human Factors Engineering Assessment. Thus the acronym "HFEA" endures, but with a new meaning.

This handbook is a guide to conducting a manpower, personnel, and training (MPT) analysis as a part of a MANPRINT Assessment, and is intended primarily for TRADOC personnel who may be tasked to produce the MPT portions of such an assessment. Others interested in the MPT sections of a MANPRINT Assessment, including contractor personnel designing the hardware and software, may also find the handbook useful. To illustrate concepts, lessons learned from three recent MPT analyses are presented. Each of the three systems analyzed represents a different level of development in the Life Cycle System Management Model (LCSMM). Those systems are the Special Operations Forces Helicopter Modification (SOF MOD), which was at the conceptual stage; the Remotely Piloted Vehicle (RPV), which was at the full-scale development stage; and the NAVSTAR Global Positioning System (GPS), which was at the initial production stage. This handbook presents some of the theory that underlies MANPRINT, as well as the technical and administrative steps involved in conducting an analysis of the MPT elements of a MANPRINT Assessment. Its aims are to inform the reader of (1) the logical sequence of activities that should be carried out in conducting an MPT analysis, (2) the rationale underlying those activities, (3) specific approaches to planning the MPT analysis, interviewing personnel, and collecting data, and (4) the sources of data that can provide relevant information about the various MPT aspects of soldier and manned system performance.

The three specific MPT analyses mentioned above are included among the references listed in this handbook. They are the sources for many of the examples cited throughout this document. On that point a note of caution is in order: Any materiel development is a dynamic, rapidly changing program, and the HFEA (now MANPRINT Assessment) itself may have promoted change. Therefore, while the MPT sections for the assessments on the three systems provide useful, realistic illustrative material, accurate when written, the reader should not make the mistake of assuming that they describe the current state of progress on the systems addressed. Put more succinctly, the MPT

input to the assessments described the three systems at earlier points in time. Significant changes may have occurred since then.

Appendix D of this handbook provides a recommended format, with examples, of an MPT report as input to a MANPRINT Assessment.

HANDBOOK FOR CONDUCTING ANALYSIS OF THE MANPOWER, PERSONNEL, AND TRAINING ELEMENTS FOR A MANPRINT ASSESSMENT

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HANDBOOK FOR CONDUCTING ANALYSIS OF THE MANPOWER, PERSONNEL, AND TRAINING ELEMENTS FOR A MANPRINT ASSESSMENT

CHAPTER 1.0
INTRODUCTION

The U.S. Army invests large amounts of resources in both materiel acquisition and the improvement of recruitment, selection and training of soldiers who will operate, maintain and support new systems. However, the growing cost and complexity of new weapon systems coupled with 1990 projections of reduced funding, manpower and soldier aptitude levels make necessary more efficient management of weapons acquisition. Concerns are specifically directed at acquiring weapon systems that are not only technologically capable of meeting the threat, but are also designed to be consistent with the relevant characteristics of the future soldier. Such an approach aims to achieve optimal soldier-machine integration, effective use of available personnel, and tolerable demands on training resources. Achieving these aims is the goal of the Army's Manpower and Personnel Integration (MANPRINT) program, explained in Army Regulation AR 602-2 (Ref. 3). It is also the reason for using the MANPRINT Assessment to evaluate the system at various stages of its development.

It should be noted that MANPRINT is a recently established policy initiative that encompasses six pre-existing technical specialties: Manpower, Personnel, and Training (MPT), Human Factors, Health Hazards and System Safety. (The MANPRINT concept is treated in greater detail in paragraph 1.2 below and the MANPRINT Assessment is explained in paragraph 1.1). MANPRINT is a management and technical effort to integrate soldier performance and reliability issues into the acquisition process and thus assure total system effectiveness. The program seeks to accomplish this by continuously integrating relevant information from the six specialty domains into the materiel development and acquisition process. The old HFEA (now MANPRINT Assessment) predates MANPRINT and was one of the major tools used in the specialty of Human Factors Engineering, as explained in Army Regulation 602-1 (Ref. 2). The scope of a MANPRINT Assessment includes all six specialty domains of MANPRINT, but this handbook will focus solely on the Manpower, Personnel, and Training elements.

1.1 Definition of a MANPRINT Assessment

A MANPRINT Assessment is a review of the MANPRINT status of an acquisition program at a particular point in time to determine whether any critical or major issues exist that should preclude the scheduled transition of the program to the next phase of the materiel acquisition life cycle. The assessment also identifies issues which, while not critical to program decisions, must be addressed during the next phase of the acquisition cycle (Ref. 19). The assessment is not intended to fix blame on any organization involved in the development of a system; rather, its primary purpose is to assist the Project Manager of the system in implementing MANPRINT requirements. Such assistance should ensure acquisition of a system which can be operated, maintained and supported efficiently.

MANPRINT Assessment Issues. There are three types of issues, defined as follows:

a. Critical Issue. A critical issue identifies a MANPRINT aspect of a materiel system which is considered highly likely to result in either a serious health, safety, or human performance problem; which could cause extensive system

damage, operational failure, serious injury, or occupational illness; or which could place an excessive burden on the manpower, personnel and training resources of the Army.

b. Major Issue. A major issue identifies a MANPRINT aspect of a materiel system which is moderately likely to result in either a serious health, safety, or human performance problem; which could cause extensive system damage, operational failure, serious injury, or occupational illness; or which could place a serious burden on the manpower, personnel and training resources of the Army.

c. Other Issues. Other issues identify MANPRINT problems of lower priority than those described as critical or major, but which over time or under stressful conditions could cause system damage or degrade performance. A large number of these issues together may be considered either a critical or major issue.

The scope of the MANPRINT Assessment includes analysis of human performance and soldier-equipment interfaces, manpower, personnel, training, health hazards, and system safety. The assessment also includes an analysis of the impact of soldier performance on system reliability, effectiveness, operational availability, and maintainability, providing adequate data exist to support such analyses. (The focus of this handbook, however, is on the three elements of manpower, personnel, and training.)

1.2 Definition of MANPRINT

Manpower, and Personnel Integration (MANPRINT) refers to the comprehensive technical effort to promote system effectiveness by integrating into the materiel development and acquisition process all relevant information concerning MPT, human factors engineering, system safety, and health hazards. Other objectives of the MANPRINT program (stated in AR 602-2 (Ref. 3)) are to:

a. Influence soldier-materiel system design for optimum total system performance by considering MPT, human factors engineering, system safety, and health hazards before making a functional allocation of tasks among people, hardware and software.

b. Ensure that Army materiel systems, and concepts for their employment, conform to the capabilities and limitations of the fully equipped soldier to operate, maintain, supply and transport the materiel in its operational environment, consistent with tactical requirements and logistics capabilities.

c. Assist the Army trainer in determining, designing, developing, and conducting sufficient, necessary, and integrated Army and joint service training. Apply MANPRINT concepts and current educational technology to analysis, design, and development of training devices.

d. Improve control of total life cycle costs of soldier-materiel systems by assuring consideration of the costs of personnel resources and training for alternative systems during the conceptual stages and for the selected system during subsequent stages of acquisition.

e. Ensure (through basic applied studies and research in human factors engineering, soldier-materiel system analysis, and experimental and cognitive psychology) that equipment designs and operational concepts are compatible with

the limits of operators and maintainers defined in the target audience description.

f. Provide MANPRINT data for the development of technical manuals, training manuals, field manuals, and other training media and technical publications.

g. Ensure that personnel trained for specific force modernization systems (by MOS and ASI) are assigned to units and positions for which they are trained and that they are assigned in sufficient quantity to support fielding and sustainment.

1. Manpower: Manpower deals with the number of spaces and the cost of these spaces to the Army. Its concern is "...to determine the system's impact on Army manpower resources and to assure each system is optimized from a manpower viewpoint" (Ref. 4). Many factors must be considered in assessing manpower; some of the most critical ones are the following:

a) Distribution of quantity
b) Distribution of skills and experience
c) Force structure changes
d) Grade structure
e) Consideration of costs

If systems cannot be supported by projected manpower resources, given manpower priorities established by Headquarters, Department of the Army, then changes in system design, organization, or doctrine must be made to achieve affordability. In the materiel acquisition process, manpower analyses and actions are necessarily conducted in conjunction with force structure and budget processes.

2. Personnel: Personnel involves consideration of the ability of the Army to recruit and retain adequately qualified soldiers. This includes their specific aptitudes, experiences and other human characteristics, such as cognitive, physical, and psychomotor skills which are required to operate, maintain and support Army systems or items.

Personnel is mostly concerned with "...the quality of individuals required by a new system" (Ref. 4). Personnel analyses must, therefore, not only consider simple availability, but also the capability of the Army personnel management system to provide the needed number of properly qualified people at a reasonable cost. The tool used to measure soldier quality today is the Armed Services Vocational Aptitude Battery (ASVAB). It is from the ASVAB that the Armed Forces Qualification Test (AFQT) and Aptitude Area (AA) scores are derived; these are the scores used to establish recruitment criteria (Ref. 4). (See further explanation, pp. 12-13.)

3. Training. Training is the process which prepares soldiers to do jobs (Ref. 4). These "jobs" consist of the various tasks 'which describe what the Army wants the soldier to do.' Training involves:

a) The formulation and selection of engineering design alternatives which are supportable from a training perspective,

b) The documentation of training strategies, and

c) The timely determination of resource requirements to enable the Army training system to support system fielding.

Training impacts on the Army's personnel system, tactical employment concept, logistics system and, equally important, on the planning, programing, budgeting, and execution system (Ref. 7). Training is conducted in two basic areas within the Army. The first is usually at the institution whose goal is to impart the initial skills and abilities to the soldier (Skill Acquisition), and the second is conducted in the unit to which soldiers are assigned to maintain the level of skills at the required criterion level (Skill Retention) (Ref. 6). Both areas present different demands upon the resources of the Army.

1.3 MANPRINT Assessment in the Life Cycle System Management Model (LCSMM)

In order to appreciate the importance of a MANPRINT Assessment, one must understand its relationship to the LCSMM. The LCSMM is an overview of the life cycle of Army system acquisition from materiel concept to the ultimate pnaseout and disposal of the system. It guides the development of materiel systems by combat developers, materiel developers, trainers, operational testers, evaluators and logisticians to ensure that each of them carries out assigned responsibilities to a given program on time (Ref. 11).

LCSMM has been described as "...a flow chart which depicts the process by which Army materiel systems are conceived, initiated, validated, developed, deployed, supported and modified" (Ref. 11, P.1-7). Two versions of the LCSMM exist: the Traditional LCSMM and the Streamlined LCSMM. The Traditional LCSMM is divided into four phases: Concept Exploration, Demonstration and Validation, Full-Scale Development, and Production and Deployment. The Streamlined LCSMM combines milestones 0, I and II into one milestone (I/II) --thereby reducing the number of decision points and, consequently, the time frame for fielding the system. In order to pass from one phase to another, the system must receive approval at either the Major Army Command (MACOM), Army or Department of Defense (DOD) level depending upon the importance, priority or cost of the system.

The decision to allow a system to proceed from one phase to another is guided in part by the results of a MANPRINT Assessment provided to the Army Acquisition Executive. Whether in the case of the Traditional LCSMM (which is event-oriented) or that of the Streamlined LCSMM (which is time-oriented), the Assessment can have an impact upon the speed with which a system's development proceeds from one phase to another. Far from being an obstacle to the timely development of a system, a MANPRINT Assessment is designed to assist all the relevant authorities involved in system acquisition and development in identifying the MANPRINT issues which impact upon the standards of operation, maintenance and support which were set for the system at the outset, and to aid in correcting identified problems. This is accomplished when inputs from the assessment as well as various other sources are used by the Army System Acquisition Review Council (ASARC). The latter then decides, based on these inputs, whether a system should proceed to the next phase of development (Figure 1). Although there are six domains of MANPRINT, this handbook covers only those of manpower, personnel and training.

MANPRINT Assessment in the Life Cycle System Management Model

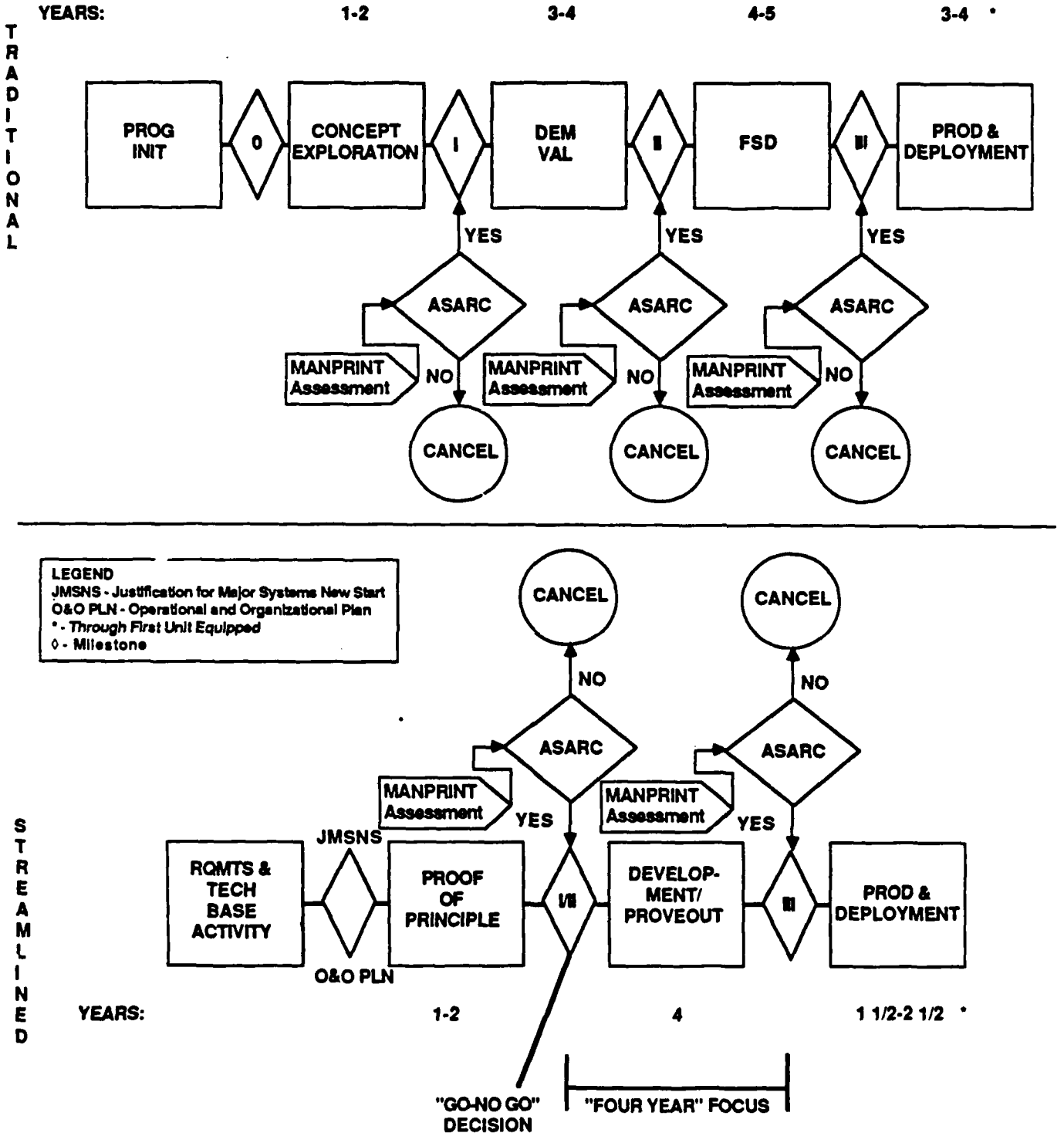


FIGURE 1

CHAPTER 2.0
MANPRINT THEORY AS APPLIED TO THE MPT ANALYSIS FOR A MANPRINT ASSESSMENT

2.1 Overview of the Chapter

This chapter provides the theoretical basis for MANPRINT as applied to the MPT Analysis for a MANPRINT Assessment of Army materiel. The chapter begins with a summary of human performance concepts and analytical approaches within which MANPRINT considerations should be studied. Then five MANPRINT rules of thumb are presented which explain the theory of conducting an MPT analysis. These five MANPRINT rules of thumb are:

(1) Soldier Performance Affects System Performance;

(2) Skill is a Function of Aptitude and Training;

(3) Measure Soldier Performance by Time and Accuracy;

(4) Equipment Design Determines Soldier Tasks; and

(5) Make the Designer Responsible for Soldier Performance.

The chapter concludes with a discussion of other important factors to consider while conducting an MPT analysis. This chapter therefore provides the MPT analyst with the basis for understanding the guidance provided in subsequent chapters of this handbook and provides the logical framework within which the MPT analysis for a MANPRINT Assessment should be conducted.

2.2 Analytical Framework for the Analysis of MANPRINT Considerations

An analytical framework for conducting the MPT analysis for a MANPRINT Assessment of Army materiel is derivable from human factors test and evaluation procedures published by HEL in Technical Memorandum 29-76 (Ref. 19). Two of the underlying factors in that analysis (i.e., personnel, and training) are clearly described in the following quote:

> "Basically, the test methodology ... works by identifying four factors (the man, his training, what he has to do, and the configuration of the equipment on which he works) and then assessing their compatibility. In addition to that assessment, data are also provided that can be used to: (1) verify that the human performance tasks required in the system can, in fact, be performed by humans, (2) accurately identify the aptitudes and skills required by system personnel, (3) establish the adequacy of the proposed training program, and (4) confirm that the materiel itself is adequately human-engineered. The requirements of ..." (the test methodology) "... are accomplished by analyzing operator performance requirements, followed by the acquisition of performance data, along with observations of potentially adverse factors such as human errors, equipment incompatibilities, interference by other operators, and safety hazards." (P.6)

The elements of the MPT analysis for a specific materiel item are captured in the question:

"Can this soldier, in this organization, with this training, perform these tasks to these standards, on this equipment." (See Figure 2.)

- The 'soldier' in this question refers to that subset of the population of Army soldiers assigned to operate and maintain the specific item of materiel of interest. The analysis focuses on soldier aptitudes and physical characteristics.

- The term 'organization' encompasses the organizational structure of the military unit within which soldiers are assigned and equipment is deployed (e.g., battery, platoon). Since the Army fields and fights units, the level of Army organization most suited to the MPT analysis involves the lowest unit of organization within which the materiel is employed. For example, the Army's Aquila Remotely Piloted Vehicle (RPV) may be fielded in a specially structured battery, organic to the Corps Target Acquisition Battalion and normally attached to the Division as a divisional resource. Therefore, the RPV battery is the lowest organizational unit of analysis. (Note also that the MPT analysis must extend to the maintenance and other units supporting the operational units.)

- The term 'training' refers to the set of activities by which soldiers learn the tasks which they must perform in order to accomplish successfully the mission of the system undergoing analysis. By inference, this element includes the duration of training, cost of training, and training effectiveness.

- The 'tasks' element in the question refers to the critical operational and maintenance tasks, the soldier's performance of which is gauged by some measure of effectiveness (MOE). These MOE are in terms of the combined time and accuracy for each critical task.

- The 'equipment' element of this question refers to the soldier-machine interface, including the system hardware, software, procedures, and system safety aspects of the materiel design.

Developing MPT in MANPRINT Assessment

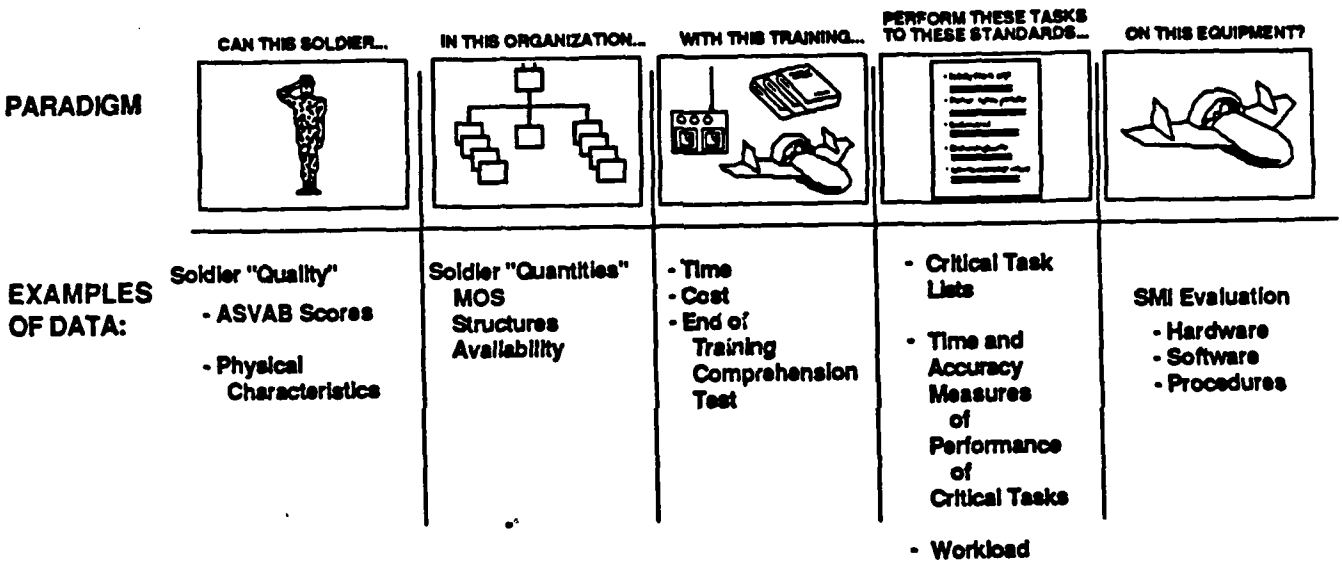


FIGURE 2.

2.3 MANPRINT Rule of Thumb One: Soldier Performance Affects System Performance (Figure 3)

In the MPT analysis for a MANPRINT Assessment, the analyst needs to address the following questions:

- To what extent are soldiers the limiting factor in system performance? Is there a 'performance gap' between that performance anticipated of the manned system by its designers and that performance actually obtained during test and evaluation or in the field?

RULE ONE

SOLDIER PERFORMANCE AFFECTS SYSTEM PERFORMANCE

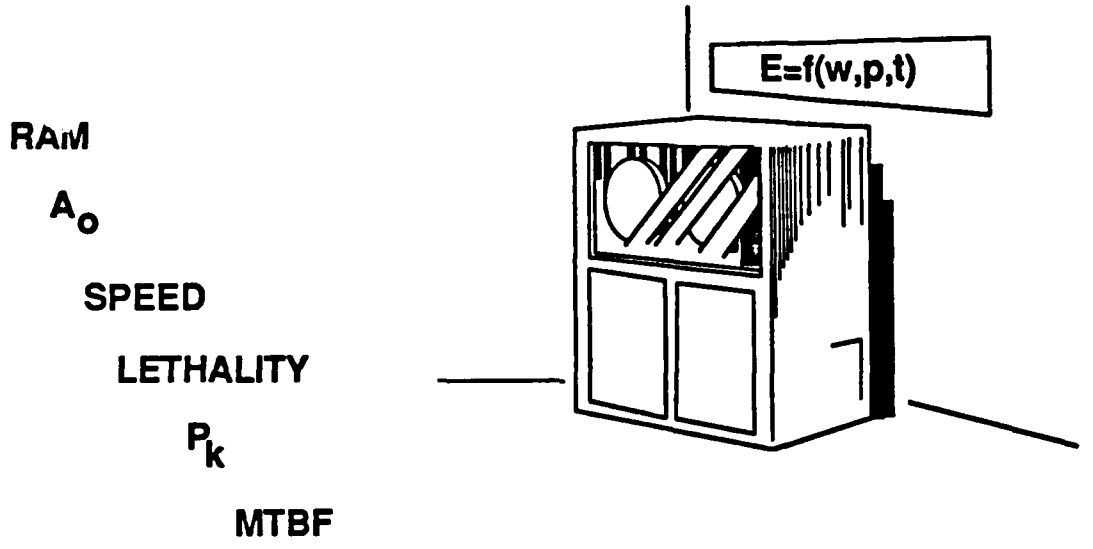


FIGURE 3.

- To what extent can soldiers across the expected range of aptitude levels within the prescribed MOS operate and maintain the hardware in order to achieve required system performance levels?
- Are quantitative soldier performance data available from which to assess these relationships?

The concept of the human operator of a machine as an integral component of the "system" and, as such, having a predictable and quantifiable impact on system performance, was seemingly overlooked for many years. However, the military has long recognized through doctrine, tactics, and training the capabilities and limitations inherent in soldiers using weapons in combat. As TRADOC PAM 71-8 (Ref. 10) states:

"Exercise of the military art has always involved understanding that the weapon system includes man. Military equipment is effective in battle only

to the degree that the soldiers who put it to use are trained to exploit its potential." (P.I-1)

It is evident that both soldier and machine must complement each other if overall manned system performance is to be successful. A lack of fit between the machine and the soldier can create a 'performance gap.' A performance gap may be defined as the inability of the manned system to achieve the system performance potential forecasted for the hardware and software alone. Technological advances have brought about the advent of superweapons; however, the capabilities of the soldiers who are to operate, maintain, and support such systems have not changed much over time. The Army has a finite pool of soldiers at its disposal with finite cognitive and psychomotor characteristics. The soldier, therefore, can become the limiting factor in system effectiveness potential. An important reason for conducting an MPT analysis is to identify any portions of manned system performance where the soldier does, in fact, become the limiting factor in achieving the desired battlefield effectiveness.

For example, the NAVSTAR GPS MPT analysis revealed a performance gap created through a failure to consider adequately the user's cognitive limitations. The following excerpts from the Findings and Conclusions section of the MPT Report illustrate the point:

"...A wide variety of soldiers from numerous MOSs are potential operators and maintainers of the MP/V version. These MOSs will contain some Mental Category IIIB personnel.

(1) The MP/V version has potential operator problems in initialization, determination of proper location, and fault determination.

(2) There are complex cognitive tasks required of the operator." (Ref. 15, P.iii).

The approach outlined in TRADOC PAM 71-8 (Ref. 10) employs the development of measures of effectiveness to analyze system performance and to identify and quantify the contribution of the soldier.

"The general model used in such analyses is: E=f(W, P, T) where E is battlefield effectiveness, being a function of 'W' the capability of the materiel, 'P' the proficiency of the soldier or soldiers manning it, and 'T' the tactic or technique of employment". According to this concept, "...'W' is determined by the materiel's built-in capabilities", ..." 'P' can be quantified by test, analysis of range scores, or other performance output", and "...'T' measures the influence of commanders or leaders in ordering the employment of the man-machine in battle." (P.II-1)

This concept, having been developed during the pre-MANPRINT period, does not identify the factor, which in this period of high visibility for MANPRINT among Army management has become the most critical aspect of soldier performance in Army systems. That factor is the aptitude of the soldier expected to operate and/or maintain Army systems. As Meister (Ref. 28), states:

"With the exception of aptitude, which can seriously constrain operator/system functioning, the variables inherent in the individual -- that is, the intrinsic variables -- probably play a minimal role

in system functioning except as they impact on aptitude and when mission requirements are highly demanding." (P.11)

Aptitude has been defined as one's capacity for learning (Ref. 41). It is "...a general characteristic of an individual that affects his or her performance on a task or set of tasks" (Ref. 37, P. 4). Aptitude is the single most important soldier characteristic to consider in assessing system performance. An analysis, conducted during a reverse engineering study of the soldier requirements for the Army's STINGER air defense missile system, pointedly illustrates the role of aptitude in soldier performance and system effectiveness. The following observations were made regarding the capabilities of soldiers to employ the STINGER system (Ref. 35):

"The lower mental category soldiers, constituting a large portion of the current population of gunners, cannot operate STINGER to meet the required single engagement kill probability." (P.12)

The essence of this issue, then, is performance as a function of aptitude. Soldier aptitude constraints should be specified for the system designer during the development of the system concept as well as becoming the central test issue against which the performance of the system is measured during test and evaluation. (See, for example, AR 602-2, para 2-12.)

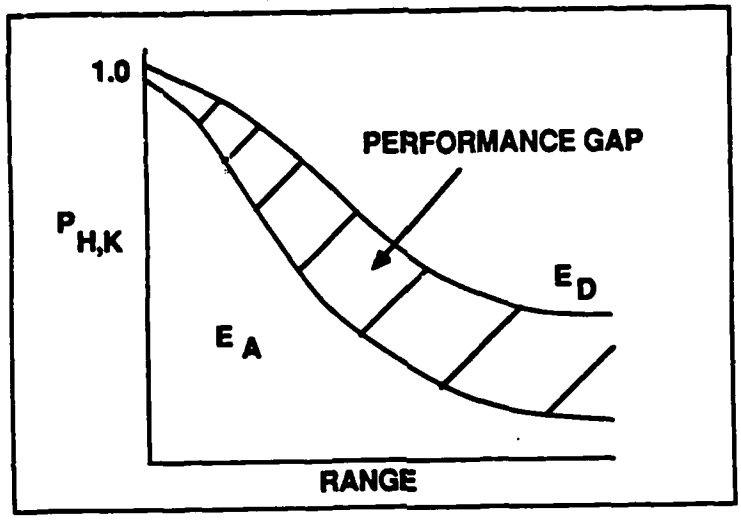
Aptitude can be made a central component of the system effectiveness model described above. The 'P' parameter can be redefined to include soldier aptitude. A similar logic has been proposed by Lowry and Seaver (Ref. 26) for developing a MANPRINT Effectiveness model for predicting the battlefield effectiveness of a manned system. Lowry and Seaver propose a methodology to measure soldier performance in terms of both time and accuracy, transform these data into probabilities, and introduce probability of correct and timely soldier performance into the manned system effectiveness model. (Note: A similar approach is described by the same authors for determining the contribution of maintainer performance to system availability, and a MANPRINT availability model is defined for this methodology.)

The instrument most widely used by the Army to measure soldier aptitude is the Armed Forces Vocational Aptitude Battery (ASVAB). The ASVAB "consists of ten separately timed and scored tests, the names of which briefly describe their content: General Science, Arithmetic Reasoning, Word Knowledge, Paragraph Comprehension, Mathematics Knowledge, Numerical Operations, Coding Speed, Mechanical Comprehension, Automotive-Shop Information, and Electronics Information" (Ref. 20, P.5). The scores obtained from the ten subtests are combined into composite scores in different ways and for specific reasons. "One combination, the Armed Forces Qualification Test (AFQT) is used by all the services for the initial selection of personnel. The other composites serve as the basis for assignment of personnel to particular jobs or training slots. A minimum qualifying score on one of the aptitude area composites is required for admission to the Army initial level training courses" (Ref. 27, P.2). For instance, the Surveillance/Communications (SC) composite is composed of the following subtests: Verbal Ability (a combination of word knowledge and paragraph comprehension), Arithmetic Reasoning, Automotive-Shop Skill, and Mechanical Comprehension). SC is used to classify recruits into the MOS 13T, Remotely Piloted Vehicle (RPV) Operator. To be considered eligible for that MOS, a recruit must score at least 105 in the SC area. The Area Composite score, as well as the scores obtained on a criterion performance, are necessary to assess the relation of the soldier's aptitude to system performance. These

scores are available in the soldiers' personnel record, and they are maintained at the Total Army Personnel Agency (TAPA). Scott (Ref. 38) has proposed a similar analytic technique for correlating soldier ASVAB scores with critical task performance.

The objective of these quantitative techniques is to provide a basis for relating the effect of soldier characteristics (particularly aptitude) to soldier performance and for measuring the impact of that performance on system effectiveness. What happens when deficiencies in test and evaluation or in the field are identified? Figure 4 presents a graph which portrays a 'performance gap' between the probability of a hit or kill (the curve labeled E-sub-D) of a given weapon system as designed (or as the engineer claims that it will work) and the measured performance of the manned system (the E-sub-A curve) in the field (Ref. 10). Without the methodology proposed above, the Army could only speculate on the reasons for the performance gaps. With the methodology and

PERFORMANCE GAP



LEGEND:

$P_{H,K}$ = PROBABILITY OF HIT OR KILL

E_D = DESIGNED EFFECTIVENESS

E_A = ACHIEVED EFFECTIVENESS

(Original graph attributed to Army Materiel Systems Analysis Activity)

FIGURE 4.

the application of a solid planning effort to develop measures of soldier performance, instrumentation to measure that performance, and collection of data on soldiers' aptitude and other relevant characteristics, the causes of such performance gaps can be quantitatively diagnosed. Clearly, the advantages of such a methodology outweigh the modest costs associated with its use.

The analysis techniques proposed by Lowry and Seaver, and by Scott are useful in the context of quantitative analysis of soldier performance. What can be done if such data are not available or are incomplete? Are we reduced to mere speculation? The answer is that the quantitative validity of our analysis is indeed reduced; however, more can be done than outright speculation. Intelligent use of system documentation combined with intensive interviews with subject matter experts (SMEs) can provide a basis for developing issues regarding the performance adequacy of a manned system. Findings and recommendations can be derived from these issues that are both comprehensive and defensible. This qualitative approach cannot substitute for the quantitative methodology described above in terms of validity and precision, but it can provide useful information to skilled MANPRINT analysts. This handbook also provides guidelines for the application of qualitative assessment techniques for evaluation of the MANPRINT implications of Army systems. When quantitative soldier performance data are available, the analyst is wholeheartedly referred to the handbooks previously identified which describe quantitative soldier performance analysis methodology.

2.4 MANPRINT Rule of Thumb Two: Aptitude Plus Training = Skill (Figure 5)

The following questions should be taken into consideration in conducting the MPT analysis for a MANPRINT Assessment.

- What are the critical tasks to be performed in the job of interest?
- How much of what aptitudes (as measured by ASVAB scores, specific ASVAB composites, and the AFQT score) are needed to perform critical tasks to the minimum satisfactory level?
- To what extent are soldiers with those aptitudes presently represented in the MOS(s) planned for the system?
- What are the existing proficiency levels in each of the critical tasks in the job to be performed of soldiers with the required aptitudes?
- How much training (in terms of time and cost) is required to bring soldiers with those aptitudes to minimum proficiency? (The difference between this list and the preceding list defines how much more training is needed as well as which tasks require such training.)
- What is the sustainment training burden (in time and cost parameters) to maintain the minimum proficiency for the required tasks?

As expressed here, skill is the product of the interaction of aptitude and training. Aptitude consists of, "...enduring traits that are difficult or impossible to alter through cost-effective training". (Ref. 37, P.4)

RULE TWO

APTITUDE + TRAINING = SKILL

APTITUDE:

STABLE OVER TIME

TRAINING:

LENGTH AND COST CAN BE QUANTIFIED

SKILL:

NOT STABLE OVER TIME

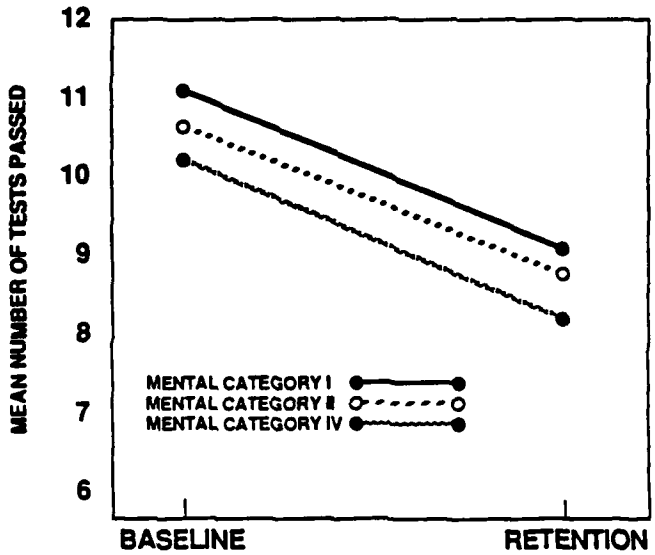
FIGURE 5.

Therefore, the traits which make up the quality called aptitude, are considered stable over time.

Training refers to a series of activities (e.g., verbal instructions, on-the-job practice) which enable soldiers to acquire skill in the tasks they must perform to accomplish Army missions. Training is most effectively evaluated on two dimensions: (1) completeness ("Did it cover everything it was supposed to?") and (2) sufficiency ("Could the soldiers perform all tasks to criterion when the training--including practice--was over?").

The term "skill" has at least two meanings in the Army environment: the specialization acquired by a soldier within a Military Occupational Specialty (MOS) (e.g., in RPV the 13TP9 (RPV Mechanic) is a specialization within the 13T (RPV Operator)), and the more common understanding of the term, "the ability to use one's knowledge effectively and readily in execution or performance" (Ref. 41). When "skill" is used in the sense of "proficiency," it becomes dependent upon: (a) the time to acquire mastery of critical tasks initially, (b) the time elapsed since tasks were last trained, and (c) the methods of training used. As a result, "skill" (in the sense of "proficiency") is considered unstable over time, due to proficiency decay as a function of time in the absence of practice. Skills decay at rates that can be quantified (Ref. 24). As shown in Figure 6, some skill decay rates tend to be similar for all aptitude categories. Therefore, at any given time "skill" is a function of the soldier's aptitude and the training he has received (Figure 7). In this sense "proficiency" of particular soldiers with known aptitudes and training can be measured at a specific time and place and then used to predict the level of performance which other soldiers with known aptitudes, training and practice can be expected to achieve.

LEARNING DECAY ACROSS APTITUDE GROUPS

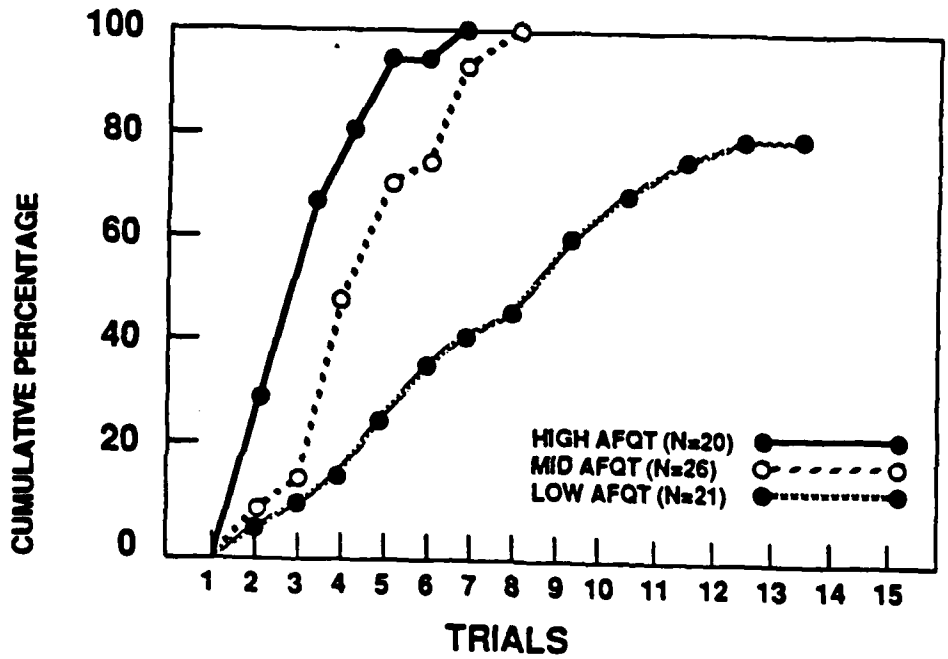


RETENTION OF 13 BCT TASKS AFTER 6 WEEKS

FIGURE 6.

COMPARISON OF TRAINING TIME REQUIRED ACROSS APTITUDE GROUPS

MISSILE TASK: CUMULATIVE PERCENTAGE OF SUBJECTS REACHING CRITERION PER TRIAL



FOR MISSILE TASK LOW APTITUDE GROUP REQUIRED:

- THREE TIMES MORE PROMPTS THAN MID-APTITUDE GROUP
- TWICE AS MANY TRIALS
- OVER TWICE THE TIME

FIGURE 7.

There is support in the literature (e.g., Ref. 40) for postulating a reliable interaction between aptitude and training: in general, higher aptitude soldiers require less skill attainment and skill sustainment training than do lower aptitude soldiers. The reverse is also true: a measured proficiency level can usually be raised either by raising the appropriate aptitude level or by increasing the training.

The relationship between aptitude level and the amount of training necessary to impart to soldiers the skills to achieve criterion performance is of great importance in the design of military equipment. Trade-offs among aptitude, training and performance are expected to be performed by equipment designers. Ideally, the most desirable situation for the Army would be to achieve the highest possible performance with the least amount of training of soldiers of lowest aptitude levels (Figure 8B). Where the designer fails to perform these trade-offs, the Army can be left in the situation requiring extensive training of high aptitude soldiers in order to obtain minimally acceptable performance (Figure 8C). It is, therefore, evident that the best opportunity to achieve the ideal balance among aptitude, training and performance is during earliest equipment design (Figure 8A).

Beyond basic training (BT), skills necessary for a soldier to operate, maintain, and support a system will be taught within a specific MOS. Because many Army MOSs allow for a wide range of soldier aptitude, the person performing the aptitude-training-performance trade-off needs to know the distribution of aptitude scores within the MOS(s) proposed for system operators and maintainers.

Figure 9 illustrates this idea. Step 1 shows that ASVAB composite scores across the soldier population of the Army are normally distributed. Step 2 shows that assignments of soldiers to a given MOS are made on the basis of a "cut score" (or minimum level of achievement on the ASVAB test). Thus, depending upon where on the normal distribution the cut score is set, a given MOS is likely to encompass a wide range of soldier aptitude. Step 3 illustrates the consequence of Step 2: Because higher-aptitude soldiers tend to be selected for leadership and other special positions in a unit, the soldiers who actually perform most frequently on the system (particularly maintenance tasks) tend to be those in the lower authorized aptitude range of the MOS. Therefore the MPT analyst needs to verify that performance data confirm that soldiers in the lower aptitude range authorized in each MOS can actually perform critical tasks correctly and in a timely manner given their successful completion of the proposed training course.

Although there are some recognized exceptions, it is generally accepted that the Army has greater latitude in adjusting the length and cost of system specific training than in raising the aptitude levels of its soldiers in a given MOS. This is why understanding the interaction of aptitude and training in producing minimum acceptable soldier performance is so important for the MPT analyst. Access to contractor's trade-off analyses on these subjects (most likely to be found in subparagraph 5 of DI-H-7056) is an invaluable aid to the MPT analysis for a MANPRINT Assessment.

EXAMPLE OF APTITUDE, TRAINING AND SOLDIER PERFORMANCE TRADE-OFF

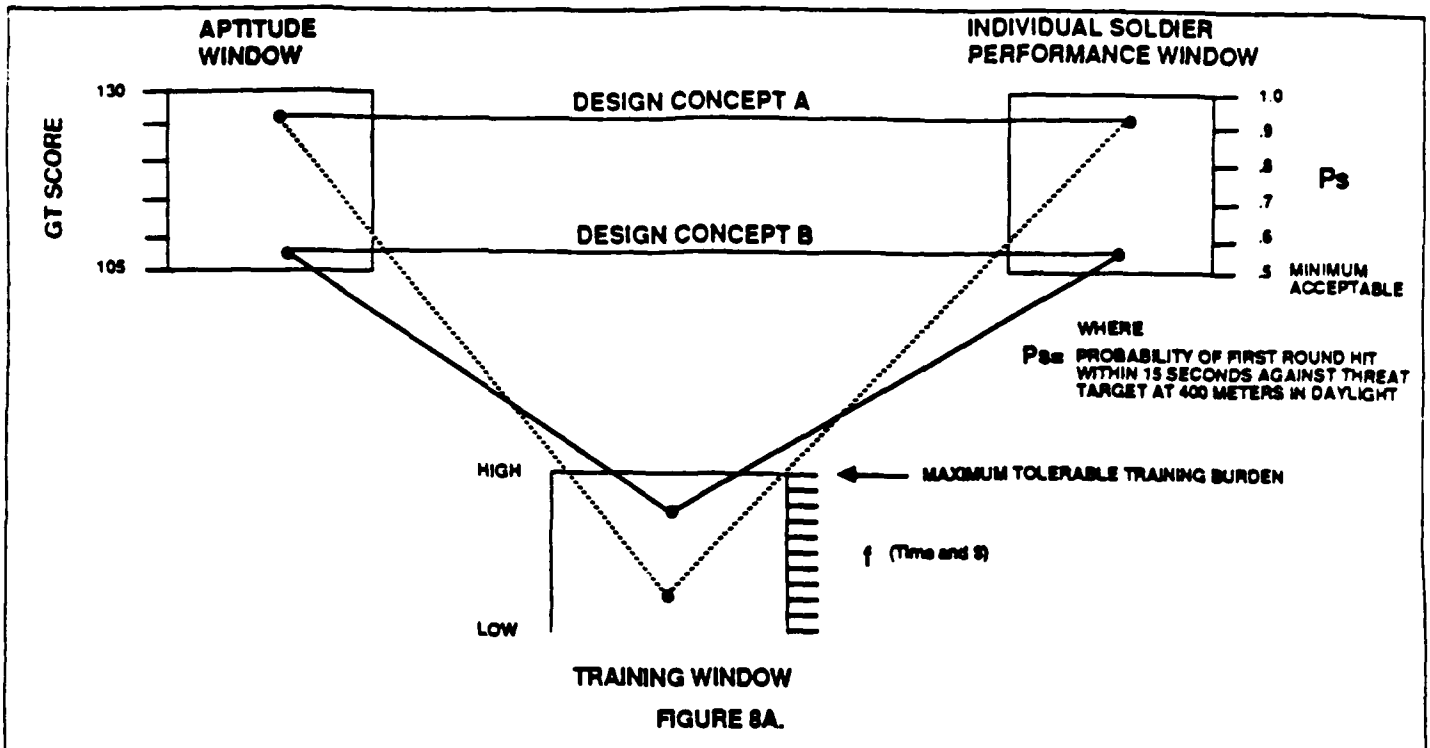


FIGURE 8A.

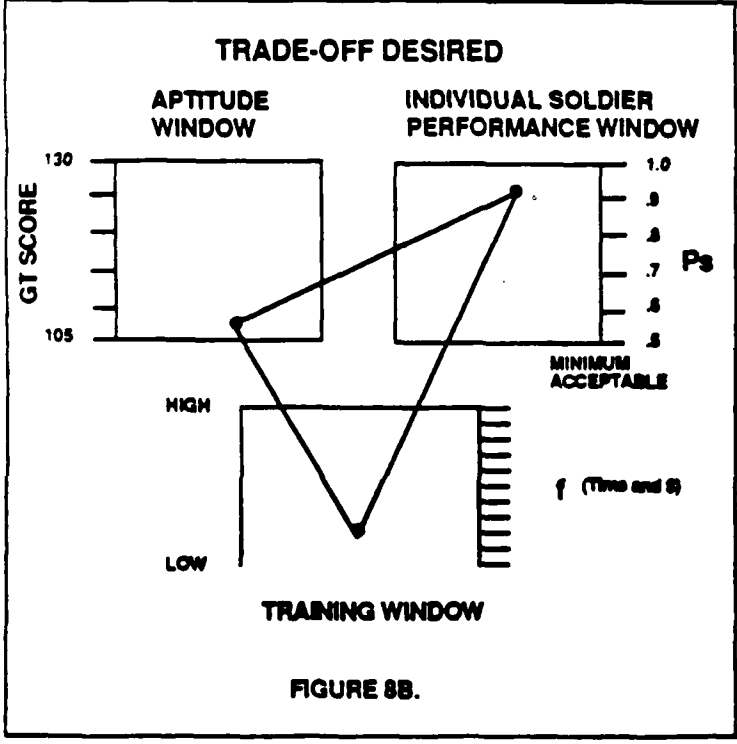


FIGURE 8B.

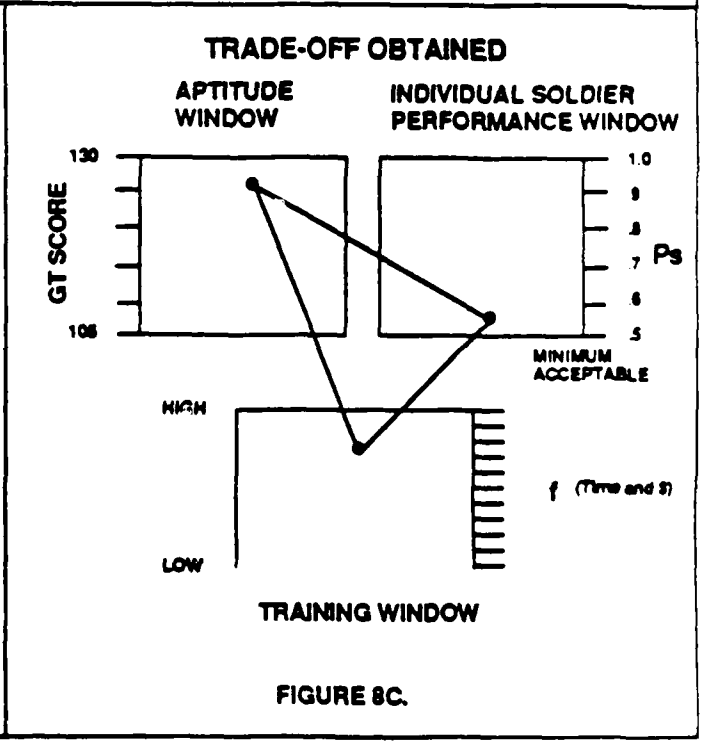
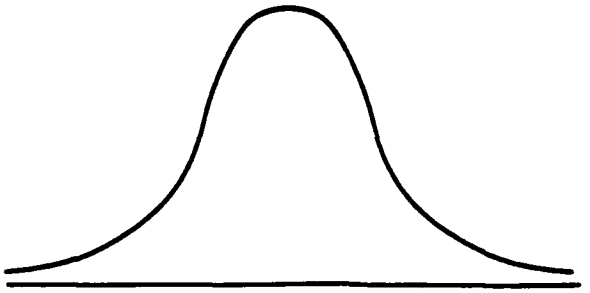


FIGURE 8C.

IMPORTANCE OF ASVAB SCORES IN SELECTION

WHERE'S THE PROBLEM?

Step 1



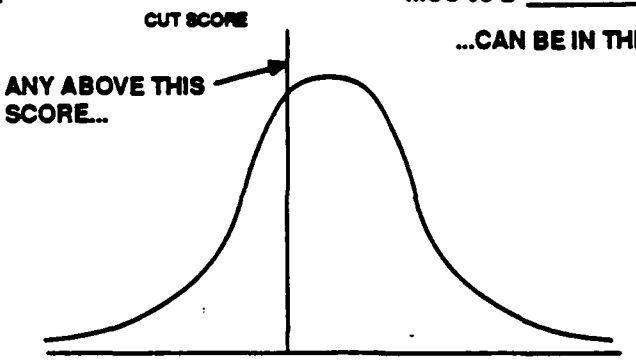
DISTRIBUTION OF SCORES
SPECIFIC ASVAB COMPOSITE

WHERE'S THE PROBLEM?

Step 2

MOS 68 B _____

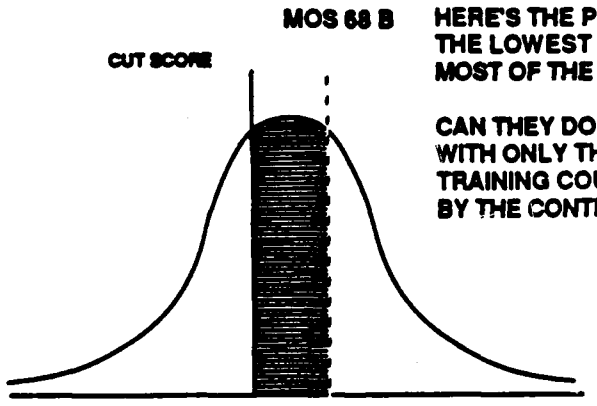
...CAN BE IN THIS MOS.



DISTRIBUTION OF SCORES
SPECIFIC ASVAB COMPOSITE

WHERE'S THE PROBLEM?

Step 3



HERE'S THE PROBLEM:
THE LOWEST 20% DO MOST OF THE WORK.

CAN THEY DO IT RIGHT WITH ONLY THE STANDARD TRAINING COURSE PROPOSED BY THE CONTRACTOR?

DISTRIBUTION OF SCORES
SPECIFIC ASVAB COMPOSITE

FIGURE 9.

The analysis of whether soldiers with the required aptitudes are recruitable may be less clear. At present, only general projections regarding trends in the recruitable population can be shown. Nonetheless, this is an important issue and should be considered by the MPT analyst in situations where performance data suggest there may be high aptitude requirements. This is a particularly critical concern in light of the competition from the other Armed Services and industry for high-aptitude individuals. A shortage of individuals 18 to 24 years old has been projected through the year 2000 (Ref. 34), and there is also speculation that the quality of the future military manpower pool may decline as well. (Ref. 36).

2.5 MANPRINT Rule of Thumb Three: Measure Soldier Performance by Time and Accuracy (Figure 10)

The following two questions are the heart of the MPT analysis for a MANPRINT Assessment:

- What are the soldier performance requirements (expressed in both time and accuracy dimensions) for the performance of critical operations and maintenance tasks?
- Do TT and UT test data show that the measured soldier performance meets the requirements?

FIGURE 10.

This MANPRINT rule of thumb refers to the collection of individual soldier performance data both in terms of the time it takes to complete critical tasks as well as the number of errors committed in the process (a measure of accuracy). This rule of thumb is an important consideration in developing any data collection plan. It allows the collection of data which will become crucial in clarifying the relationship between certain soldier characteristics (most importantly aptitude) and soldier performance. Data collected in this form permit the MPT analyst to make objective assessments of system effectiveness which would otherwise not be possible. Moreover, this rule of thumb recognizes that time and accuracy are linked measures of soldier performance; neither is fully interpretable without the other. (Consider, for example, what happens to the error rate when a person is told to go faster. Whether that person is a typist, pianist or rifleman, his accuracy is nearly always decreased.)

Figure 11 provides a graphic illustration of the value of quantitative time and accuracy data. Miles and Hazam (Ref. 32) maintain that the figure "...shows hypothetical test data points of time and accuracy for the prototype new system used by trained soldiers plotted against the original TRADOC performance requirements (assumed to have been a total system accuracy of .7 and an engagement time of not more than 65 seconds --as indicated by the heavy grid). Ideally, all data points would fall in the second quadrant (above minimum accuracy and below maximum time). However, in order to achieve that ideal,

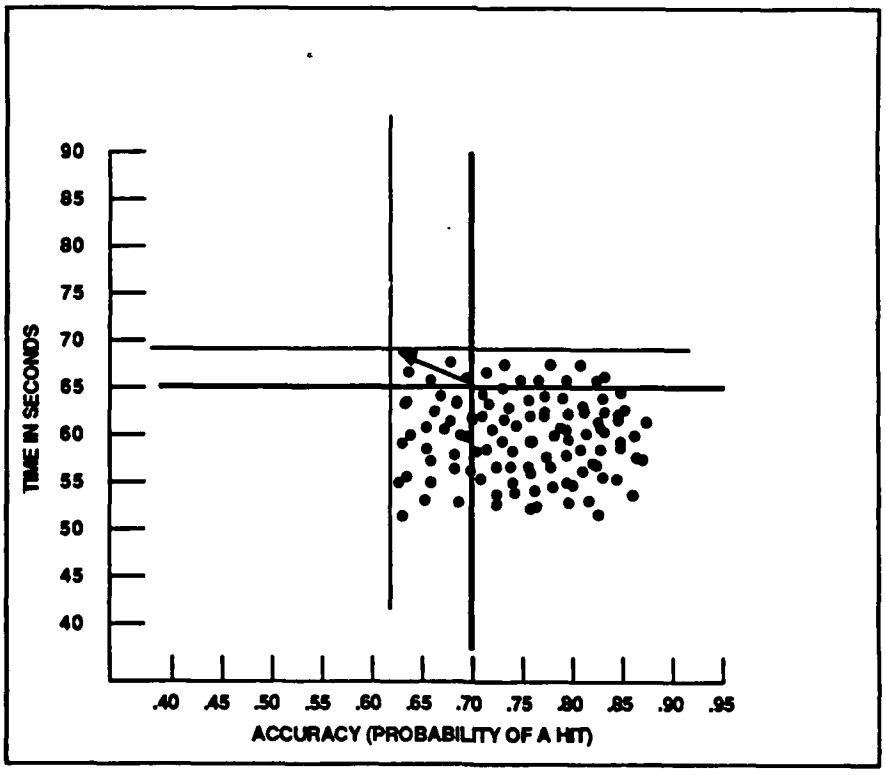


FIGURE 11.

the requirements must be reset (to the lesser accuracy of .62 and the greater time of 69 seconds--indicated by the lighter grid). The combat developer needs to reassess the source of the original requirements and determine whether the adjusted axes would provide militarily acceptable performance." (PP.45-46)

A range of approaches is presented in the Miles and Hazam article in order to achieve this new performance criteria, two of which are: raising the personnel selection criteria and increasing the training. In any case, the important point to make is that a quantitative analysis based on time and accuracy data is the optimal manner in which to produce definitive findings regarding the impact of the quality of soldier performance on system performance.

Certain measurement problems need to be avoided that are associated with measures of soldier performance. Among these are the following most crucial to the analysis, namely:

- test instrumentation should be as unobtrusive as possible (Ref. 42), in order to avoid contaminating the results obtained,
- time and accuracy measures should be based on performance standards specified for critical operations and maintenance tasks (para 2-8e, AR 602-2), and
- the sample size of test participants representative of the equipment users should be large enough to permit data analyses to have statistical power.

The guidelines presented above seem most relevant to quantitative analysis of soldier performance data. In fact, the representation of the relationship between soldier characteristics and soldier performance in terms of numbers makes it easier to understand such relationships. Furthermore, there are useful methodologies for analyzing such quantitative data (Ref. 26 & Ref. 37).

In spite of the obvious advantages of collecting quantitative data in the form suggested by this rule of thumb, the MPT analyst may find data whose value is questionable, or no data at all. The absence of quantified time and accuracy data on soldier performance of critical tasks does not prohibit the conduct of the performance portion of a MANPRINT Assessment. However, it places a heavy reliance on the skills of the MPT analyst to derive from anecdotal sources (i.e., SMEs and available documentation) the information that is needed in order to arrive at a fair assessment of soldier performance. Furthermore, it reduces the power of analyses of data which must, as a result, be mostly subjective. Qualitative data should be corroborated as much as possible by SMEs and/or through observations of the soldier operating and maintaining the equipment.

Even when the only data available are qualitative, questions of time and accuracy are of critical importance and are the criteria against which the system or equipment is judged. For instance, whether the MPT analyst is observing the soldier operating or maintaining the equipment, or interviewing SMEs about the contribution of soldier performance to system performance, questions on how well the soldier may be expected to accomplish critical tasks are answered in terms of the rate of errors committed or observed (a component of accuracy) and the time it might take a soldier to accomplish critical tasks. These are the questions to be asked regardless of the nature of the data or data source.

Analysis of qualitative data, although often requiring some creativity on the part of the MPT analyst, can be rendered more precise through the development of extensive documentation. This involves the use and maintenance of a logbook of contacts and statements made by SMEs regarding the contributions of soldier performance to system performance; the collection of reference documents from which to draw information regarding a system and its MPT implications; and frequent meetings of the MPT analysis team to trade information, exchange viewpoints and findings, and to develop a consensus on any issues identified. Consequently, it is important that the team be composed of MPT analysts that are both skilled in the collection and use of qualitative as well as quantitative data.

2.6 MANPRINT Rule of Thumb Four: Equipment Design Determines Soldier Tasks (Figure 12)

In the MPT analysis for a MANPRINT Assessment, the analyst needs to determine the following:

- What tasks are required to operate and maintain each item of equipment as designed?

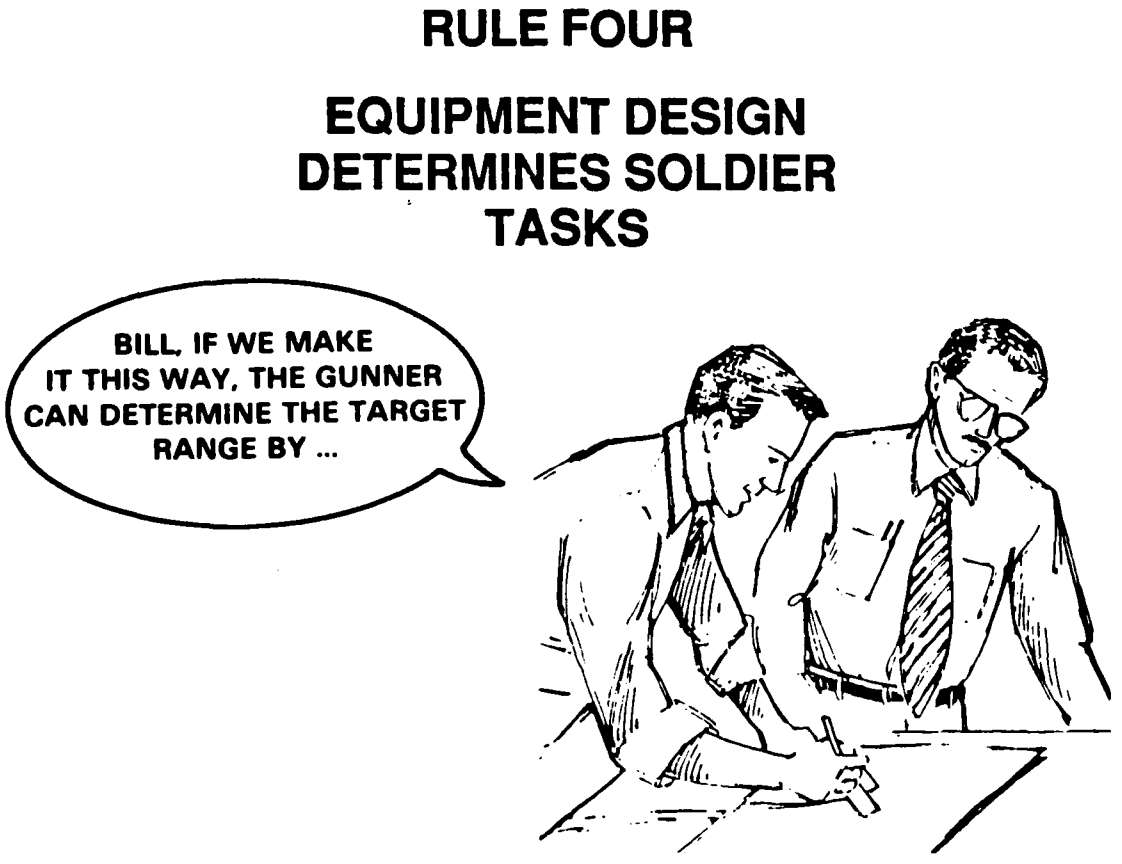


FIGURE 12.

- Does the design of any system hardware or software induce an unacceptable rate of soldier error?

- To what extent do procedures required by design, mission, or SOP's impact upon soldier tasks?

The essence of this rule of thumb is that the equipment (and software) designer has the power both to create and to eliminate soldier performance tasks. A "system" to perform a particular mission may, therefore, involve very simple equipment and software attended by numerous and highly-skilled operators, or highly automated equipment with few operators of much less skill. The starting place for the MPT analyst beginning his or her portion of the MANPRINT Assessment of a particular system is identifying the critical soldier performance tasks for operations and maintenance. Ideally this information will be found in the task analysis for the system.

Knowledge of equipment design and operation concepts are critical to interpreting the actions performed by operators and maintainers on the equipment. As Miller (Ref. 33), aptly stated:

> "Task analysis is both a rational and empirical method. It can be used in the absence of empirical data about job performance on the basis of the following rationale: The behavioral requirements of a man-machine task are given by the equipment itself in the form of (a) the displays from which the operator must make essential discriminations, (b) various response alternatives from which decisions by the operator select a course of action, and (c) the controls which must be activated in certain ways in order that the machine will produce the criterion output intended for it within the quality tolerances specified for it. More simply stated, the way the machine is built and has to be used determines what the operator has to do. (Emphasis supplied.) The study of the display-control characteristics of the machine into which the operator is fitted as a critical linkage or channel provides data from which behavioral requirements may be directly inferred. These inferences may remain defined by the job and task operations with a minimum of abstracting into general human traits or attributes." (P.4)

2.7 MANPRINT Rule of Thumb Five: Make the Designer Responsible for Soldier Performance (Figure 13)

In the MPT analysis for a MANPRINT Assessment, the analyst needs to determine the following:

- Did the government define and make available to the contractor appropriate MANPRINT design criteria (i.e., specifications of soldier aptitude constraints, tolerable training burden, and desired performance standards) in the System Specification; and did the SOW require the contractor to perform trade-off analyses to obtain the most cost-effective mix of soldier aptitude with institutional and unit training to achieve the minimum standard of manned system performance?

- Does the audit trail of deliverable documents (primarily data items) from the contractor show that soldier performance was examined and that MANPRINT design criteria in fact were used as system design constraints?

RULE FIVE

MAKE THE DESIGNER RESPONSIBLE FOR SOLDIER PERFORMANCE.

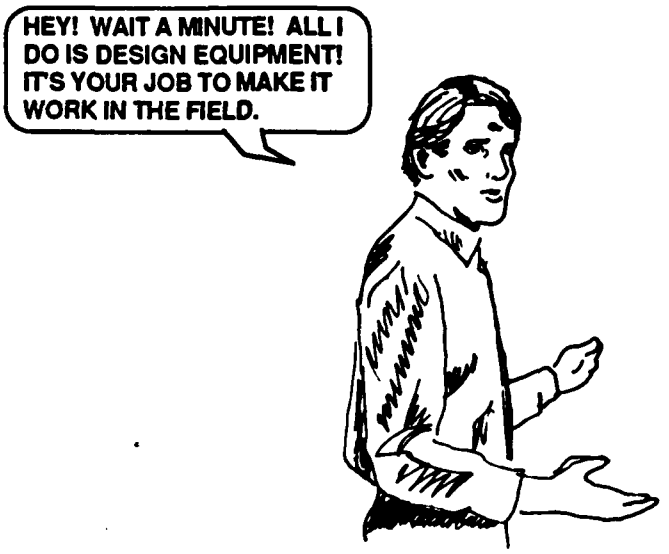


FIGURE 13.

Determining the answer to these questions requires an understanding of the implications of this rule of thumb.

We know from the fourth rule of thumb that the design of equipment (hardware, software, and procedures) determines the tasks performed by soldiers in operating and maintaining equipment. The inference that one draws from this is that the equipment designer is responsible for defining what soldiers do--whether or not he is aware of this fact. If the designer considers the characteristics of soldiers in his designs, then the resulting equipment should operate efficiently and thereby allow soldiers to accomplish required mission objectives within the time and accuracy limits specified. However, we know from experience that equipment designers do not always consider the requirements of soldiers in their designs. As Meister and Farr (Ref. 29), state:

"1. The designers whose behavior we investigated had little or no interest in human factors information or in the incorporation of human factors criteria in their designs."

"2. The degree of design analysis performed by these subjects" (the designers who participated in the Meister and Farr experiment) "is minimal and is at a molecular level which is hardly conducive to the application of human factors principles to design." (P.85)

In the discussion of these conclusions, Meister and Farr further state:

"The primary effort to ensure that human factors information and considerations will be utilized by designers should center on the design specification, as the one information source to which designers do respond." (P.86)

However, this activity should not amount to simply defining a blanket requirement for "meeting the requirements contained in the appropriate specifications". As Miles (Ref. 31), points out:

"The problem with 'meeting the spec' is that nobody asked whether 'the spec (or even the Scope of Work)' addressed those kinds of issues" (i.e., implementation of MANPRINT requirements into system development), "required the contractor to address them in the work breakdown structure, and promised to pay him for doing so." (P.4)

Unless the government (the customer) works to ensure compliance with even well-defined MANPRINT requirements, they still may not be fully implemented. Meister and Farr (Ref. 29) conclude that, "Putting more teeth into design specifications and insisting on the fulfillment of design requirements must depend on the willingness of the customer to be hard-nosed about these requirements." (P.86)

Test and evaluation is the mechanism by which the government verifies compliance with design requirements. This is also where MANPRINT requirements --in particular soldier performance criteria--are best verified. The third MANPRINT rule of thumb (Measure soldier performance in terms of time and accuracy) provides the quantitative means to verify the adequacy of soldier performance and adherence to MANPRINT design constraints for soldier capabilities and limitations. Paramount in this is the verification that soldiers with the aptitudes of the intended equipment users can achieve the specified performance standards (both time and accuracy) for operations and maintenance.

The MPT analyst preparing to review test and evaluation reports for the manned system should look for the ASVAB profiles of all test participants and some record of end-of-training proficiency. Where test records disclose only the social security numbers (SSNs) of military test participants, their ASVAB profiles may be obtained from either the Enlisted Master File at TAPA or the Defense Manpower Data Center). Berson and Crooks (Ref. 19), and Geddie (Ref. 23), both provide guidelines for the collection of test participant data on which to conduct analyses of the relationship of soldier characteristics to soldier performance.

2.8 Organizational Analysis

There is also a need to analyze the adequacy of manpower to operate, maintain, and support the system, and the organizations in which the system will be employed by the Army. As expressed earlier, equipment is fielded and employed in units (organizations of people and materiel) in the Army. Each unit has specific missions defined which are based upon its expected wartime employment and doctrinal concepts. The manning level or manpower allocated to the unit and the specific unit structure is intended to optimize accomplishment of those wartime missions. Further, manpower requirements are determined by the collective and individual tasks which must be performed to support mission accomplishment and the equipment on which the tasks must be performed. Hence, any analysis of manpower for a system must consider the organization in which the system is found, and manning in both quantitative and qualitative terms. To do any analysis on manpower and organization, it is first necessary to understand the process used to design a unit.

a. The basic document for any tactical organization or unit in the Army is the Table of Organization and Equipment (TOE). The TOE provides information on the mission, structure, and composition of units and describes in general terms the unit's capabilities, operational relationships, limitations, and operational doctrine. It also describes in detail the minimum essential personnel and equipment necessary to accomplish the stated wartime mission. The TOE is the first document the MPT analyst should review in any manpower and organization analysis.

b. While the TOE presents all equipment and manning for the unit, the MPT analyst also needs to be able to examine the manpower and organizational requirements driven specifically by the system in question. The documents that contain these requirements are the Basis of Issue Plan (BOIP) and the Qualitative and Quantitative Personnel Requirements Information (QQPRI). The BOIP states the total quantity of systems required by the Army; the number of systems to be fielded in each type unit; associated items of equipment by type and quantity; personnel needed to operate and maintain it by skill; training programs for required skills; and equipment displaced by the system. The QQPRI provides a detailed list of required, system-peculiar personnel by MOS, skill level, and duty position for each type unit where the system will be fielded or supported. These two documents are the basis for the TOE which reflects the organization in which the system will be employed. Manpower requirements to perform combat support (CS) and combat service support (CSS) functions (primarily maintenance and support) are developed using historical data from predecessor systems; engineering estimates for reliability, availability, and maintainability (RAM) of the new system; and the manpower requirements criteria (MARC) process as defined in Army Regulation 570-2 (Ref. 1). Manpower levels for combat functions are established by doctrine (e.g., an infantry squad is nine men; the crew of the M1 Tank is four men).

c. Validity of manpower for most workload-driven positions (CS & CSS) can be accomplished using the formula $R = (A \times B) / C$, where:

A = Productive man-hours required per work unit
B = Number of work units
C = Annual available productive man hours
R = Manpower requirement

As mentioned previously, data from predecessor systems and engineering estimates for RAM (A in the formula above) are used initially as a basis for manpower requirements. As the system matures and more definitive knowledge is gained on actual system performance through sample data collection or testing, the MARC formula can be used to determine if the projected manpower requirements remain valid. For example, suppose engineering estimates for a system indicated that the mean time to repair (MTTR) was X. After gathering sample data during the development process and testing the system in the field with user troops, it was determined that actual MTTR was Y. If Y > X, then it is obvious that more manpower than previously estimated will be required to support the system. It is very important that the MPT analyst review the RAM Rationale Report, test reports, and sample data collection efforts to determine if there are changes in system performance which may affect manpower requirements.

2.9 Conclusions

This chapter has presented a technical discussion of the theoretical basis for conducting the MPT analysis for a MANPRINT Assessment of Army materiel. It began with the description of an analytical framework for conducting the analysis, which contains the following question: "Can this soldier, in this organization, and with this training, perform these tasks to these standards, using this equipment?" The five MANPRINT rules of thumb for use in conducting MPT analyses for a MANPRINT Assessment were explained, and the chapter concluded with a short discussion of organizational analysis. This chapter provides the basis for understanding the guidance offered in subsequent chapters of this handbook and gives the logical framework within which the MPT analysis for a MANPRINT Assessment should be conducted.

CHAPTER 3.0
ADMINISTRATIVE AND TECHNICAL ACTIVITIES IN AN MPT ANALYSIS

Chapters Three to Seven will discuss the administrative and technical activities which support the theoretical underpinnings already presented in Chapter Two. Chapter Three opens with a flow chart showing an overview of the administrative and technical activities in an MPT analysis. These activities are subsumed under four major categories: 1) MPT analysis planning, 2) data collection, 3) data analysis and development of MPT issues, and 4) report preparation and briefing (see Figure 14). The activities in each of these headings are presented in sequence.

The major activities illustrated in Figure 14 will be discussed in greater detail in the subsequent chapters, and various sources of information required to carry them out will be described. Where relevant, examples from the three MPT analyses mentioned earlier will be used to clarify the points being made.

It should be pointed out that the depth of an MPT analysis is bounded by many factors, the most critical of which are the following: 1) absence of (or incomplete) data; 2) state of evolving doctrine, organizational structure, and tactics; and 3) time constraints to conduct the MPT analysis and complete the report. In fact, the timeframe for analyzing the three systems mentioned above varied from one week (for SOF MOD) to approximately three months (for RPV). In spite of these constraints, the MPT analysts must do their best to obtain quantitative data on individual soldier as well as manned system performance. Even small amounts of quantitative data might be amenable to useful statistical analyses or might clarify anecdotal reports. However, should quantitative data not be available within the time allotted for conducting the MPT analysis, one approach which lessens the detrimental effects is the extensive use of subject matter experts' (SMEs) judgments. SMEs can help the MPT analyst to interpret or clarify issues which otherwise might go unnoticed. For instance, during the MPT analysis of the RPV, the issue of the absence of leadership was one identified by a SME who was a retired Army officer. It should be noted that SMEs can also be members of the MPT analysis team. The best way of making optimal use of the available time is through thorough planning.

Experience with the three MPT analyses mentioned in this handbook points out four assumptions which should be expected to influence most MPT analyses. These assumptions are:

a. Expect a short timeframe to conduct the analyses.

b. Do not be dismayed by incomplete quantitative data. (Although analyzing adequate, objective, quantitative data should be a goal in every analysis, until development contracts require submission of MANPRINT performance data (as in DI-H-7058), it may simply be unavailable.)

c. Count on heavy dependence on SMEs to complement or clarify available quantitative data or as the only sources of (mostly anecdotal) data.

d. Expect to use the group consensus method to analyze subjective data.

MAJOR CATEGORIES OF MPT ISSUES DEVELOPMENT FOR A MANPRINT ASSESSMENT

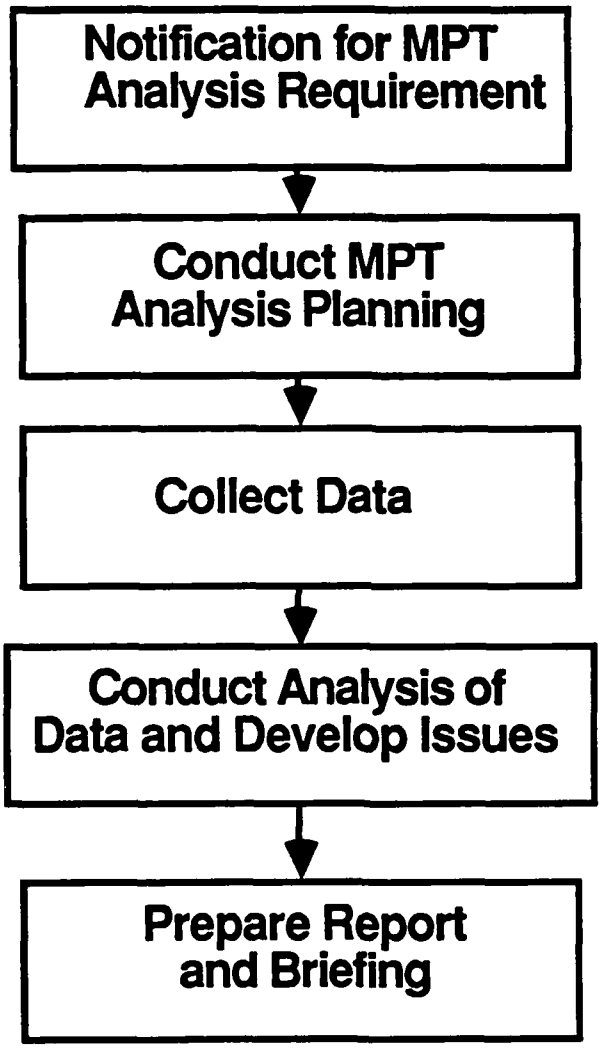


FIGURE 14.

These assumptions should be considered early in the MPT analysis planning, because they reveal what may be important constraints on the analysis. Also, planning the MPT analysis around what is evidently a worst case scenario has the major advantage of forcing efficiency in the process.

CHAPTER 4.0
MPT ANALYSIS PLANNING

Before beginning an MPT analysis, the MPT analyst should have adequately planned the various activities which will be required. Figure 15 illustrates the MPT activities which will be discussed in this chapter, as well as their logical sequence. Planning the MPT analysis is crucial, especially when the resources available to conduct such analyses (e.g., time, money, manpower) are limited. To understand how MPT planning fits within the framework of the MPT analysis, one must appreciate its five major components (shown in Figure 14) and their sequence. The first component is the notification that an MPT analysis is required to support the development of a MANPRINT Assessment for a specific system. The second component is the MPT analysis planning. The third component is the data collection stage. The fourth component is data analysis and development of MPT issues. The process is concluded with the fifth component, preparation of the MPT analysis report and briefing.

4.1 Overview of the MPT Analysis Planning

Although MPT Analysis Planning appears as only one component of the process, this component permeates all those which follow it. Of the five components discussed in this handbook, it contributes the most to the quality of the final product--particularly when time is short. Planning an MPT analysis entails the following steps: 1) deciding the composition of the MPT analysis team (i.e., number and expertise); 2) identifying the data needs (e.g., soldier performance data in operation and maintenance) and sources; and 3) determining the need for site visits.

4.2 Initial MPT Analysis Planning

Initial planning should consider such things as the categorization and classification of the system, the system's developmental status, fielding schedule, what system data are available, what resources may be needed for the analysis, and the criteria to be used in selecting the MPT analysis team. A factor which always effects planning is the amount of time available to complete the analysis. Since time available varies with the system, there is no hard and fast rule which can be applied. Completion of the MANPRINT Assessment is usually tied to a milestone decision point (ASARC), the date for which is subject to change based on the schedules of the participants. Needless to say, the less time one has to conduct the analysis, the more important planning becomes in order to insure that no time is wasted. The following paragraphs will address each of the factors which should be considered in planning the MPT analysis.

4.3 Notification of MPT Analysis Requirement

The proponent for the MANPRINT Assessment will notify the agencies responsible for the six MANPRINT domains of the requirement for their input to the assessment.

MPT Analysis Planning

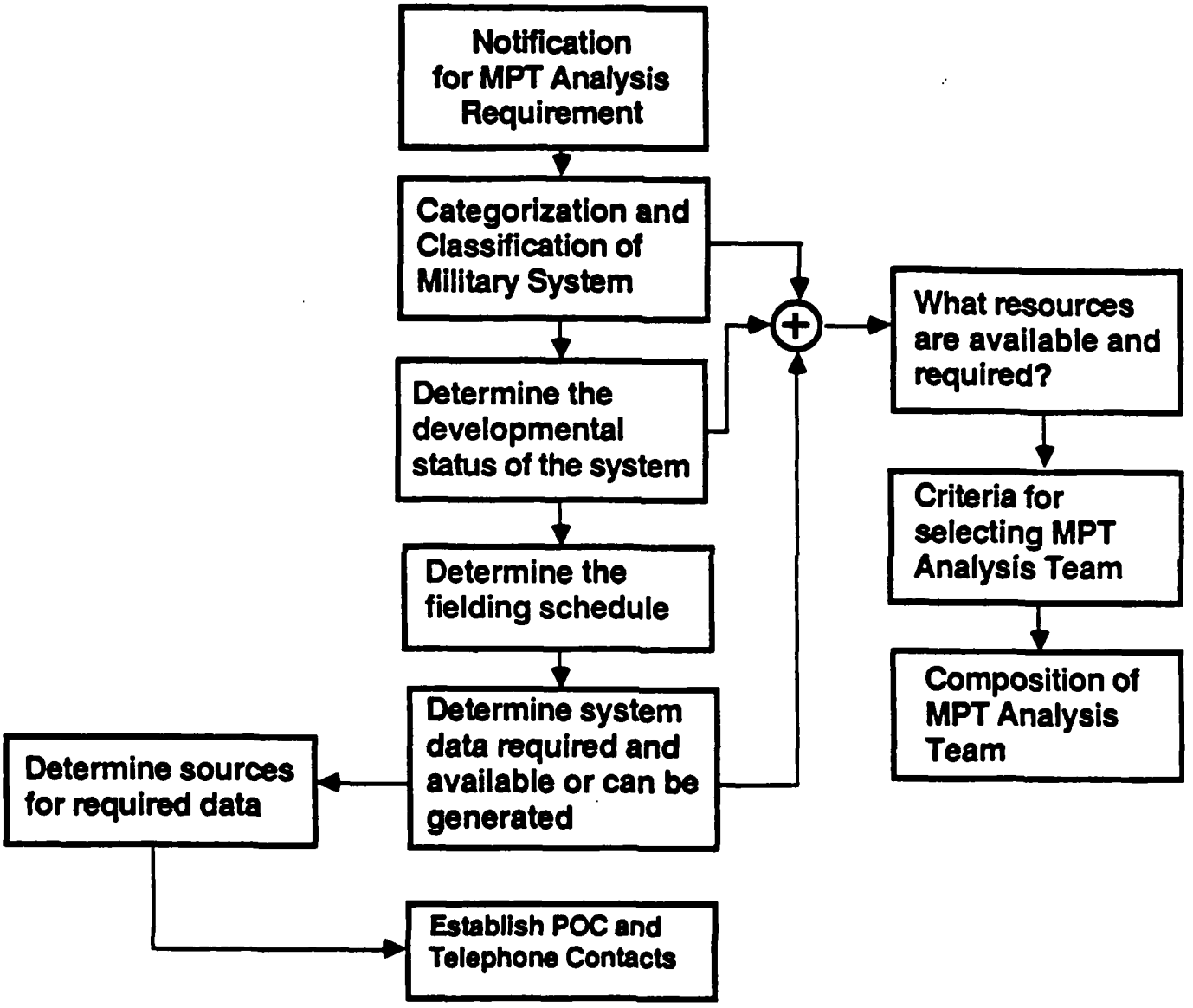


FIGURE 15.

4.4 Categorization and Classification of Military System

Categorization of the system is simply determining in which branch of the Army it will be used, such as Artillery, Armor, Infantry, etc., in order to know where to find information and data about the system. More importantly this will help to define the expertise and knowledge required to assemble the MPT analysis team. The commandants of the TRADOC schools are usually also the branch proponents. Therefore, if information about an Infantry system is needed, the team would go to the Infantry School at Fort Benning, GA. In some cases, more than one branch will be involved. Should this occur, the Integrating Centers for TRADOC--of which there are three--would normally assume the proponent role. In any case, the importance of categorization of the system is to know where to begin to look when establishing points of contact and identifying relevant documents.

Classification is performed to determine the specific type of system. Some system types will be obvious by their name, for example, M1 Tank, 155mm Howitzer, AH-1S Attack Helicopter. Those are (respectively): a tank which is associated with armor, a howitzer which is associated with artillery, and a helicopter which is associated with aviation. Other systems may not be so obvious--such as TACFIRE, GLLD, and RPV. These are all systems in the field artillery mission area, but they are not guns. The RPV is a Remotely Piloted Vehicle to be used by artillery units to locate and engage targets. TACFIRE is a data transfer system used to call for artillery fire and provide information on target location. GLLD is a Ground Locator Laser Designator used to provide ranging information and designation for precision guided munitions by the artillery forward observer. It is important to know what classification of system you are dealing with so that you can anticipate what kind of SMEs to look for during the analysis. It would also be very helpful to have someone on the MPT analysis team who has some background or experience with other systems in that classification. In fact, the success of the SOF MOD MPT analysis was in large part due to information on an organization similar to the one that will use the SOF MOD helicopters. Personnel from that organization possessed training and experience which provided valuable input for the projected SOF MOD training requirements. This resource might have been ignored were it not for the knowledge and expertise of one of the MPT analysts on the team.

4.5 Developmental Status of the System

Another important planning factor is to determine the developmental status of the system. The further along a system is in the life cycle, the more mature the system is and the more data ought to be available (both contractor and Government) on which to conduct the MPT analysis. Table 1 lists the sources of data which are expected to be available at different phases of the life cycle of the system.

4.6 Fielding Schedule for the System

The next step in the planning process is to determine the schedule under which the system is intended to be fielded. You will want to analyze this schedule to determine if it can be supported from an MPT resource point of view. For example, if planned courses of instruction do not begin early enough to provide sufficiently trained soldiers to operate and maintain the hardware, some adjustment to either the training plans or the fielding schedule must be made. You will also want to look at training device fielding schedules to determine if they will support the system fielding schedule and will be

Table 1

Documents Available at the Concept Exploration Phase, the Demonstration Phase, and the Full-Scale Development Phase

PHASES		
Concept Exploration	Demonstration	Full-Scale Development
CONTRACT	BOIP	ITP
CONTRACTOR TESTING	COEA	
MNS	CTEA	
HARDMAN	FC	
ECA	FM	
STRAP	IOTE	
O&O Plan	NETP	
RFP	QQPRI	
ROC	TC	
SMMP	TM	
TAD	TOE	
TECHNICAL TESTING		

- Although documents available in an earlier stage are also used at later stages, they are only mentioned once.

- A description of each document shown in this table is provided in Appendix B.

available to support any institutional training for which they are required. In addition to the training impacts the fielding schedule may have, there is also a possibility of impacts on manpower and personnel. Unless personnel of the requisite aptitude can be recruited in sufficient numbers and at the required rate to enter the training program, the expected system performance may never be achieved.

4.7 System Data Required and Available

Once the developmental status and fielding schedule of the system have been determined, a list of relevant supporting documents should be compiled and the documents obtained, usually from the authoring agency. For planning purposes, group the source documents into those which describe system requirements (JMSNS, ROC, O&O Plan, RFP, Contract); those which relate to manpower, personnel, and organizations (SMMP, TAD, QQPRI, BOIP, TOE); those which relate to training (STRAP, NETP, ITP, Soldier Training Products); test results (TT, IOTE, Contractor Testing); and related studies or analyses (COEA, CTEA, HARDMAN, ECA, PPT, IPT). Reviewing the source documents in this sequence will allow you to: 1) understand the concept and how the system is supposed to function on the battlefield; 2) know what kind of soldiers are planned to operate, maintain, and support the hardware in what organization and with what training; 3) determine the relationship of soldier performance to system performance (effectiveness and availability); and 4) use other studies and analyses to verify findings. Of particular importance will be the availability of individual soldier performance data. If such data do not exist, it is virtually impossible to relate soldier performance to system performance and to determine whether the soldier aptitude (projected in the TAD) is adequate to achieve the manned system performance goals. When documentation review is complete, a list of data requirements for the MPT analysis of the system can be developed. An example of such a list is shown in Table 2.

4.8 Resources Required and Available for the MPT Analysis

Resources can be expressed in terms of people, dollars, and time. For the most part, time will be established by the letter of notification. Be sure to allow sufficient time for staffing drafts of the report at the completion of the analysis. Time available will, to some extent, drive the MPT analysis team requirement in the sense that if little time is available, more people will usually be required to accomplish the task. However, it is desirable to keep team size as small as possible and still be able to conduct a thorough analysis. Interaction and constant exchanges of information are crucial to a good analysis effort, and this becomes harder to do if too many people are involved. The dollars required for the analysis will be primarily to support travel for the team. As a minimum, plan to visit the user representative, the Project Manager's office, the manufacturer, and the field site if testing is ongoing at the time of the analysis. If sufficient funds are not available for separate trips to each location, consider visiting all or most locations in a single trip, or splitting the team to cover two or more locations concurrently. (However, splitting the team geographically is the least desirable course of action.)

Table 2

Example of Data Requirements

NAVSTAR GPS MPT Data Requirements
(For both Army aircraft and manpack versions)

1. System Requirements

   a. System performance requirements, including effectiveness and availability criteria, RAM requirements and mission profile. (Suggested sources: LOA, ROC, O&O, other requirements documents).

   b. System design requirements. (Suggested source: SOW of RFP or current development contract.)

   c. Expected GPS equipment distribution and density in U.S. Army. (Suggested source: BOIP).

   d. Profile of expected GPS operators and maintainers in U.S. Army. (Suggested source: QQPRI).

   e. Training requirements or limitations established for U.S. Army personnel.

2. MPT Products in Support of System Design

   a. List of critical tasks for operations and maintenance.

   b. Identification of aptitudes required for operations and maintenance of GPS equipment (expressed in ASVAB scores).

   c. Training requirements analysis for operations and maintenance. New skills training requirements.

   d. Identification and description of training aids and devices.

   e. Identification and analysis of skill acquisition or skill maintenance problems.

   f. Cost and training effectiveness analysis.

   g. Copies of training and technical materials and manuals for operations and maintenance.

   h. Identification of physical requirements for GPS Army operators and maintainers.

3. System Performance Verification

   a. Manpower and personnel test issues and criteria. (Suggested sources: SMMP, TEMP, Prior OT and TT Reports.)

   b. Training and training device test issues and criteria.

   c. Performance data (expressed in measures of time and accuracy) for critical operations and maintenance tasks from representative user personnel. (Suggested source: DI-H-7058.)

   d. ASVAB profile of representative user personnel from whom performance data were obtained.

   e. Records of manpower, personnel and training issues and problems noted in prior tests of the GPS. (Suggested sources: SMMP, as well as other tests.)

4. Predecessor System Performance Data

   a. System description

   b. ASVAB profile(s) of equipment operators and maintainers.

   c. Training programs (POI, training aids and devices, training manuals).

   d. Performance data (expressed in measures of time and accuracy) for critical operations and maintenance tasks.

   e. Records of manpower, personnel and training issues and problems noted in system tests and assessments. (Suggested source: SMMP.)

4.9 Criteria for Selecting the MPT Analysis Team

The most obvious criterion to use for selecting team members is that individuals possess experience or background in one or more of the areas of manpower, personnel, and training. It's important that at least one individual on the team be able to speak with some authority on each technical area for the analysis to have credibility. It's also important to have at least one team member who is well rounded in all areas. This individual would provide a cohesiveness for the team and be able to recognize if there are relationships between issues in different areas. Another desired trait, although subtle, is tact. In the absence of empirical data on which to base the analysis, the MPT analyst must be able to draw a lot of information from interviews with SMEs. This requires a skilled and tactful interviewer in order to glean as much relevant information as possible.

4.10 Composition of the MPT Analysis Team

On the average, an MPT analysis team will consist of 3-5 individuals. It is possible but less desirable to perform the MPT analysis with fewer than three team members. However, with more than six, it becomes increasingly difficult to maintain the interaction and coordination necessary to conduct a good analysis. If the system is still in the very early developmental stages of the life cycle, there will be limited data sources available which means fewer people are required. Conversely, if the system is almost ready for fielding, there will be a large number of data sources which will require a larger team. Whatever the make up of the team, once it is established, each member should be assigned specific responsibilities in order to avoid duplication of effort. It is particularly important to assign at least one team member to each of the MPT areas. Additionally, it may be more efficient to assign responsibility for all travel arrangements to one team member while another would schedule and coordinate visits and interviews with SMEs. This will allow the team leader more time for management of the team's overall efforts.

4.11 Points of Contact (POC) and Subject Matter Experts (SMEs)

The last of the planning activities is to compile an initial list of individuals to interview. The first question is how to determine who these people are and where they are located. A handy approach for the identification of SMEs is to work by organization. At various headquarters level, contact, using the proper channels and procedures: the Weapon System Staff Manager (WSSM) at AMC, the TRADOC System Staff Officer (TRASSO) and, at Soldier Support Center, National Capital Region (SSC-NCR) the action officer providing the manpower and personnel expertise for the system. For the most part, all of these individuals should be able to provide a broad perspective of potential MPT and performance issues from a staff standpoint. For more detailed information, get lower down the chain of command and closer to the system. There are four other sources to look at to establish points of contact. These are: the Materiel Developer, primarily the Project Manager's Office; the Combat Developer, consisting of the proponent TRADOC school staff and the TRADOC System Manager's Office; the manufacturer; and other agencies which may have been involved in either testing or research on the system during its development (e.g., OTEA, TECOM, AMSAA, and ARI or HEL Field Units). Names and phone numbers for many of the above POCs can be found in the New Equipment Training Plan (NETP). An example list of points of contact is shown in Table 3. Other POCs or SMEs may exist of whom the MPT

analysts may not be aware; therefore, it is important always to ask an interviewee if he or she is aware of anyone else who should be contacted on the same subject. Extensive information can be gathered in this manner. Another important thing to remember is to maintain an audit trail on all interviews conducted. It is very easy to become confused about what was said by whom--especially after speaking to a large number of people several times each. Always start the interview by jotting down the date and time, the individual's name, grade or rank, title, office file symbol, mailing address, and phone number, followed by notes of the interview. This will make it much easier to go back and verify statements and resolve conflicts.

Table 3

EXAMPLE LIST OF POINTS OF CONTACT

FUNCTION	NAME	TITLE	OFF SYM	ADDRESS	AV PHONE	COML/FTS
TRASSO						
WSSM						
TSM						
PM						
Proponent School						
Testing Agency						

CHAPTER 5.0
DATA COLLECTION

Quantitative data should always be collected when available. The appropriate analysis and interpretation of such data may provide a much clearer understanding of a soldier or system performance issue which might otherwise go unnoticed. The collection of quantitative data provides an empirical basis for a precise assessment of the manpower, personnel and training issues underlying manned system performance and increases confidence in the conclusions drawn.

As mentioned in Chapter 3, even a little quantitative data is better than none. Even incomplete quantitative data can provide clues of trends whose interpretation might then be clarified by complementary qualitative data. Should the MPT analyst be unable to locate any quantitative data, he or she must then rely on the qualitative data available. Even when quantitative data are available, the collection of qualitative and anecdotal data can be helpful in interpreting the relationships among soldier performance and manpower, personnel, and training issues. This is especially true when there is no opportunity to observe the operation of the system. For instance, an issue regarding leadership in RPV operations could not have been derived solely from the clues that, during operational testing, the Remote Ground Terminal (RGT) generator had run out of fuel two or three times. Given that the MPT team was unable to observe the operation of the RPV system, it was the anecdotal data of SMEs who had observed RPV operations and had knowledge of that facet of the system which permitted identification of this issue. Nevertheless, all efforts should be made to gather or generate quantitative data whenever possible, while remaining sensitive to relevant qualitative data. In this section, the activities linked with data collection, as well as the source(s) and kind of data to be expected will be described. The relevant data collection activities as well as their logical sequence are illustrated in Figure 16.

5.1 Preparation for Site Visit(s)

Site visits can accomplish a number of goals. For instance, a test site can afford the MPT analyst the best opportunity to see the system and observe its operation. Hopefully, the system is being tested with the same type of soldiers who are planned to be its eventual users and whose aptitudes and training are the same as those assumed in the preliminary estimates of system effectiveness. In some cases, it may even be desirable (if the occasion arises) for the MPT analyst to operate the system. If the site is a school, the MPT analyst may be allowed to observe training of the soldiers who will eventually operate, maintain, and support the hardware. When the site visited is the contractor's facilities, the MPT analyst has a chance to speak to SMEs who have participated in the design of the hardware, software, training and training devices.

Before visiting any site, adequate preparation is necessary to take advantage of these opportunities and to make the best use of the available resources. The following are some of the most important activities in preparing for a site visit, in their recommended sequence:

a. Keep a log of MPT relevant activities. This includes not only written documents but also telephone interviews. Keeping a log will provide an audit trail and will simplify the task of documenting the MPT process should any of its aspects come under questioning later on. A log is extremely

important--especially in the absence of quantitative data--because the sources of data may be mostly conversations or brief observations. During the MPT analysis of the RPV, the need arose to identify some of the sources of the anecdotal data used as basis for the MPT issues. This task was easily accomplished, because a log of the critical events in the analysis had been kept.

b. Review system relevant documents. As soon as the MPT team is aware of the system which will be analyzed, the system relevant documents should be obtained and reviewed. The extent of the review will depend on the available time for the MPT analysis as well as the number of people on the team and the complexity of the system. A review of the system relevant documents will not only allow some familiarity with the system, but should also sensitize the MPT analyst to potential MPT issues which will guide his preparation (developing MPT questions) for the site visit. It is very important, while reviewing the various documents, to become aware of any inconsistencies among them concerning manpower, personnel and training requirements. (For instance, a discrepancy was discovered between the ROC and the TOE's crew requirements for SOF MOD.)

c. Identify individuals in charge at the site. In order to obtain information on the manpower, personnel, and training aspects of a system, the MPT team members should know to whom to address their requests. This saves time and maximizes the chance of obtaining the information needed, if it is available. Furthermore it avoids frictions which may occur by leaving out of the MPT analysis the input of individuals who may have unique information about the system. The MPT team should also identify those individuals (civilian and military) who are in control of access to the sites which may be visited.

d. Send visit request letters. As soon as the sites to be visited are identified, visit request letters should be sent. These letters should state the projected date and purpose of the visit (to obtain MPT and performance information about the system, interview SMEs, and review documents). Inquiries should also be made about the level of security clearance required at the site.

e. Send data requirements list. The data requirements list (Table 2) should be sent as soon as the MPT team members have identified the data needed to conduct the MPT analysis. The data requirements list can be sent with a visit request letter. The data requirements list should clearly delineate the data needed as well as the timeframe within which the team is operating. In addition to finding out what data are available at a site, the MPT analysis team should also find out whether such data require SMEs to interpret them. Should this be the case, arrangements should be made to discuss the data with SMEs during site visits.

Data Collection

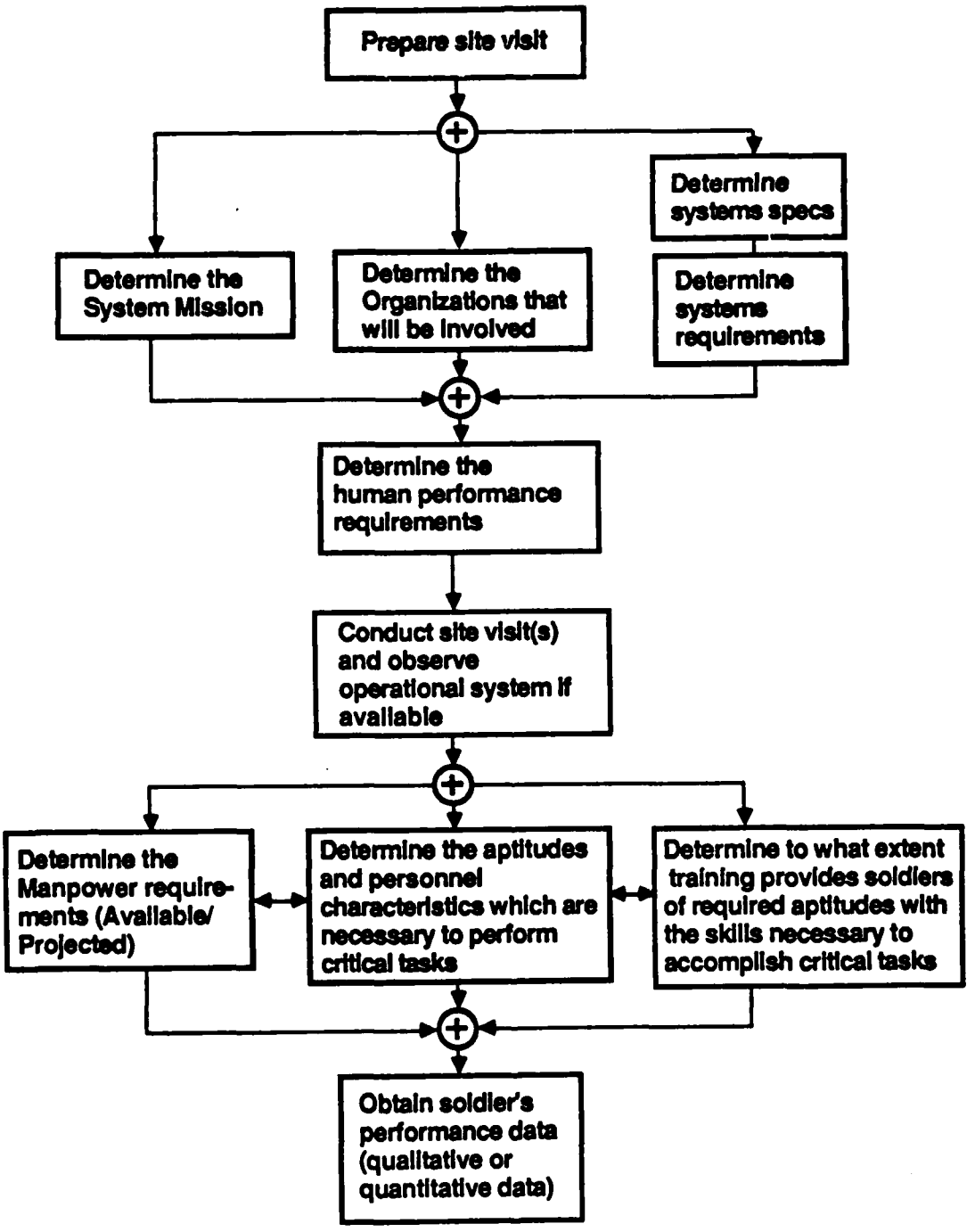


FIGURE 16.

f. Identify data voids. Once the MPT analysts know which data are available, they are in a better position to assess the data still needed. Given adequate time and resources, arrangements can sometimes be made to have such data collected. If that is not feasible, the impact of the missing data on assessment of system performance and MPT supportability needs to be clearly identified.

g. Set up interviews with SMEs. SMEs are normally a rich source of data in any MPT analysis. As was the case for all three MPT analyses mentioned earlier in this handbook, SMEs provided valuable anecdotal data enabling the MPT analysis team to identify manpower, personnel, and training issues. If the MPT analysts plan to interview SMEs at a specific site, they should make appointments with the SMEs for specific dates and times during their site visits. It is recommended that SMEs be identified early in the MPT analysis and that they be consulted from the beginning. This approach involves them very early in the MPT analysis, favoring the development of a certain level of ease between the SMEs and MPT analysts.

It is best to plan interviews of SMEs individually to avoid biasing an interview toward a particular SME, especially when one is more vocal or of a different rank than another. This not only permits an SME to voice his opinion with fewer constraints than he would have if he had to worry about judgment from colleagues, but also allows more effective corroboration of data. The MPT analyst should plan to use prepared questions on MPT issues as a guide for conducting the interview; this will ensure coverage of the areas and provide a basis upon which to expand if additional questions are necessary. The use of the prepared questions also conserves the analyst's time as well as that of the SME.

SMEs are valuable in providing information on the system, especially when the development program is in the early stages and documentation is incomplete or sketchy. For instance, during the MPT analysis of the SOF MOD, although two different helicopters were to be part of the program, we could locate no documentation addressing changes in manpower, personnel, and training requirements which might result from the modifications of these aircraft. Specialized knowledge of the MPT requirements in current special operations forces units on the part of SMEs in the MPT team helped to identify important MPT issues. The importance of SMEs in that process can be inferred from the following passage in the MPT report for SOF MOD:

> "A range of subject matter experts were interviewed for information related to the MPT implications of the SOF MOD program. ....They provided much information regarding the current evolution of the SOF MOD concept and requirements. The most significant information was obtained from the warrant officers regarding lessons learned from their previous experience. It was the interviews with the warrant officers that verified intuitive but undocumented issues identified by the HFEA [now MANPRINT Assessment] team on the MPT implications of the SOF MOD program." (Ref. 17, P.4)

h. Design MPT questionnaire. The MPT analysis team should develop questions which address the manpower, personnel, and training aspects of the system being evaluated. The questions are guided by the MPT analyst's understanding of the MPT issues based on clues gathered from initial reviews of the system relevant documents and conversations with SMEs. When very little information is available, the questions may be broad. More specificity can be

introduced during interviews as more information on the system becomes available. Examples of the MPT questionnaire developed for the RPV are shown in Table 4.

5.2 Structure of Data

Although the MPT analysis for each system will have its unique characteristics, there is a general structure common to all. This structure is explained in the following paragraphs.

5.3 Identification of System Mission

One must first determine the system's mission in order to assess whether its forecasted performance is achievable and its MPT requirements are supportable. A system's mission is a statement of what the system is to do (segmented in terms of identifiable beginning and end points), and the circumstances under which it is expected to accomplish that mission. For instance, the system mission for the RPV is, "The TADARS RPV system is to provide the ground commander real-time battlefield information by detecting, recognizing, identifying and locating stationary and moving enemy forces that are located beyond line-of-sight" (Ref. 14, P.3-1). Understanding the system mission provides the background against which MPT considerations are derived. Information on the system mission may be obtained from the following sources: ROC, O&O Plan, RFP, and the TOE. (See Chapter 4 for more details about these documents.) However, mere existence of these documents does not necessarily mean accessibility; the information they contain might be under various levels of classification (for instance in the MPT analysis for the Special Operations Forces Helicopter Modification (SOF MOD), the O&O Plan was classified). It is, therefore, important for the MPT team leader to know the security clearance required for access to these documents and either to possess the level of clearance necessary to review these documents or to select MPT team members who do. Depending on the time available for the MPT analysis, it may be necessary for analysts to plan a site visit in order to have access to the available documents (as was the case for SOF MOD), or to speak to individuals who are knowledgeable about the system mission. Such individuals and documents are most likely found at the TRADOC proponent school.

5.4 Identification of System Relevant Organizations

It is important to learn in what organization(s) the materiel will be fielded, and how it is to be manned within such organizations. The type of organizations which will be involved in the fielding of the system has a direct impact upon the manpower and personnel requirements of the system (e.g., which MOSs will be involved and the recruitment status of each). Organizations are divided into two levels: primary and secondary.

Table 4

EXAMPLES OF MPT QUESTIONS USED FOR ANALYSIS OF RPV

MANPOWER Questions

1. Is the proposed unit organization (DTOE) consistent with the operational concept?
2. Are personnel grade and skill level sufficient to support operations and maintenance?
3. Are sufficient personnel of the required mental aptitude available in the personnel pipeline?
4. Does the TOE reflect sufficient spaces to accomplish operations and maintenance tasks?
5. Are sufficient leadership positions designated to ensure proper operation?
6. Have the support and maintenance requirements been accounted for in the Corps Target Acquisition Bn? What are external support requirements from DIVARTY? Are they accounted for?
7. Do data exist to demonstrate the unit's capability to meet likely mission assignments under combat conditions?

PERSONNEL Questions

1. Were critical tasks identified for GCS operations (especially target acquisition/identification) and for central launch and recovery operations?
2. Are soldier performance data (time and accuracy) on critical RPV operations and maintenance tasks available on which to establish aptitude requirements?
3. Does the system have aptitude-sensitive critical tasks (especially GCS and CLRS tasks)?
4. To what extent can soldiers whose aptitude is at least 105 on the SC ASVAB composite perform critical operations and maintenance tasks ?
5. Was a HARDMAN study conducted for the RPV? If so, what were the conclusions?
6. Has a Target Audience Description (TAD) been established for RPV?
7. Was task analysis and/or soldier performance data used in establishing the TAD?
8. If not, on what basis has the TAD been justified?

TRAINING Questions

1. What are the critical tasks for operation and maintenance of the RPV?
2. How many of these tasks are planned for institutional training and how many for unit training?
3. Are training resources available to support the proposed training program?
4. What training devices are required to support the proposed training program? Will they be fielded concurrently with the RPV system? Can they be maintained?
5. Does the unit have the capability to conduct required training?
6. What constraints are placed on training at the institution? At the unit? (Training areas? Ranges? Air space?)
7. Will embedded training be utilized?
8. Are any skills especially perishable over time? Will embedded training support the sustainment of these skills (e.g, target acquisition/identification)?
9. What is the NET strategy? Will it support the fielding plan?
10. Is Instructor and Key Pers nel Training (IKPT) planned?
11. What is the reading grade level established for the technical manuals?

The primary level is the immediate unit where the materiel is employed (e.g., platoon, battery). It is necessary to identify the primary level of employment because it is at this level that the operators are located. It is also at the primary level of employment that unit level maintenance is performed. The identification of the primary level of employment also allows the analyst to know what TOE to study. The unit mission stated there should be examined for consistency with the mission of the system under analysis.

The secondary level comprises the intermediate and higher headquarters of units concerned with the employment of the system (e.g., battalion, brigade, etc.). Operators of the materiel will not generally be found at this level; however, this is where higher level maintenance and support to the primary level is located. An understanding of the allocation of maintenance and support to the primary level coupled with a knowledge of the mission allows the analyst to identify any discrepancies in MPT planning.

HARDMAN studies of a system may have disclosed that soldiers in several different MOSs in the Army currently perform tasks similar to those required by the new hardware. Where that is the case, the MPT analyst should review the justification for the choice of MOS(s) for the new system to determine whether one or more of those MOSs are currently listed as "short" or "surplus."

The organizational concept is the structure which links the manpower, personnel, training and mission considerations into a meaningful whole. Furthermore, understanding the relationship between the primary and secondary levels of organization allows the analyst to detect issues which impact on manpower, personnel and training. One such issue is leadership. For instance, during the MPT analysis of the RPV, leadership was identified as an indirect cause of the Remote Ground Terminal (RGT) Generator running out of fuel on several occasions during OT II and causing mission failure. That issue was reported as follows:

> "Analysis of the TOE for the RPV shows only two commissioned officers (battery commander and executive officer). All of the SMEs with whom we discussed "the leadership question" were unanimous in predicting that both of those officers would be too busy with other duties to influence the normal conduct of GCS operations." (Ref. 16, Append. F, P.12)

The mission failures referred to above could not be fully understood outside the context of the organization in which they occurred. In fact, the leadership issue was identified by two SMEs with military experience who were familiar with the organizational structure proposed for the RPV. This also points to the importance of interviewing SMEs who are knowledgeable about the organizations in which the system is to be deployed as well as studying such documents as the O&O Plan and the BOIP.

5.5 Identification of System's Performance Requirements

The system's performance requirements are based upon its mission. The major difference between the two is that the system mission is a general statement about the purpose to be accomplished, while the performance requirements are quantitative statements of performance the system must achieve to complete the mission. The following is a good.example of a system performance requirement:

"The design of the system will provide a soldier-machine interface (SMI) which allows the "ready" XM99, operated by soldiers identified in the Target Audience Description with no more skill attainment/sustainment training than described below, to engage a stationary threat system at 1/2 maximum range of the XM99 within 15 seconds after detection with 7 kilometer visibility in a benign countermeasures environment... The hit probability (Ph) for such an engagement shall be at least .87 when calculated by an equation/formula containing one or more specific terms describing the soldier performance of critical tasks." (Ref. 9, P.4-52).

System performance requirements establish a threshold of performance and thereby drive the system specifications. System performance requirements also have a direct impact upon soldier performance requirements by driving the standards of time and accuracy to be met. System performance requirements should be found in paragraph 5 of the ROC and also in the system specification portion of the RFP. Where they are lacking, SMEs should be used as much as possible to identify or derive system performance requirements.

Although the term "system" is often misused to refer to hardware alone, the more correct view includes consideration of soldier performance. No matter how sophisticated the hardware and software components of a system, the level of competence of the human operator will be a major factor in its performance (Ref. 39). Where the performance requirements of a system have been well thought-out, there will be an error budget (prepared by either the government or the contractor) allocating error to sources including soldier operators and maintainers. Where system testing has been competently done, data will exist showing the amount of soldier error introduced. However, until MANPRINT requirements and methodology are more widely understood in the R&D community, MPT analysts are likely to encounter more crudely written system performance requirements.

5.6 Identification of System Specification

The system specification is a document written largely in procurement terms, that is, in language so precise that objective verification is presumably possible. Its purpose is to give legal notice of the system performance requirements to offerors who might be interested in bidding on the system, to the system's "user" (normally TRADOC) which originated the performance requirements discussed above, and to the test and evaluation agencies which need to begin preparation for measuring the performance. System specifications will therefore normally be both longer and more detailed than statements of performance requirements found in TRADOC requirement documents. The system specification is usually a separate document attached to the RFP or contract (for a large system) or stated in Section C of an RFP or contract (for a smaller system).

Ideally, a system specification includes subparagraphs concerning soldier performance requirements (expressed in time and accuracy dimensions) as well as a statement (in the Target Audience Description) of the aptitudes of the soldiers who are planned to perform the operations, maintenance and support tasks, and the maximum tolerable training burden (for skill attainment and sustainment). (Where this information is missing from a system specification, the MPT analysis team may be able to create it by following the instructions in paragraph 3.2.4 of Ref. 5).

5.7 Identification of Human Performance Requirements

Usually the most critical portion of the MPT elements of a MANPRINT Assessment involve the issue of performance: determining what the soldiers in the system have to do, how well, and under what conditions. Ideally, at least the first part of this information exists in a task analysis prepared by the contractor as part of either his design effort or the beginning of his training development program. However, task analyses are seldom available; when available, they are rarely current. Section 5.11 (below) presents recommended procedures for developing the necessary data and then analyzing it.

An example of an issue involving human performance requirements occurred in the GPS. In that system, the Operational Mode Summary (OMS) proposed that essentially any soldier could use the MANPACK version successfully. However, one of the tasks required for successful operation of the hardware was "initialization," and members of the MPT analysis team were treated to a demonstration of how conceptually difficult this task was given the current state of software design. This issue appeared in the GPS final report as follows:

> "Because the operator of the MANPACK/Vehicular version of the GPS had been specified as a General Purpose User (GPU), anyone in the Army could be expected to use the receiver, including personnel who were classified by the Armed Forces Qualification Test (AFQT) as Category IIIB. The upcoming OT IIA was an opportunity to determine if such personnel could be trained to operate the equipment to criterion. If the testing showed that they could not (within acceptable limits on training resources), then the policy on users and training would need to be re-examined." (Ref. 15, P.6)

5.8 Identification of Manpower Requirements (Available/Projected)

As mentioned earlier (in Section 1.2), manpower refers to "spaces," more correctly titled "manpower authorization levels." The manpower inquiry is "...to determine the system's impact on Army manpower resources and to assure each system is optimized from a manpower viewpoint" (Ref. 4, P.G-2). The determination of manpower requirements entails finding out the number of soldiers and their MOS required to operate, maintain and support the system. Analysis of manpower requirements also involves consideration of the career progression of soldiers in those specific MOSs.

Many other organizations compete for the same shrinking pool of young people the Army is interested in, especially those in the high aptitude range. Therefore, unless manpower is considered at the conceptual level early in a system's acquisition, the possibility exists that the hardware can be developed and fielded without adequate numbers of the right quality of soldiers to operate, maintain, and support it.

To assess the manpower supportability of a system, the MPT analyst needs to know whether the number of soldiers planned to perform various critical tasks required by the hardware is sufficient to meet the system performance requirements. To do so, he must consult the TOE and the O&O to identify the number of soldiers by MOS projected to accomplish specific tasks within the timeframe specified in the Operational Mode Summary (OMS). Next, quantitative soldier performance data of critical tasks are needed to find out if the OMS performance prediction is realistic, given the number and MOSs of soldiers

planned. As is often the case, no quantitative data might exist for the system. In such cases, two alternatives may be available -

The first alternative is to extrapolate manpower supportability data from a similar system. This approach was used in the case of SOF MOD. Data on a unit which is similar to the organization proposed for SOF MOD suggested that the manpower requirements for SOF MOD were inadequate. The manpower issue identified in the SOF MOD report was -

> "...the proposed TOE reflects an MH-47E company with 35 pilots, 32 crewmembers, and 16 aircraft. Given the extended duration of the missions and the demands of the organization, this virtual one-man per one seat organization appears to be less than adequate." (Ref. 17, P.6)

The second alternative is to consult SMEs who are knowledgeable of the manpower requirements of the system. For RPV, no data existed to alert the MPT analysts of the inadequacy of the Launch/Recovery section for round-the-clock operations. This issue was pointed out by an SME, and, as developed, was -

> "...the launch and recovery operations of an RPV currently employ eight crewmembers. This manning level presents no problems for scenarios in which the RPV is capable of daylight operations only. However, if the FLIR technology (now under development) is added to the RPV's capabilities, round-the-clock operations will then be possible. Under such conditions, the commander would have the choice of dividing the CLRS personnel into two 12-hour shifts of four crewmembers each, reducing the number of flight missions, or simply working the men until they dropped (or the error rates became so high that all AVs were destroyed)." (Ref. 16, Append. F, P.12)

5.9 Identification of Aptitudes and Personnel Characteristics Necessary to Perform Critical Tasks

Personnel refers to consideration of the abilities and aptitudes of soldiers needed to operate, maintain and support the new system. These considerations also include the cost of recruiting and training individuals (who possess the aptitudes and abilities identified) over the life cycle of the system.

To determine the personnel characteristics necessary for operations, maintenance, and support, the following steps are necessary:

Step 1 Identify the critical tasks.

An enormous amount of human activity is required by most advanced military systems. To organize the description of that activity in an easily comprehensible form, MIL-H-46855, the Department of Defense military specification on human engineering (Ref. 13), provides a classification (called a "taxonomy") of human behavior from "job" (everything one human does in a system) through "task element" (the smallest unit of human performance). But the most common unit of human behavior is the "task". This is the unit which is common to the trainer, tester, designer, and logistician. A single system may require a large number of tasks from an individual crewmember. For efficiency and cost-effectiveness, MPT analysts customarily focus on that subset of tasks called "critical tasks." Although MIL-H-46855 contains (in subparagraph 6.2.1)

an official definition of critical task, the term is customarily assumed to mean the main parts of soldier performance related to the mission of the system. An interim Military Standard on Task Analysis (Ref. 12) may be a source of additional assistance. It describes in greater detail than in MIL-H-46855 what a task analysis report can and should provide.

At the conceptual level, critical tasks may be approximated through an Early Comparability Analysis (ECA), especially when a predecessor system exists. As the system matures, a critical task list may be available from either the prime system contractor or the TRADOC proponent school.

Step 2 Define the TAD.

The second step in assessing the aptitudes and personnel characteristics necessary to perform the critical tasks is to review the Target Audience Description (TAD). This document, produced by TRADOC, describes the range of individual qualifications on many cognitive, physical, psychomotor, as well as biographical and motivational dimensions. The TAD also describes how these characteristics are related to the soldier's ability to accomplish tasks associated with the operation, maintenance and support of the system being acquired. Particularly in complex or sophisticated weapon systems, the cognitive or mental ability of soldiers is the most important part of the TAD. Cognitive ability is measured by the soldier's scores on the ASVAB.

Step 3 Judge whether the soldiers in the TAD can perform the critical tasks.

To determine whether the soldiers can perform the assigned critical tasks to the standards specified in the TRADOC requirements document(s), the MPT analyst needs access to individual soldier performance data on those critical tasks. Once these data are available, the next step is to correlate the performance data with the ASVAB scores of each soldier from whom the performance data were collected. (That procedure is described in detail in Ref. 38.) The correlation coefficient obtained identifies the existence of aptitude-sensitive critical tasks. Ideally, there will be none.

Step 4 Ask SMEs to judge whether soldiers in the TAD can perform critical tasks.

When quantitative data are not available, the MPT analysts must make use of SMEs to evaluate whether the soldiers in a specific MOS can be expected to perform to standard the critical tasks in the operation, maintenance, and support of a system. Often anecdotal data from training and testing can be used to indicate existence of problem areas. For example, the operational testing of the RPV system failed to include either measures of individual soldier performance or analyses of such performance as a function of soldier aptitudes. But experienced SMEs had observed that certain system failures seemed to be associated with crew changes. Analysis of human performance requirements (particularly in the Ground Control Station) disclosed the need for highly complex cognitive performance in a stressful environment.

Step 5 Use the consensus method to determine the influence of soldier aptitude on performance of critical tasks.

In executing step 4, judgments should be obtained from as many SMEs as practicable, and each should be asked to provide examples to support his conclusions. For instance, in the MPT analysis for the NAVSTAR GPS, the

recommended MOS was purported to be the "general purpose user" (which means that soldiers of all aptitudes in all MOSs would be expected to operate the equipment). Yet, a review of the operator's manual of the MANPACK/Vehicular equipment revealed cognitively demanding soldier performance. This complexity was due to the large number of steps required for initialization, most of which had to be memorized by the soldier. In fact, completing initialization took 20 steps, setting the orientation involved 25 steps, and checking and entering magnetic variation and map datum required 16 steps.

Sometimes the TAD for a system is not defined. This is more likely when a system is in the conceptual stage of development (e.g., SOF MOD). When the TAD is absent, it may be estimated if one or more of the following conditions is met: 1) the critical tasks involved in operating, maintaining, and supporting the system are known, 2) a predecessor system with a defined TAD exists, or 3) similar tasks are found in other systems whose MOS is defined. As mentioned earlier, the MPT analysts should consult one another to arrive at a consensus upon the applicability of the criteria, and upon the aptitude range of a strawman TAD.

5.10 Determination of Training and Its Impact on Critical Soldier Tasks

In determining the adequacy of training, the MPT analyst must examine planning for both skill acquisition and retention. In the RPV it was found that target detection and identification were difficult skills to acquire and retain, yet the method selected for training them did not promote either their acquisition or retention.

Another consideration should be the plan for institutional training and unit training. This was a particularly critical issue in SOF MOD, where no plans were found for institutional training. Training has often been used as a band-aid for all kinds of performance problems. Although training is one of the most important elements in attaining system performance goals, it should not be expected that additional training will always completely compensate for poor equipment design or lack of aptitude on the part of the soldier.

In order to investigate the training issues in an MPT analysis, the MPT analysts must determine the following:

a. What are the soldier tasks?

To assess the efficacy of training, the MPT analyst needs to know:

1. the tasks to be performed by soldiers,
2. the performance standards established for these tasks, and
3. the types of soldiers who are to perform these tasks.[1]

b. What is the training plan?

After the soldier tasks and their performance standards are known, the analyst can evaluate how soldiers are to be trained to meet the task performance standards. This involves knowing the following:

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[1] This is a personnel concern whose influence upon performance must be understood if one is to understand the contribution of training to manned system performance.

1. length of initial and sustainment training,
2. whether primary training for each task will be in the institution or at the unit,
3. plans for refresher training (e.g., frequency and duration of refresher training), and
4. plans for Instructor and Key Personnel training (IKPT).

c. What training equipment/materials are used?

This includes knowing the following:

1. The training devices used (e.g., simulator, actual system, training aids)
2. The Technical Manuals (TM) used (e.g., Is TM's reading grade level appropriate for those soldiers for whom manuals were intended?).

These components of training address not only plans for the acquisition of skills, but also for skill retention.

The training issues identified in the three MPT analyses addressed the above components of training; for instance, one of the training issues identified for the SOF MOD specifically addressed the training plan; it read:

> "Both SOF Aviation ROCs reflect a requirement for all training (operator, maintainer, and supporter) to be conducted at unit level. This includes both initial qualification and sustainment training. There is no provision for hand-off of this training responsibility in the event of mobilization or deployment on a contingency mission. Either case would effectively remove the training base and interrupt the personnel replenishment pipeline." (Ref. 17, P.11)

One of the training issues in the analysis of the NAVSTAR GPS addressed the issue of length of training. The report stated:

> "...training problems were identified with the helicopter operators in the October 1984 operational assessment. A significant performance difference was demonstrated in those experienced UH-60 pilots who had previously received training on inertial navigation systems (doppler) and experienced pilots without that training. Data indicated that the initial level of training was directed at pilots with doppler experience and additional training was needed to bring the other pilots up to required performance levels." (Ref. 15, P.E-5)

One of the training issues in the RPV report addressed the training equipment/materials component of training. In that situation, anecdotal data suggested that the air vehicle operator, the mission payload operator, and the mission commander all experienced difficulty in performing target recognition and identification. These difficulties may have been directly related to the fact that visual materials used in training were unlike those experienced in operating the RPV and did not include a broad range of current hostile targets.

Information on the training requirements of the system may be obtained from the following documents: IKPT, ILSP, ITP, CTEA, NETP, STRAP, and the ROC (para 8C). (See MPT HFEA Planning for details.) Availability of these documents depends upon the developmental phase of the system.

Whether documents are available or not, the most current and complete training information can normally be obtained from SMEs in the TRADOC proponent school. The SMEs can often provide supplementary information not available in documents. Furthermore, they may help in the interpretation of information gathered from observations and from review of documents. The MPT analysts should then consider the training information obtained from their document reviews and from interviews of SMEs, and interpret the data (quantitative and/or anecdotal) in order to reach a consensus about the training issues that exist.

5.11 Soldier Performance Data (Quantitative and/or Qualitative)

This is one of the most important aspects of the data collection. Ideally, the MPT analyst would locate quantitative time and accuracy data on operator and maintainer performance of critical tasks. Depending on the developmental phase of the system, such data may or may not be available. In the Demonstration phase, results of technical tests (TT) and HARDMAN may be helpful if data were collected in terms of time and accuracy. Data from User Tests (UT), if available, should be closest to realistic system employment, since the UT tries to follow the OMS concept of operations, maintenance and support.

Another source of soldier performance data is the TRADOC proponent school. Training data may be available from that source in a format which would be convertible to dimensions of time and accuracy. With the data mentioned above, the MPT analyst must also obtain soldier aptitude data in terms of ASVAB scores.

The MPT analyst should primarily identify the party(ies) responsible for initial collection and evaluation of the relevant soldier performance data needed; he or she should ascertain the steps necessary to obtain such data, and should send a written request for those data. The letter should clearly state the MPT analyst's authority and identify the specific data needed. If a site visit is required for collection of these data, the letter should include the exact dates and extent of such visit. This is a very important aspect of the data collection phase. It may prevent delays in the data collection activities of the team and prevent misunderstandings among the persons involved--an occurrence which can jeopardize the whole analysis.

Following the collection of quantitative data, the relationship between aptitude and performance can be assessed using appropriate statistical analyses (Ref. 26 and Ref. 38).

It is, unfortunately, not always possible to obtain quantitative data; however, all is not lost under these conditions. As mentioned earlier, all three MPT analyses (NAVSTAR, SOF MOD and RPV) from which this handbook draws examples were devoid of quantitative data; yet some highly important MPT issues were identified. The absence of soldier performance data was specifically addressed in the RPV Report. An excerpt of this issue follows:

> "Even though the RPV development program antedates the Army's MANPRINT program by nearly a decade, we discovered some ten-year-old plans... which required exactly the sorts of data needed for the MPT analysis. One of those, AMSAA's "Test Design Plan for Development Test II of the Target Acquisition, Designation, and Aerial Reconnaissance System (TADARS)"... describes in clear, unequivocal terms the requirement for collecting soldier data... Unfortunately... these soldier performance test issues were somewhat reduced in the 1981 version of the test design plan... and totally deleted in the 1983 version... As a

consequence, the DT II test report contains no individual soldier performance data on which to conduct any quantitative analysis of soldier aptitude and training and their effect on soldier performance and RPV system effectiveness." (Ref. 16, Append. F, P.8)

Much qualitative/anecdotal data may be obtained from SMEs about the operation, maintenance, and support of the system. Such SMEs include the trainers at the proponent school, system users (operators, maintainers and support personnel), and TT and OT observers. SMEs may also be found in the contractor's office (e.g., engineering and training personnel). Although the absence of quantitative data decreases the influence of the MPT findings, important MPT issues may be identified if the MPT analyst does the necessary planning and SME interviews. One of the ways to increase the precision of the qualitative/anecdotal data available to the analyst is to construct a questionnaire in a manner which will allow some quantification of the answers. This technique permits a better comprehension of the responses gathered, similar responses to the same question (whether by SMEs or in documents), and corroboration for the concern being addressed. Even when quantitative data are available, the collection of qualitative/anecdotal data may help interpret the numbers one has. Another way to address the qualitative/anecdotal data is the group consensus approach mentioned earlier; it is a simple and effective method when little time is available for an MPT analysis. This method was used in the three MPT analyses which provided the illustrative material for this handbook. That method is described in greater detail in the next section.

The MPT analyst must be sensitive to the perception of his activities as potentially threatening to agencies and individuals involved with the materiel development program. (That is why following the protocol of contacting the proper authorities in explaining charter and data needs helps to diffuse some of the reticence which may exist between the MPT analyst and the organizations whose collaboration is needed to carry out the analysis.) Although these matters may be more in the realm of human relations than data collection, when ignored, they may jeopardize the whole data collection process.

CHAPTER 6.0
DATA ANALYSIS

The data analysis phase of an MPT analysis is divided into two parallel procedures. When quantitative individual soldier performance data are available, the MPT analyst should follow the procedures outlined in section 6.1 (see Figure 17). In the event that no quantitative individual soldier performance data are available, the MPT analyst should follow the procedures described in section 6.2. Figure 17 includes a flow chart of the steps to conduct data analysis when quantitative data are not available. In the event that an incomplete or partial data base of quantitative soldier performance data is available, a combination of both sections should be employed. This decision should be made on a case-by-case basis.

A major focus during the conduct of the three MPT analyses mentioned earlier was to attempt to apply quantitative analysis to relate soldier performance to system performance. Unfortunately, all three programs lacked adequate soldier performance data. Thus, this handbook can illustrate no specific examples of the quantitative data analysis which is so strongly recommended. The paragraphs which follow are a description of what can be done when the right data are available.

6.1 Development of MPT Issues, When Quantitative Individual Soldier Performance Data Are Available

Whenever quantitative individual soldier performance data are available, the opportunities for definitive evaluations of the MPT issues inherent to a system are increased dramatically. This is because all of the MANPRINT rules described earlier in Chapter 2 come fully into play. It becomes possible to relate the effects of soldier performance to achieved levels of system performance (MANPRINT Rule #1), because the quantitative tools--time and accuracy data (MANPRINT Rule 3)--are available. In addition, it is also possible to relate soldier characteristics (especially aptitude) to soldier performance on those critical tasks which impact most upon system performance achieved. This can be performed when ASVAB scores, training data, and soldier performance time and accuracy data are available. It is then possible to identify skill levels of soldiers by examining the relationship of soldier aptitude and training to soldier performance (MANPRINT Rule #2). Because we know that equipment design determines soldier tasks (MANPRINT Rule #4), we can determine the acceptability of proposed equipment designs by examining critical soldier tasks.[1] Quantitative measures of soldier performance on these critical tasks provide us the ability to focus our efforts on those tasks which most impact system performance. This results in an identification of those equipment design features which most tax the Army's MPT resources. Since we can trace the effects of soldier performance to specific equipment design features, we will have defined those areas in which the equipment designer should be held accountable. Through adherence to accepted practice in materiel procurement

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[1] This determination is limited in scope to MPT concerns (i.e., whether the equipment design creates too many or too complex soldier performance tasks for effective personnel and training support). A separate part of the MANPRINT Assessment addresses the concerns of human factors engineering.

Data Analysis

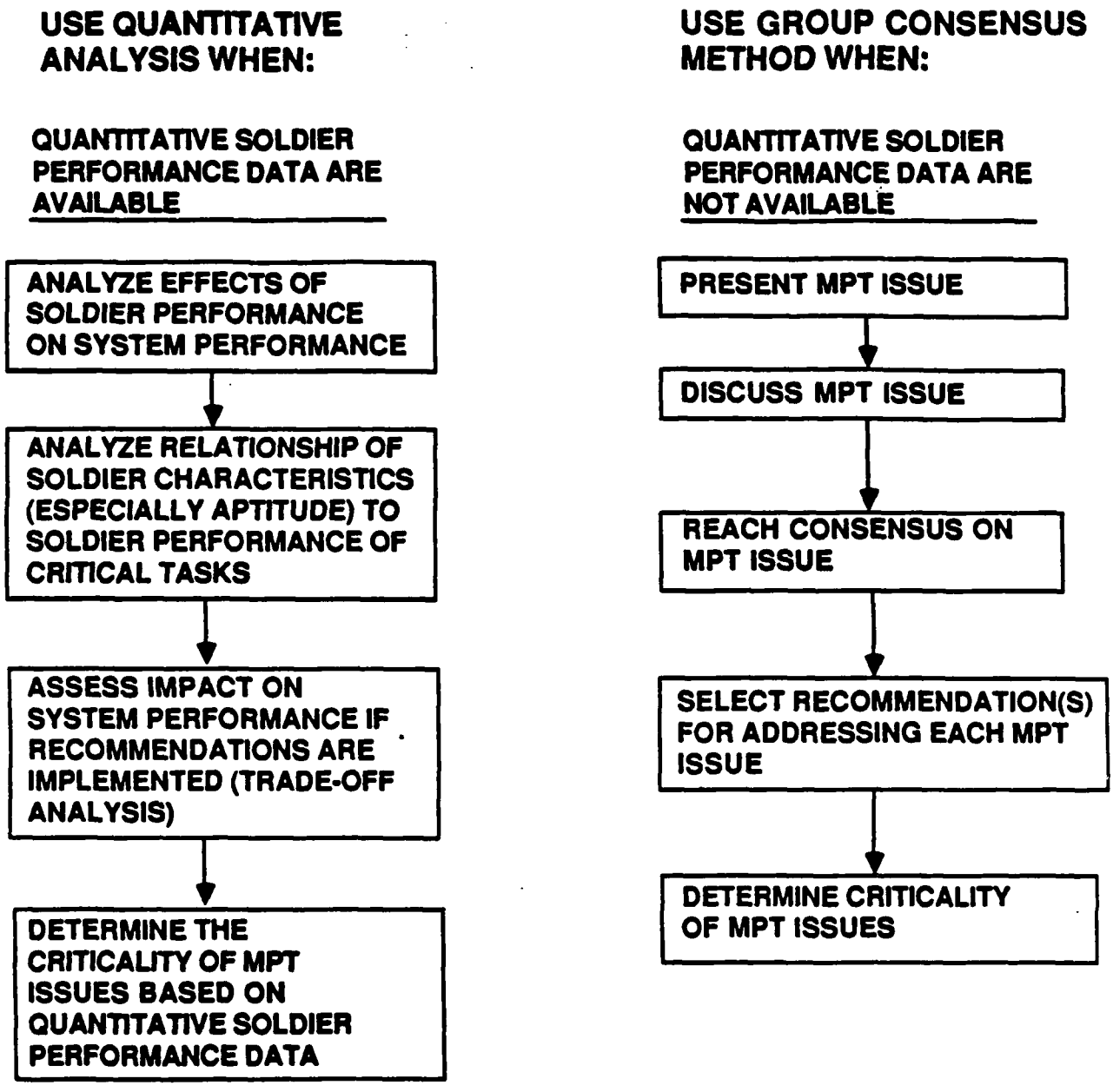

FIGURE 17.

and contracting, the Army can make the designer responsible for making design changes which will improve soldier performance (MANPRINT Rule #5). In summary, quantitative individual soldier performance data measured in terms of time and accuracy provide the basis for objectively determining how effectively a manned system works as well as pointing the way for making improvements--so that both soldier and system performance standards are achieved.

The paragraphs that follow summarize the steps to be followed when quantitative data are available upon which to develop MPT issues. Specific methodologies for accomplishing these steps are presented in Refs. 26 and 37.

- Analyze Effects of Soldier Performance on System Performance.

As described in Chapter 2 under MANPRINT Rule #1, Soldier Performance Affects System Performance, a significant part of the effort should be on identifying soldier performances of significance to system performance. This requires use of a manned system performance model for effectiveness and one for availability. Ref. 26 gives models reasonably easy to use and entirely appropriate for an MPT analysis in a MANPRINT Assessment.

The MPT analyst takes the time and accuracy soldier performance data and converts them (via a scattergram) into probabilities of satisfying the performance standards of time and accuracy. (For example, in a weapon system, each engagement has both a time and an accuracy--hit or miss--dimension. Those dimensions are scored either as a "1" (hit within the time limit) or a "0" (miss or hit after the time limit). The average of 0s and 1s for each test participant is calculated by range and other conditions. These averages (falling on the interval 0,1) become the inputs to the manned system model described in Ref 26. The result presents a complete picture of the performance of the manned system under a given set of conditions.

Use of these models can provide early warning of MPT problems while there is still time to make cost-effective changes to the system concept (which is really the point of doing the MANPRINT Analysis in the first place).

When these quantitative analyses have been conducted it is possible to relate the effects of soldier performance to system performance. In addition, it is possible to focus attention on any tasks which either take too long to perform or have high error rates associated with them (or both) and identify ways in which to improve soldier performance such that overall required system performance levels will be achieved in the field.

- Assess Impact on System Performance If Recommendations Are Implemented.

Ideally, the results of the previous activity will show that soldiers with the aptitudes of the projected operators and maintainers, and with no more skill attainment training than TRADOC can support, achieve or exceed the performance standards for all critical tasks. When the MPT analyst can legitimately reach that conclusion, he or she then prepares that good news for the MANPRINT Assessment. However, where performance problems are disclosed by the data, the next step is to determine what can be done to improve performance by conducting a series of statistical 'what if' analyses. The intent of these analyses is to project (within the bounds that the data will support) what would happen to soldier performance as a function of a change either in a soldier characteristic (such as aptitude) or in training.

For example, using regression analysis to project a rate of improvement in performance of critical maintenance tasks as a function of using progressively higher aptitude soldiers, the MPT analyst can identify a minimum aptitude level required to meet the task performance standards. This then can become the basis for establishing the new ASVAB cutoff score for system maintainers. (Raising aptitude levels is not an inexpensive solution to performance problems, however; see discussion in Ref. 32.)

- Determine the Criticality of MPT Issues Based on Quantitative Soldier Performance Data.

The MPT analysis for a MANPRINT Assessment cannot produce the improvements required to achieve required system performance levels. That task becomes the responsibility of others to implement. However, it is the responsibility of the MPT analyst to determine the criticality of each MPT issue identified and to provide this information in the form of recommendations. System performance data provide an ideal basis on which to establish the criticality of MPT issues. If, for example, system availability predictions are lower than desirable due to the effect of soldier performance, these data can be examined to determine the severity of the performance shortfalls. If it is determined to be significantly lower than desired, the MPT issue should be rated CRITICAL. This problem simply should not be allowed to progress beyond the current stage of acquisition unresolved. If, however, the performance levels achieved are only moderately below the levels desired (and especially if there also appear to be plausible alternatives for improving soldier performance without exceeding either the TRADOC maximum training burden (AR 602-2, para 2-8e) or raising the soldier aptitude requirements), then the MPT issue should be rated MAJOR. This deficiency should be attended to during the next stage of the acquisition. If the performance levels achieved are borderline, then the MPT issue should be rated OTHER. In summary, quantitative analysis of soldier and system performance provides an objective basis for establishing the criticality of MPT issues. No other basis can be more definitive.

6.2 Development of MPT Issues, When Quantitative Individual Soldier Performance Data Are Not Available

In the absence of quantitative evidence of MPT issues, the MPT analysis team falls back on a group process in which each member contributes his expertise to the derivation of MPT issues. The group hammers out a consensus as to the validity of each MPT issue, its form, substance, and recommendations for addressing it. This approach, labeled the Group Consensus Method, involves the systematic steps outlined in the sections below. While it is a poor substitute for quantitative analysis of soldier performance data, it was applied three times with reasonable success in the MPT analyses for the NAVSTAR GPS, SOF MOD, and RPV. It was especially useful for the short time frames under which these analyses occurred.

- Group Consensus Method for Deriving MPT Issues.

The Group Consensus Method uses the expert judgment of the MPT team members to analyze qualitative, anecdotal data gathered during the data collection phase. The three major steps involved in the group consensus methodology are:

a. Issue Presentation. Each team member independently presents his or her observations about potential MPT issues, based on interpretation of relevant documents, SME interviews, observation of the system, and personal knowledge, experience, and expertise in the area.

b. Group Discussion. Group discussion of each issue is initiated in order to clarify the issue, tie its justification to some data source (i.e., literature, interviews, personal knowledge), and devise arguments for and against its validity.

c. Group Consensus. An observation is justified as an issue when consensus is reached about its validity. In cases where consensus is not reached (e.g., split decision), the team leader makes the call.

The success of the Group Consensus Method is dependent upon close coordination and open discussion by the MPT analysts regarding the MPT issues. Experience in the three MPT analyses suggests that it is necessary to plan time for the team to meet at the end of each workday. This is especially true during site visits conducted in the data collection phase. These meetings are designed to allow team members to make maximum effective use of all of the day's activities and to develop the database from which group consensus can later be forged. This is necessary, since each MPT analyst may have interviewed different SMEs and had access to documents his colleagues have not seen. Under those conditions, each member would have information about only a part of the system.

During the data collection phase of the MPT analysis for the RPV, a number of incidents were cited by SMEs that had occurred during OT II for the RPV (which was underway at the time the MPT analysis team visited the test site). These incidents seemed to be occurring in spite of the training that the RPV operators had received in the two years prior to the OT for RPV. Operator errors were occurring in critical RPV tasks associated with: mission planning, air vehicle hand-off, target acquisition (especially target search tasks), and lost link operations. Procedures were prescribed for each of these operations, yet GCS operators were not consistently following them.

Other incidents (apparently unrelated to those in A/V flight operations) were identified by SMEs familiar with the ongoing OT. These incidents were occurring with sufficient frequency as to create concern among the SMEs. For instance, 30 KW generators ran out of fuel, causing interruption to the missions for over an hour each time it occurred. Although there is a generator mechanic assigned to the section whose job it is to service generators, he was not reminded of the necessity to refuel the equipment. These errors of omission (passive failures to perform a necessary task, as opposed to errors of commission which are active failures to perform critical tasks correctly) were considered by the SMEs to be errors which should not have occurred. In fact, they were labeled as cases of 'Murphy's Law.' The existence of these unexplained operator errors became a challenge for the MPT analysis team to explain.

In the wake of the discussion with SMEs on these incidents and their causes, various informal discussions occurred among the MPT team members to consider alternative explanations for the cause(s) of these apparently unrelated events. Random error was rejected as a cause on the basis of the systematic manner in which the operator errors occurred. Inadequate training of the GCS operators did not seem to be the cause. GCS operators simply were not

consistently following prescribed procedures on which most of them had been trained for over two years. Experience of GCS personnel did not seem to hold any clue as to the cause, since the same GCS personnel had been with the RPV unit since it was created. If they couldn't operate RPV without committing these errors, then no one could be expected to do so.

Members of the MPT analysis team began their own investigation into the causes of these operator errors. Once again, however, SMEs provided the first clue as to where to focus the investigation. Several SMEs stated that they felt that "if someone were in charge, these incidents might not have occurred: they (GCS personnel) have had an adequate amount of training and know what their jobs are." This clue led the MPT team members to an examination of the TOE for RPV. The organization of the RPV Battery (as shown in TOE 06417L000), reflected spaces for two commissioned officers, both at the battery headquarters (Battery Commander, CPT; Executive Officer, LT). Because the concept of operation (as defined in the O&O Plan) dictated that the battery commander and executive officer could not exercise specific operational leadership over each section, they depended on personnel assigned to the sections to exercise leadership for them. As a result, supervisory actions, normally thought to be routine, were not always performed as a matter of course. The incidents in which the generators ran out of fuel were examples. These incidents would probably have been avoided if it were part of the pre-mission planning a leader would normally accomplish. Further examination of the TOE revealed that each section was assigned a warrant officer RPV Technician (212A) and an E-7 Section Chief (13T40). These individuals appeared to be the logical candidates for assuming these responsibilities.

Following this activity, the MPT analysis team discussed leadership training for RPV personnel to determine the extent to which leadership tasks were identified and trained. The training programs for both the warrant officer and the E-7 were primarily technical in orientation and contained no emphasis on leader tasks associated with RPV operations. In fact, the Front End Analysis (FEA) for RPV training did not identify any specific leader tasks (according to SMEs familiar with RPV training).

The results of this investigation were presented and discussed in the MPT team sessions that occurred to develop a group consensus on the nature and definition of the MPT issue. During this group session, alternative explanations of the incidents that occurred during the OT were examined. Each was systematically rejected until a consensus was reached that the only appropriate explanation was the lack of leadership and supervisory tasks in GCS operations.

The derivation and wording of MPT issues follows directly from the results of the analyses carried out in the previous section. If links are found between manpower, personnel and training and deficiencies in system performance (e.g., an RPV mission fails when the generator runs out of fuel), an issue exists. The MPT analysts need to determine whether the evidence obtained from review of documents, interviews, and observation points to a specific MPT element or a combination of elements as being related to the performance shortcoming observed. Deriving the MPT issues will, therefore, depend upon the team's expertise in interpreting the anecdotal data related to the MPT elements, as well as the demonstrated relationship of these elements to performance.

It is appropriate to report an issue when it can be shown that the MPT element concerned has a direct or causal connection upon below-standard soldier or system performance. Justification of the MPT issue will require that the MPT analysts determine, using the Group Consensus Method, if the MPT elements derived are the most plausible explanations for the performance difficulty observed, based on the review of documents, interviews, and or observation.

- Select Recommendation(s) for Addressing Each MPT Issue.

In the course of identifying the MPT issues which are involved in a system, the MPT analyst should consider options that might be pursued in addressing each issue. In the case of the three MPT analyses cited in this handbook, those options amounted to recommendations for the conduct of further analyses to quantify whether or not the MPT issues identified from anecdotal data do in fact exist and how much impact they actually have on achieved system performance. For example, in the RPV leadership issue discussed in the previous section, it was recommended that analyses be conducted to determine the leader tasks which should be performed and to provide training to those personnel who should perform those tasks.

CHAPTER 7.0
REPORT WRITING AND BRIEFING

7.1 Development of MPT Sections and Transmission to Proponent

After the MPT issues have been identified and their criticality level assessed, the MPT report can then be written and briefing materials prepared (Figure 18). The report is the mechanism for conveying the MPT information for inclusion in the MANPRINT Assessment. Usually a Working Group is convened to prepare the MANPRINT Assessment report on a specific system. This Working Group has the task of integrating the reports of all six MANPRINT domains. The Assessment report strives for brevity and follows a prescribed format. Thus the MPT report must express MPT issues clearly, succinctly and as specifically as the data and analysis thereof will support. Discussion should be limited to that which will assist the working group in preparing the final MANPRINT Assessment report. The MPT report is transmitted by letter to the organization which requested the MPT analysis. The letter makes brief mention of some of the critical findings of the MPT analysis, and furnishes the name and phone number of the point of contact of the senior author.

The report itself opens with an Executive Summary. Although it is the first part of the report, it is easier to write it last, since the points to be summarized will have been developed. The Executive Summary identifies the system, gives a synopsis of the conduct of the MPT analysis and summarizes the conclusions and recommendations.

The Introduction is composed of three subsections:

1) Authority - describes the authority to conduct the MPT analysis.

2) Conduct of MPT Analysis - describes in broad terms how the MPT analysis was conducted and what opportunities and obstacles were encountered.

3) General Concept (of the system under analysis) - describes the nature of the system, its function, and the organizations which will use it.

The next major section on Data Sources and Limitations describes the major sources of data, such as documents (BOIP/QQPRI, Contract, Tech Manuals), personnel interviews, and/or observation. This section also reports on the data gaps found by the MPT team and assesses the impact of such gaps upon the MPT conclusions.

The most important sections of the report are the Manpower and Personnel Issues section, and the Training Issues section which contain the results of the MPT analysis. These sections are followed by the Conclusions and Recommendations section. The report would, of course, not be complete without a thorough reference section on the documents reviewed, as well as a section on all the personnel interviewed during the MPT evaluation. Preparation of these is greatly facilitated by a well maintained log of activities (e.g., persons interviewed, dates, organizational affiliations, and observations recorded at the time).

Report Writing and Briefing

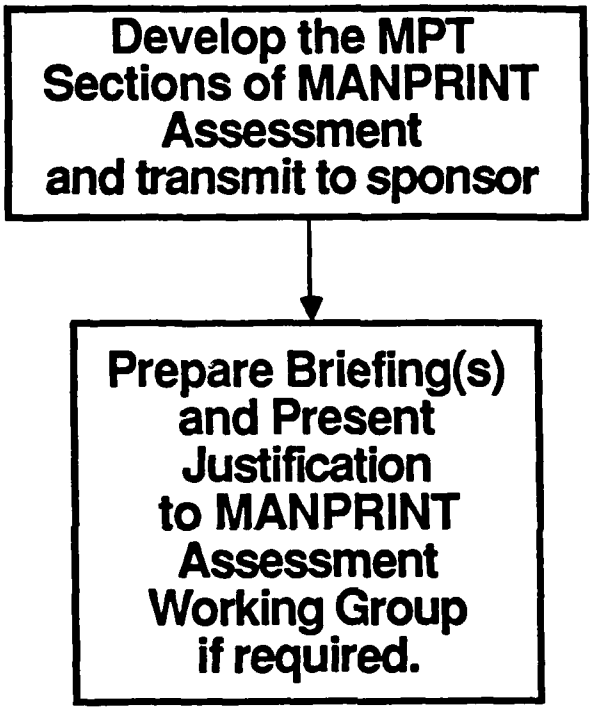

FIGURE 18.

A well-supported MPT report provides a clear trail as to how the MPT analysis was conducted, (an important point since the MPT analyst may not be present during the write-up of the final MANPRINT Assessment and must, therefore, produce a document which stands on its own). The report will also serve the same purpose for other organizations which may have questions about the procedures used in collecting the data or the validity of the findings.

Although the major sections described above might not always appear in the exact order described, addressing them is an important part of the writing of the MPT report. Appendix D presents a report format illustrated with examples from three different systems at different stages of development (e.g., SOF MOD at the conceptual stage, RPV at the production and fielding stage, and NAVSTAR GPS at the initial production stage).

7.2 Preparation of Briefing(s) and Presentation of Justifications to MANPRINT Assessment Working Group

This last step may not be required after the delivery of the MPT report. However, should the working group require a briefing, it will usually be necessary to develop viewgraphs based on the MPT report. This includes the documents reviewed, the personnel interviewed, the methodology for collecting the data, and the opportunities and limitations which had impact on the data collection (e.g., as in the case of RPV, in which the team was denied emerging test results; or, as in the case of SOF MOD, information was not available due to the classification and restricted distribution of the documents which contained it). The central element of the briefing should be the reporting of the manpower, personnel, and training issues and their justifications. Finally, recommendations as to the decision which should be made concerning the progress of the system to the next developmental stage. After the MANPRINT Assessment has been completed, MPT team members may be called upon to defend or explain the issues and recommendations to various decision or inquiry bodies. Therefore, a centralized location for notes and documents should be established and available to team members for some time after submission of the final MANPRINT Assessment.

CHAPTER 8.0
CONCLUSION

The preceding chapters presented an expert-based approach to conducting an MPT analysis. The methodology accommodates either the presence or absence of quantitative soldier performance data. The successful MPT analysis team should have expertise in the areas which are relevant to the system being analyzed. Such expertise should include: a) Army operations knowledge (e.g., organizations and doctrine), b) knowledge of MPT (human performance as well as quantitative data analysis), and c) skills in technical writing, oral presentation and group interaction.

The MANPRINT Analysis offers a significant opportunity to bring MPT issues to the attention of decision-makers at a time when cost-effective improvements can usually be made. The technology is in place to provide meaningful, quantitative data and interpretations of those data in terms of the likely battlefield effectiveness and availability of a new system.

APPENDIX A

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NOTE ON ORDERING PUBLICATIONS

a. Army employees should order Federal Agency, DOD and Army publications through official publications channels. All other personnel may request Federal Agency and DOD publications from Superintendent of Documents, Government Printing Office, Washington, DC 20402, and Army publications from Commander, Army AG Publications Center, 2800 Eastern Boulevard, Baltimore, MD 21220.

b. AMC publications should be requested from Hq, USA AMC, ATTN: AMCIM-SA, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001.

c. TRADOC publications should be requested from Hq, USA TRADOC, ATTN: ATCD-SP, Fort Monroe, VA 23651-5000.

d. Army Research Institute publications may be requested from Commander, U.S. Army Research Institute (ATTN: PERI-SM), 5001 Eisenhower Avenue, Alexandria, VA 22333-5600.

e. Human Engineering Laboratory publications may be requested from Director, Human Engineering Laboratory, ATTN: Technical Reports Office, Aberdeen Proving Ground, MD 21005-5001.

f. References 21, 24, 29, and 32 are articles that have appeared in professional journals and are available at most public and military libraries.

g. References 20, 30, 33, 36, 37, and 39 are available from the Defense Technical Information Center (DTIC), Building 5, Cameron Station, Alexandria, VA 22304-6145. DTIC is a general source (for government personnel and current contractors only) of reports that have completed the editorial and clearance processes.

h. Reference 31 is available through Automation Research System, Ltd. ATTN: MANPRINT PM, 4480 King Street, Alexandria, VA 22302.

i. Reference 41 is a published book that is available at most bookstores, at public or military libraries, or through the publishers.

j. If uncertain about how to obtain a particular document, consult "How to Get It - A Guide to Defense-Related Information Resources", published by the Institute for Defense Analysis and available from DTIC under AD Number A110000.

APPENDIX B

DEFINITION OF ACRONYMS

IN TABLE 1

DEFINITIONS OF ACRONYMS IN TABLE 1

- Concept Exploration Phase

Contract - The legally binding document between the government and the contractor completed after a proposal has been accepted. The contract will reflect all work to be accomplished by the contractor, to include MANPRINT requirements. A contract will normally be signed for each phase of the acquisition cycle.

Contractor Testing - Although primarily technically oriented, results of contractor testing can provide insights into the areas of personnel and training.

ECA - Early Comparability Analysis. A "lesson learned" approach to identify manpower, personnel, and training resource intensive tasks (high drivers) on current materiel that must be resolved in new or product-improved systems. By-products of the methodology are initial MPT constraints and inputs to the target audience description.

HARDMAN - Hardware versus Manpower. The HARDMAN methodology is a structured approach, using comparability analysis, to determine the manpower, personnel, and training (MPT) requirements of the system in the earliest phases of its development. Although the methodology can be applied during later phases of the materiel acquisition process, it is most effective during early development stages, the "front end" of the system's life.

MNS - Mission Need Statement. (Formerly JMSNS - Justification for Major System New Start.) The document which establishes the basic need and justification for starting development of a major new system. Program initiation depends upon MNS approval.

O&O Plan - Operational and Organizational Plan. Based on the Army's doctrinal concept for fighting the air-land battle, this document describes how the system will be employed and the organization which will support it. This is an important document to review as part of the analysis.

RFP - Request for Proposal. The document developed by the materiel developer based on the user needs which states the Government requirements for the system and invites industry to make a proposal. Of particular interest to the MPT Analyst are the MANPRINT requirements set forth in the Statement of Work (SOW) section of the RFP.

ROC - Required Operational Capability. The document which states the Army's requirements for the system, describes required system capabilities in broad bands of performance, threat to the system, RAM requirements, MANPRINT Requirements, Training Device Requirements, and expected cost for the system. The ROC is a TRADOC responsibility and is written by the proponent school or integrating center assisted by the materiel developer.

SMMP - System MANPRINT Management Plan. A living document that serves as a management guide and audit trail for issues, concerns, tasks, analyses, trade-offs, and decisions which have MANPRINT impact. The SMMP will be updated during the materiel acquisition process. The SMMP will be invaluable as a reference as it lists issues already identified and who is responsible to resolve them.

STRAP - System Training Plan. The master training management plan for a new system. It addresses who will be trained, what will be trained, and when, where, and how training will be conducted. It plans for all necessary training support, training products, and courses. It sets milestones to ensure the training strategy is fulfilled. The STRAP provides as means to identify and communicate training and resource requirements. These requirements may be inserted into the Planning, Programming, Budgeting and Execution System (PPBES) via the Training Requirements Analysis System (TRAS) IAW TRADOC Regulation 351-1.

TAD - Target Audience Description. This document describes both the quantity and quality of individuals who are expected to operate, maintain, and support the system. Qualifications will be listed on all relevant physical, mental, physiological, biographical and motivational dimensions. Soldier aptitudes will be stated by ASVAB score ranges.

Technical Testing - (Formally Developmental Testing or DT). Technical Testing is performed by the Government (usually TECOM). Results are published in a report which lists findings on test issues identified in the Test Design Plan.

- Demonstration - Validation Phase

BOIP - Basis of Issue Plan. This document lists the total quantity of systems required by the Army, the number of systems to be fielded to each type unit, associated items of equipment by type and quantity, personnel needed to operate and maintain it by skill, training programs for required skills, and equipment displaced by the system. The BOIP and the QQPRI form the basis for the Table of Organization and Equipment (TOE) which reflects the organization where the system will be employed.

COEA - Cost and Operational Effectiveness Analysis. The COEA is a comparison of hardware or system alternatives, usually via computer simulation using standard scenarios, used to determine which system provides the largest increase in force effectiveness for the least cost. Although of limited value to the MPT Analyst, the COEA can provide some insight to system performance (based on engineering estimates) which could prove helpful in determining the impact of soldier performance on system effectiveness.

CTEA - Cost and Training Effectiveness Analysis. The CTEA is a comparison of training alternatives used to determine the most effective means of training the soldier for the least cost. This document is a good reference for understanding the rationale behind the training strategy for the system.

Draft Publications. Draft versions of Field Manuals (FMs), Field Circulars (FCs), Training Circulars (TCs), and Technical Manuals (TMs) for both operators and maintainers should be available by this time.

IOTE - Initial Operational Test and Evaluation (formally Operational Test or OT II/III). Testing conducted by TRADOC or OTEA to determine if the system meets operational performance requirements when operated and maintained by the typical user soldier in field conditions. Results are published in a report which lists findings on test issues identified in the Test Design Plan.

NETP - New Equipment Training Plan. The NETP is a document published by the materiel developer which provides the most up-to-date information available concerning planned training for the system. The NETP is updated and published semi-annually. Tentative start dates for classes on each MOS, course length, class size, classes per year, names and phone numbers of POCs at each TRADOC school, and training scheduled for Instructors and Key Personnel are the types of information you can expect to find in the NETP.

QQPRI - Qualitative and Quantitative Personnel Requirements Information. The document provides a detailed list of required system specific personnel by MOS, skill level, and duty position for each type unit where the system will be fielded or supported. This document can be updated as changes occur.

TOE - Table of Organization and Equipment. The basic document for any tactical organization or unit in the Army. The TOE provides information on the structure and composition of units and describes in general terms the unit's mission, capabilities, operational relationships, limitations, and operational doctrine. It also describes in detail the minimum essential personnel and equipment necessary to accomplish the stated wartime mission.

- Full-Scale Development Phase

ITP - Individual Training Plan. The ITP consists of a set of documents which collectively constitute the TRADOC proponent school's plan to analyze, design, develop, implement, and evaluate an individual training program. The ITP addresses only one MOS, Area of concentration (AOC), or functional training program and looks at all of the systems that specialty or program supports. Documents included in the ITP are: Individual Training Plan Proposal (ITPP), Updated ITPP, Course Administrative Data (CAD), Annotated Task List (ATL), and Program of Instruction (POI).

Soldier Training Products. Training products which support sustainment training for the individual soldier. These include the Trainer's Guide, Soldier's Manual, and Job Book.

APPENDIX C

GLOSSARY OF ACRONYMS

GLOSSARY OF ACRONYMS

AA: Aptitude Area

AFQT: Armed Forces Qualification Test

AMC: Army Materiel Command

AMSAA: Army Materiel Systems Analysis Activity

AOC: Area of Concentration

AR: Army Regulation

ARI: Army Research Institute

ASARC: Army Systems Acquisition Review Council

ASAP: Army Streamlined Acquisition Process

ASA(RDA): Assistant Secretary of the Army for Research, Development and Acquisition

ASVAB: Armed Services Vocational Aptitude Battery

ATL: Annotated Task List

AV: Air Vehicle

AVO: Air Vehicle Operator

BT: Basic Training

Bn: Battalion

BOIP: Basis of Issue Plan

CAD: Course Administrative Data

CLRS: Central Launch and Recovery Section

COEA: Cost and Operational Effectiveness Analysis

CS: Combat Support

CSS: Combat Service Support

CTEA: Cost and Training Effectiveness Analysis

DA: Department of the Army

DASC: Department of the Army System Coordinator

DCOPS: Deputy Chief of Staff for Operations

DCSPER: Deputy Chief of Staff for Personnel

DIVARTY: Division Artillery

DOD: Department of Defense

DSARC: Defense Systems Acquisition Review Council (Obsolete term, see JRMB)

DT: Developmental Test

DTOE: Developmental Table of Organization and Equipment

ECA: Early Comparability Analysis

FC: Field Circular

FISO: Force Integration Staff Officer

FLIR: Forward Looking Infrared

FM: Field Manual

GCS: Ground Control Station

GLLD: Ground Laser Locator Designator

GPS: Global Positioning System

HARDMAN: Hardware vs Manpower

HEL: Human Engineering Laboratory

HFEA: Human Factors Engineering Analysis

IKPT: Instructor and Key Personnel Training

ILSP: Integrated Logistics Support Plan

IOTE: Initial Operational Test and Evaluation

ITP: Individual Training Plan

ITPP: Individual Training Plan Proposal

JMSNS: Justification for Major System New Start (Obsolete term, see MNS)

JRMB: Joint Requirements and Management Board

LCSMM: Life Cycle System Management Model

LOA: Letter of Agreement (Obsolete term, see LR)

LOS: Line of Sight

LR: Letter Requirement

(GLOSSARY continued)

MACOM: Major Army Command

MANPRINT: Manpower and Personnel Integration

MARC: Manpower Requirements Criteria

MNS: Mission Need Statement (formerly JMSNS)

MOS: Military Occupational Speciality

MP/V MANPACK/Vehicular

MPO Mission Payload Operator

MPT: Manpower, Personnel and Training

MTTR: Mean Time to Repair

NAVSTAR: Navigation Timing and Ranging

NDI: Nondevelopmental Item

NET: New Equipment Training

NETP: New Equipment Training Plan

OA: Operational Assessment

OMS: Operational Mode Summary

O&O Plan: Operational and Organizational Plan

OPM: Office of Personnel Management

OT: Operational Testing

OTEA: Operational Test and Evaluation Agency

PAM: Pamphlet

PERSSO: Personnel System Staff Officer

PM: Program/Project/Product Manager

POC: Point of Contact

POI: Program of Instruction

QQPRI: Qualitative and Quantitative Personnel Requirements Information

RAM: Reliability, Availability and Maintainability

RFP: Request for Proposal

(GLOSSARY continued)

RGT: Remote Ground Terminal

ROC: Required Operational Capability

RPV: Remotely Piloted Vehicle

SC: Surveillance and Communications

SME: Subject Matter Expert

SMMP: System MANPRINT Management Plan

SOF MOD: Special Operations Forces (Helicopter) Modification

SOW: Statement of Work

Spec: Specification

SSC-NCR: Soldier Support Center-National Capital Region

SSI: Specialty Skill Identifier (Changed to AOC)

SSN: Social Security Number

STRAP System Training Plan (formerly Individual and Collective Training Plan).

TACFIRE: Tactical Fire Direction System

TAD: Target Audience Description

TADARS: Target Acquisition/Designation and Aerial Reconnaissance System

TAPA: Total Army Personnel Agency (formerly Military Personnel Center).

TC: Training Circular or Type Classification

TECOM: Test and Evaluation Command

TM: Training Manual

TOE: Table of Organization and Equipment

TP: Training Plan

TRADOC: Training and Doctrine Command

TRASSO: TRADOC System Staff Officer

TSM: TRADOC System Manager

TT: Technical Test(ing)

(GLOSSARY continued)

UT: User Test(ing)

WSSM: Weapon System Staff Manager

APPENDIX D

MPT REPORT FORMAT

The purpose of this Appendix is to guide the reader in writing an MPT report. It provides a report format and examples from systems at three different stages of development. The SOF MOD represents a system at the conceptual stage, when only ideas (concepts) as to how the system is to be developed and what it is accomplish are addressed. The NAVSTAR GPS represents a system at the initial production phase, when an operational model of the system is developed in order to demonstrate its feasibility. Finally, the RPV exemplifies a system ready for full scale development, a system ready to be fielded. The examples are intended solely to illustrate the report format. They cannot be used verbatim or in a "boilerplate" fashion for two reasons. First, the examples are unique and specific to the system addressed. Second, they were applicable to that specific system at an earlier point in time. In this appendix the examples are enclosed by black lines thusly:

(Example)

FINAL REPORT

Evaluation of Manpower, Personnel and Training Sections
of the
MANPRINT Assessment
of the
(Materiel name)

Month, Year

EXECUTIVE SUMMARY

(Description) The executive summary briefly identifies the system and the acquisition phase or milestone for which the MANPRINT Assessment is being prepared. Include a short description of the nature and scope of the information on which the MPT analysis is based. The major portion of the Executive Summary summarizes the MPT issues and the recommendations under the headings of "Manpower and Personnel," and "Training." The Executive Summary rarely exceeds one page and never exceeds two pages.

(Example)

"The purpose of this analysis was to develop the manpower, personnel, and training (MPT) issues associated with the helicopter and MANPACK/Vehicular versions of the NAVSTAR Global Positioning System (GPS) and to report the findings to the Human Engineering Laboratory (HEL) for inclusion in the Human Factors Analysis (HFEA) [now MANPRINT Assessment] for the Milestone III decision review.

Critical MANPRINT issues were identified by examining operational equipment, reviewing relevant publications, conducting interviews with military, civilian, and contractor personnel, and analyzing the collected data. The data voids encountered for both systems were the lack of an approved QQPRI/BOIP and lack of task analysis and soldier performance data.

The following critical MPT issues and recommendations were derived from the analysis:

MANPOWER AND PERSONNEL

1. A wide variety of soldiers with numerous MOSs are potential operators and maintainers of the MANPACK/Vehicular version. These MOSs will contain some Mental Category IIIB personnel. Anecdotal data indicates that:

    a. The MANPACK/Vehicular version has potential operator problems in initialization, determination of proper location, and fault determination." (Ref. 15, P. iii)

(Note: The following paragraphs are paraphrases rather than direct quotes from Ref. 15.)

b. Complex cognitive tasks are required of the operator.

2. Data relating soldier aptitude to the performance of critical tasks were not used in the initial design of the MANPACK/Vehicular version.

RECOMMENDATION: It is recommended that a Low Rate Initial Production (LRIP) of the MANPACK/Vehicular version be withheld pending completion of one of the following:

a. The contractor submits data verifying that Mental Category IIIB personnel can satisfactorily operate and maintain the MANPACK/Vehicular version with initial and skill sustainment training not exceeding a tolerable burden on the Army's training resources; or

b. The MANPACK/Vehicular version is redesigned to significantly reduce the cognitive requirements (to the level of Mental Category IIIB) to initialize the system, to determine location, and to detect errors.

TRAINING

The operator training program proposed for the helicopter version appears not to be equally satisfactory for student pilots and experienced pilots with and without doppler experience.

RECOMMENDATION: It is recommended that the Army restructure the training program to address all tasks of each of the three subgroups of operators of the helicopter version (i.e., student pilots and experienced pilots with and without doppler experience, with particular attention paid to the third subgroup).

FORMAT FOR
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LIST OF FIGURES (if any)

Title — Page

1. (Figure caption exactly as it appears on figure)
2.

etc.

LIST OF TABLES (if any)

1. (Table caption exactly as it appears on table)
2.

etc.

1.0 INTRODUCTION

1.1 AUTHORITY

(Description) This brief paragraph identifies the document requesting the MANPRINT Assessment and the authority for the organization performing the MPT analysis. Include suspense dates and special features of the request as well as subsequent changes in these dates and features, if any.

> (Example)
>
> "In accordance with Army Regulation 602-1, Human Factors Engineering Program, the Project Manager for the RPV on 1 June 1986, requested that the Human Engineering Laboratory (HEL) of the U.S. Army Laboratory Command prepare an HFEA [now MANPRINT Assessment] of the RPV project. On 25 July 1986, HEL requested (via Reference 6) that ARI provide assistance in the domains of manpower, personnel, and training (MPT). On 16 January 1987, the due date of the MPT analysis was changed (by Reference 7) to 2 March 1987." (Ref. 16, Append. F, P.2)

1.2 CONDUCT OF MPT ANALYSIS

(Description) Describe the size and make-up of the MPT team. Indicate the rank, technical qualifications and organizational affiliations of team members in brief and general terms. List the agencies and sites visited, other important contacts, and observations made. Mention the nature of major documentation examined and note the absence of data whose presence would have strengthened the MPT analysis. This section is both brief and rather general in nature. Details come in a later section of the report.

> (Example - paraphrased from Ref. 16)
>
> This agency responded to the request by forming an MPT team consisting of two lieutenant colonels (USA, Retired), both pilots, and three MANPRINT evaluators. Four of the five team members were contractors. The team visited the RPV Program Manager's (RPV-PM) office at Redstone Arsenal (Huntsville, AL); the contractor's plant (Lockheed Austin Division); and Ft. Hood, TX, where TRADOC and AMC personnel familiar with the program (hereinafter called "subject matter experts" or "SMEs") were observing the OT II for the system. In addition, telephone interviews were conducted with other SMEs who were at other sites. These personnel were most helpful in providing information and assistance. The team acquired and studied relevant documents concerning RPV development and acquisition. Those documents are identified in Appendix A.

1.3 GENERAL CONCEPT OF (the system under analysis)

(Description) Describe here the operation of the system and its mission in terms of its major hardware components and the using units. The description

focuses on features of the materiel, concept of operations, and organizational structure which have MPT implications. Highlight aspects such as manpower requirements; MOSs assigned to operation, maintenance, and support; new MOS requirements; size and crew composition; aptitude levels required; skill levels required; and initial and sustainment training for both operation and maintenance. Include information on factors which shape manpower requirements and personnel performance and/or impact training requirements such as continuous and/or sustained operations, mission duration, hostile threat, isolation, confinement, environmental, and NBC/MOPP conditions.

(Example)

"The Target Acquisition/Designation and Aerial Reconnaissance System (TADARS) Aquila Remotely Piloted Vehicle (RPV) is an 'eye in the sky' system designed to provide the ground commander realtime battlefield information by detecting, recognizing, identifying and designating (for laser-guided weapons) stationary and moving enemy forces which could threaten him but which are beyond his immediate line-of-sight. The airborne portion of the RPV system is a small, unmanned, tailless, all-wing air vehicle (AV) which carries a low-light-level, daylight, black and white television camera, a laser rangefinder and designator, a sensor electronic chassis, and stabilized optics mounted in a gimballed turret. (For greater detail, see Reference 32, pp. 3-4.) Flight commands to the AV and video from the airborne television sensor are passed via the Modular Integrated Communications and Navigation System (MICNS) data link to a Ground Control Station (GCS) which is the operational control center for the RPV system. The GCS transmits and receives data via a Remote Ground Terminal (RGT) which can be located up to 750 meters away using fiber optic cables. This remoting capability allows maintenance of optimum electronic line-of-sight with the AV by the RGT component as well as providing cover and concealment for the manned GCS component. Launch and recovery of the AV is accomplished using truck-mounted launch and recovery subsystems. At present, the RPV can perform only daylight operations. However, a forward looking infrared (FLIR) night mission payload system is under development; when it is introduced, the RPV should acquire round-the-clock performance capability (Reference 32, pp. 3-5).

The RPV system is presently planned to be fielded in nine battery-level units, each consisting of 94 officer, warrant officer, and enlisted personnel. The TOE for the unit (Reference 4) shows an organization consisting of a battery headquarters, two central launch and recovery sections (CLRS), three forward control stations (FCS), and two maintenance sections--one each for the air vehicle and the ground equipment. This organization is shown in Figure 1." (Figure omitted here.)

"The principal equipment components of the RPV system are the (1) air vehicle, which carries the payload that enables it to perform its target acquisition and laser designation functions, and the airborne data terminal (ADT) for communicating with ground personnel; (2) launch and recovery (L/R) section, which launches and recovers the AV; (3) ground control station (GCS), which receives AV-gathered intelligence via video, and from which the airborne AVs are

controlled; and (4) remote ground terminal (RGT), which is the communications link between the AV and the GCS. An illustration of these components of the system is shown in Figure 2." (Figure omitted here.)

"The RPV battery is conceived as a corps asset to meet the reconnaissance and target acquisition and designation needs of a division (Reference 32, p. 3-1). Typically, the battery will be attached to a division by corps headquarters, and further attached to the division artillery. The division will normally retain operational control of the RPV sections, retaining the two CLRSs in the division area and assigning to the three FCSs the mission to support divisional subordinate units, usually the maneuver brigade. Such an employment is illustrated in Figure 3. (Figure omitted from this example.) It is planned that the GCS in each RPV section will have the capability to transmit realtime mission video to its supported maneuver headquarters by means of microwave or millimeter wave radio links. All CLRS and FCS sections have the capability to control RPV missions, however, only the CLRS has the capability to launch and recover the AV.

A new Military Occupational Specialty (MOS), 13T, has been created specifically for the operation, maintenance, and support of the RPV (Reference 32, p. 6-1). All soldiers must have a score of 105 or higher on the ASVAB composite surveillance and communications (SC) to qualify as a 13T (Reference 3, p. 33)--regardless of whether their duties involve the cognitively complex (and allegedly stressful) tasks within the GCS or duties common to soldiers throughout the Army (like driving a truck). Currently, only the Operator/Mechanic receives an Additional Skill Identifier (ASI) of P9 which is earned at the end of four additional weeks of training (beyond the nineteen weeks common to all 13Ts-) in organizational maintenance (Reference 32, p. 6-1).

The heart of RPV mission effectiveness is in the hands of three soldiers in the ground control station: the mission commander, the air vehicle operator, and the mission payload operator. Each performs tasks which are critical to mission effectiveness. During a mission, limited time is allowable in which to correctly perform (or recover from incorrectly performed) tasks. Examples of these critical tasks include: monitoring of programmed waypoints, reprogramming of waypoints during a mission, AV hand-off between the CLRS and the FCS, and recovery of AV following data-link loss. Anecdotal data suggests that during the OT, soldiers in the GCS were committing "a number of errors" causing serious mission problems. However, no records (either government or contractor) were found that a formal analysis had ever been conducted to determine the personnel aptitudes required for the successful completion of such tasks. Furthermore, although we found excellent plans (e.g., Reference 33) for the collection and analysis of such data while the RPV was being exercised, it appears that the test agencies involved did not, in fact, collect those data (despite the relative ease of doing so). Duties inside the GCS are admittedly cognitively complex and stressful, and it is not clear at this time whether the enlisted personnel* currently planned for these positions

*The Israeli RPV uses officers as operators.

will be able to achieve the full effectiveness that the RPV hardware and software should make possible." (Ref. 16, Append. F, PP.2-4)

2.0 DATA SOURCES AND LIMITATIONS

(Description) The introductory paragraph to this section describes the general types of sources from which the MPT data came. Also, identify types of data, which while desirable were unavailable. Indicate the cut-off date for data and information on which the MPT analysis is based. This is important for defending the analysis within the context of a changing materiel development program.

(Example)

"The analysis of the MPT considerations of the Aquila RPV for the HFEA [now MANPRINT Assessment] was based solely upon review of available documents and interviews with SMEs. For reasons . . . . . ., it was not possible to conduct any quantitative analysis of soldier performance as a function of aptitudes and training. Despite the existence of excellent test plans calling for the collection of quantitative soldier performance data by individual soldiers, we were not able to locate any. In order to meet the suspense date of 2 March 1987 set by HEL, the MPT analysis was restricted to that information available to us as of 16 February 1987. This analysis represents a "snapshot" of the MPT issues identified in the RPV program as of that date." (Ref. 16, P.7)

2.1 DOCUMENTS

(Description) Enumerate here the nature and kinds of documents reviewed, e.g., ROC, O&O Plan, SMMP, RFP, BOIP, QQPRI, NETP, etc. A complete reference for each document is included in a Document List later in the report, usually in Appendix A.

(Example)

"The documents reviewed included system requirements documents (e.g., Required Operational Capability (Reference 31), the Operational and Organizational Plan (Reference 32), the RPV contract and system specifications, (References 46 and 47)); the System MANPRINT Management Plan; personnel and training planning documents (e.g., Qualitative and Quantitative Personnel Requirements Information (Reference 30), New Equipment Training Plan (Reference 14)); technical manuals for MOS 13T; training course materials (e.g., Program of Instruction (References 28 and 29)); and baseline documents (e.g., RPV Battery Table of Organization and Equipment (Reference 4)). The complete list of documents considered in the MPT analysis is shown in Appendix A." (Ref. 16, P.7)

2.2 INTERVIEWS

(Description) This paragraph parallels 2.1 and identifies by position or title and organization, personnel interviewed in the course of the MPT analysis. A detailed list of personnel by name, position, organizational address, and telephone number is included later in the report, usually in Appendix B.

(Example)

"Personnel familiar with the RPV development program were interviewed for information related to the MPT analysis. These personnel included: the staff of the RPV Project Manager's Office at the U.S. Army Missile Command (MICOM), Redstone Arsenal, Alabama; the Modular Integrated Navigational and Communications System (MICNS) program management staff from the U.S. Army Communications Electronics Command (CECOM), Ft. Monmouth, New Jersey; the training development and TRADOC System Manager (TSM) office staff officers from Ft. Sill, Oklahoma; . . . . . the Army Materiel Systems Analysis Activity (AMSAA), and supporting contractor personnel; and DA and TRADOC Headquarters staff officers (including the PERSSO, WSSM, and TRASSO. All . . . . personnel provided information and background concerning the MPT aspects of the RPV system. Of especial importance were anecdotal comments regarding incidents which occurred during training, developmental testing, and incidents which were allegedly occurring during OT II that demonstrate MPT impact on RPV system effectiveness. All proposed findings in the MPT analysis were discussed with source SMEs for verification or correction. Appendix B contains a list of the SMEs interviewed during the analysis." (Ref. 16, PP. 7-8)

2.3 LIMITATIONS OR ABSENCE OF HUMAN PERFORMANCE DATA

(Description) Identify data important to the MPT analysis which were not available. Briefly give the reason(s) the data were unavailable (e.g., nonexistent, not accessible within the time constraints, withheld by the custodian, etc.) Also, use this paragraph to point out soldier performance data which should be collected in ensuing phases of the materiel acquisition program.

(Example)

"Ideally, a MANPRINT evaluation would include quantitative analyses of the effects of soldier characteristics (especially aptitude) and training on the performance of critical operations and maintenance tasks. Even though the RPV development program antedates the Army's MANPRINT program by nearly a decade, we discovered some ten-year-old plans (References 33 and 38) which required exactly the sorts of data needed for the MPT analysis. One of those, AMSAA's "Test Design Plan for Development Test II of the Target Acquisition, Designation, and Aerial Reconnaissance System (TADARS)" (Reference 33) describes in clear, unequivocal terms the requirement for collecting soldier performance data:

'1.5.7 Can personnel trained with Skill Performance Aids (SPA) perform required tasks to the specified level of proficiency? [p. 3]'

Unfortunately, and for reasons we could not determine, these soldier performance test issues were somewhat reduced in the 1981 version of the test design plan (Reference 37) and totally deleted in the 1983 version (Reference 38). Developmental Test (DT) II was conducted between May 1985 and May 1986 (primarily in February - May 1986) in accordance with the test design plan published in 1983 (Reference 38). As a consequence (and in spite of TECOM Regulation 70-5), the DT II test report contains no individual soldier performance data on which to conduct any quantitative analysis of soldier aptitude and training and their effects on soldier performance and RPV system effectiveness.

The OT II, underway at the time this report is being prepared, is also apparently not collecting any soldier performance data which could be used for MPT analysis. The 1985 version of the Test Design Plan for OT II for RPV (Reference 41) calls out the same soldier performance data requirement as that described in the 1983 version of the DT II Test Design Plan (Reference 38). The issue of soldier performance and system effectiveness is to be addressed only with "comments data." While OT II is apparently collecting some performance data on critical RPV operations tasks, the structure of those data* does not permit them to be used to analyze the effects on RPV system performance of soldier aptitudes and training.

*As determined from an examination of Reference 41." (Ref. 16, PP 8-9)

3.0 MANPOWER AND PERSONNEL ISSUES

(Description) An introductory paragraph is optional and is written only if needed. Otherwise proceed directly to presentation and discussion of the first issue in a subparagraph numbered 3.1 with a brief, but descriptive title. Each issue identified in the MPT analysis is presented in a separately numbered subparagraph. The significance, ramifications, and impact of the issue are also discussed. The subparagraph concludes with brief statements of the advantages and disadvantages of each approach to solution or amelioration of the issue generated by the MPT analysis team.

(Example)

"3.0 MANPOWER AND PERSONNEL ISSUES

The analysis of available information revealed five significant issues.

3.1 EFFECTS OF SOLDIER PERFORMANCE ON SYSTEM EFFECTIVENESS

DISCUSSION: Neither the government nor the contractor has collected soldier performance data on critical operations and maintenance tasks suitable for use in: (1) measuring the effects of soldier performance on system effectiveness, or (2) relating individual aptitude and training to soldier performance. Such data are necessary to determine whether man is the limiting factor in RPV system effectiveness (in which case either or both the personnel management plan and the training concept for support of RPV need to be redone) or whether the current personnel management and training plans are valid (and the serious operations problems reported are largely engineering matters). However, it is neither difficult nor particularly expensive* to collect and analyze such data while the system is being exercised. Particularly in view of the dramatic differences between the U.S. and Israeli concepts for staffing the ground control station, our concept needs to be validated.

*An HEL report (Reference 48, p. 24) estimates the actual cost of collecting such data on an RPV ground control station as less than $20,000 (in FY 75 dollars). That test involved only a mockup and only three subjects, so its cost estimate is not directly applicable to a system as advanced as the Aquila. Nevertheless, the increment of cost to obtain soldier performance data on critical tasks linked to individual soldiers whose aptitudes and training are known is not substantial.

While there are several alternatives for collecting such data,** the most attractive is to add this task to the RFP for the next contract and have the contractor (using the RPV GCS simulation facility in Austin) train and test military personnel (from nearby Fort Hood) in the performance of critical GCS operations tasks. Such data should be analyzed (as explained in References 49 and 50) to identify any critical tasks which are aptitude-sensitive and to estimate the institutional and unit training burdens for satisfactory soldier performance of those tasks.

3.2 VALIDATING THE ASVAB COMPOSITE AND CUTOFF SCORE FOR RPV PERSONNEL

DISCUSSION: The ASVAB composite SC (surveillance and communication) was selected for all soldiers to be assigned to an RPV battery. A score of 105 or higher is necessary to be eligible for the 13T MOS. Selection of the SC composite and choice of the 105 cutoff score were allegedly to duplicate the decision for the Army's Field Artillery Firefinder Radar Operator (MOS 13R). We were not able to locate any analytic effort (either by the contractor, in a MANPRINT analysis, or by the Army, during DT or OT) to justify that selection and choice for RPV personnel. If the data described in paragraph 3.1 above are collected, they can be used to identify the military aptitudes (and their levels) associated with successful RPV performance.

3.3 DIVERSITY OF RPV OPERATIONS AND UNIT MAINTENANCE TASKS TO BE PERFORMED BY A SINGLE (LOW DENSITY) MOS

DISCUSSION: Operation and maintenance of the RPV entails three distinctly different groups of tasks: 1) those performed by the air vehicle operator, mission payload operator, and mission commander (which are highly cognitively complex and involve multiple simultaneous judgments requiring high accuracy); 2) those performed by the launch/recovery team (which, while specialized to the RPV, are not unlike a number of similar Army jobs involving trucks, generators and heavy equipment); and 3) those performed by the RPV mechanic (which requires a detailed knowledge of the RPV hardware). Although one previous analysis (Reference 1) recommended creation of a separate MOS for each group of tasks, only one MOS--13T--was created. That decision was apparently based on the very real difficulty of managing extremely low density MOSs (less than 1000) with the Army's current personnel management system. It is possible* that a result of this decision has been to select soldiers with higher aptitudes than are required for the tasks in group two, but with lower aptitudes than are required for GCS operation. It is also possible that an alert commander can select from the enlisted personnel assigned to his RPV battery those few who have sufficient aptitude to excel at GCS tasks and assign them to those positions.

**Other, more expensive alternatives include extending the current OT to collect such data on the actual hardware; having USATECOM use some troops to conduct a separate MANPRINT test at APG or EPG; and having an independent contractor collect these data at his own facility or a government installation.

*One can only speculate without the data.

At present all enlisted personnel with MOS 13T are scheduled to receive the same training, except the RPV Mechanic who receives an additional nine weeks training in unit maintenance (Reference 32, p. 6-1). Ideally, this provides for a unit of thoroughly cross-trained personnel who will be capable of sustained operations in several different positions. That concept was not tested in the current OT II.

3.4 POTENTIAL FOR INSUFFICIENT MANNING TO SUPPORT RPV BATTERY OPERATIONS

DISCUSSION: The operational concept for RPV (Reference 32) dictates that the battery be employed by sections separated over a division area. Because of this separation, tasks not directly associated with RPV operations (such as local area security) become more difficult for available personnel to perform. Anecdotal data suggests that the RPV Operational and Organizational Plan and Draft Field Circular (FC) 6-RPV describes tasks which, when taken cumulatively and subjected to a time-line analysis, appear to be beyond the capability of current manning levels in the proposed TOE.

As an example, the launch and recovery operations of an RPV currently employ 8 crewmembers. This manning level presents no problems for daylight operations only. However, if the FLIR technology (now under development) is added to the RPV's capabilities, round-the-clock operations will then be possible. Under such conditions, the commander would have the choice of dividing the CLRS personnel into two 12-hour shifts of 4 crewmembers each, reducing the number of flight missions, or simply working the men until they dropped (or the error rates became so high that all AVs were destroyed). If the FLIR capability is added to the RPV, the TOE for the system should be reconsidered in light of soldier capabilities and limitations disclosed by the data (discussed in paragraph 3.1 above).

3.5 LEADERSHIP AND SUPERVISION IN GCS OPERATIONS

DISCUSSION: While there are a number of reports which document a connection between soldier aptitude and military performance, it is axiomatic in the military that a good leader can elicit from a soldier the very best performance of which he is capable. As we struggled to explain (without data) the anecdotes about soldier errors in the GCS, we were directed to instances of alleged mission failure because the generator ran out of fuel, or the temperament of a mission commander (e.g., "Don't make any mistakes.") led payload operators not to report potential targets for fear of false report. Analysis of the TOE for the RPV shows only two commissioned officers (battery commander and executive officer). All of the SMEs with whom we discussed "the leadership question" were unanimous in predicting that both of those officers would be too busy with other duties to influence the normal conduct of GCS operations. Each GCS is assigned a warrant officer RPV Technician (212A) and an E-7 Section Chief (13T40). The current training program for both of these individuals is technically oriented and involves close supervision of such critical tasks as mission planning, air vehicle hand-off, target acquisition, and lost link operations. There appears to be no one designated to perform leadership tasks associated with RPV operations. The Front End

Analysis (FEA) for RPV did not identify any specific leader tasks, according to Ft. Sill DOTD personnel. It is possible that an analysis of the data discussed in paragraph 3.1 above could lead to the identification of specific leadership tasks whose training would significantly stabilize GCS operations and help achieve RPV performance goals." (Ref. 16, PP. 10-12)

4.0 TRAINING ISSUES

(Description) This section parallels Section 3, but presents and discusses the training issues and approaches to their solution which the MPT team has analyzed.

(Example - Note that, unlike the example in Section 3, this example uses no introductory paragraph.)

*4.1 LACK OF INSTITUTIONAL TRAINING BASE

Both SOF Aviation ROCs (References 1 & 5) reflect a requirement for all training (operator, maintainer, and supporter) to be conducted at unit level. This includes both initial qualification and sustainment training. There is no provision for hand-off of this training responsibility in the event of mobilization or deployment on a contingency mission. Either case would effectively remove the training base and interrupt the personnel replenishment pipeline. Establishment of an institutional training base would insure continuous replenishment of SOF Aviation units with trained personnel.

4.2 STANDARDIZATION OF TRAINING FOR SOF AVIATION UNITS

It is planned that not all SOF Aviation units will be collocated. This plan, coupled with the current training strategy to conduct all qualification and sustainment training at unit level, could result in a lack of standardization (i.e., accepted aviation practice for both flight and maintenance procedures) throughout SOF Aviation. This situation could lead to inconsistencies in training effectiveness and degraded combat effectiveness when different units participate in combined operations. The establishment of an institutional training base, as noted in 4.1 above, would provide a central proponent to insure that standardization of training is maintained throughout SOF Aviation.

4.3 INADEQUATE PROVISIONS FOR INSTRUCTOR AND KEY PERSONNEL TRAINING (IKPT)

The SOF Aviation Training System will include all programs of instruction (POIs), technical and courseware material, and training devices necessary to train operation, maintenance, and support personnel for the aircraft at unit level. The SOF Aviation ROCs (References 1 & 5) describe this training system in detail, but do not adequately address the training required by unit instructors to initiate the training system. Conduct of formal IKPT will provide a vehicle for transfer of skills and knowledge to the government and an opportunity for validation of the training support package by unit instructors.

4.4 INAPPROPRIATE SOURCING OF TRAINING ANALYSIS

The ROCs (References 1 & 5) for both aircraft recognize the need for an analytic effort to be performed by the contractor early in the development of the training program, but each document specifies (in paragraph 7) that the Logistic Support Analysis/Logistic Support

Analysis Record (LSA/LSAR) process will be used for this analysis. Because there are some complex individual tasks and crew interactions which require analysis prior to development of the SOF MOD training program (e.g., the tasks of the third and fourth crewmen when the pilots are flying low level/contour at night using Global Positioning System (GPS), Aviator Night Vision Intensification System (ANVIS), and Forward Looking Infrared (FLIR) and the aircraft comes under hostile ground fire), a more sophisticated analytic method (such as those described in Reference 18) should be used." (Ref. 17, PP. 11-12)

5.0 CONCLUSIONS AND RECOMMENDATIONS

(Description) This section opens with the MPT team's recommendation supporting or opposing transition of the system to the next phase of the materiel acquisition process. Address each major conclusion in a numbered subparagraph with a short descriptive heading. Although the conclusions flow from and must be supported by the contents of Section 3 or Section 4, they are clearly and succinctly stated here without repeating previous discussion. For each conclusion, recommend a course of action addressing the issue. Use of separate subsections on Manpower and Personnel and Training may facilitate the presentation if the list of conclusions and recommendations is extensive.

(Example)

"5.0 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that the proposed transition of the RPV system to Milestone IV (Production) not be delayed on the basis of MPT issues, however, priority attention should be directed to the following:

5.1 NEED FOR SOLDIER PERFORMANCE DATA AND VALIDATION OF SELECTION MEASURES

Data collection conducted during RPV developmental and operational testing to date does not support the quantitative soldier performance analyses required to address key MANPRINT considerations, especially the effect of soldier aptitude and training on RPV system effectiveness. It is simply not clear whether the effectiveness of RPV target acquisition (its primary purpose) requires all high-aptitude personnel (who are expensive to recruit and retain), or whether lower aptitude personnel with improved (not necessarily longer) training could do as well. In addition, the validity of SC as the 13T selection measure has not been established.

Recommend that individual soldier performance data on critical operations and maintenance tasks be collected by the contractor using military personnel during the next phase of system acquisition. Such data collection should occur early during the RPV production contract, and provisions should be made for any necessary changes to the personnel selection and training concepts disclosed by data analysis.

5.2 NEED FOR VALIDATION OF PERSONNEL SUPPORT CONCEPTS FOR RPV SYSTEM

The MOS structure for support of the RPV system should be reconsidered in the light of the data analysis (recommended above).

Recommend that consideration be given to identifying the special personnel capabilities which seem to be necessary for efficient GCS operation, either by (1) initiating a "unit qualification" concept (similar to that now common in Army aviation units), or (2) establishing additional skill identifiers (ASIs) for GCS personnel in the RPV system. Consideration should also be given to curtailing GCS training for personnel who are unlikely to perform the highly-technical GCS tasks with sufficient frequency to maintain proficiency.

5.3 NEED FOR REASSESSMENT OF RPV BATTERY MANNING LEVELS

Round-the-clock operation of the RPV system may require more battery personnel than are currently provided in the TOE.

Recommend that an analysis be conducted to determine whether manning levels in the current organization can support all tasks which must be performed by the RPV battery in a continuous operations scenario. A review of the HARDMAN results, which recommended a 14% increase in personnel (107 vs. 94), ought to be helpful as a part of this analysis.

5.4 NEED FOR ANALYSIS OF GCS LEADERSHIP AND SUPERVISION TASKS

Leadership and supervision tasks within the GCS have not been identified and assigned to battery personnel.

Recommend that an analysis be conducted by the contractor to identify leader tasks associated with Ground Control Station operations. The results should be used to identify the battery section personnel who should perform them and the contractor should be tasked to develop that training.

5.5 NEED FOR IMPROVED TARGET ACQUISITION (DETECTION, RECOGNITION, AND IDENTIFICATION) TRAINING

Initial and sustainment training for target acquisition tasks may be inadequate to achieve the desired proficiency in performing target acquisition tasks.

Recommend that the following actions be taken:

a. Training materials for MPOs should be revised to provide learning experiences which have greater fidelity to the actual GCS experiences. In particular, training materials concerning combat vehicle recognition and identification should be provided which have aspect angles typical of those encountered within RPV flight envelopes. (A reconsideration of the combat vehicle identification training concepts presented to Ft. Sill by the ARI Field Unit at Fort Hood would be an appropriate beginning for this effort.)

b. Training for MPOs should be restructured to stress the importance of following proper scanning techniques during high-stress scenarios. MPOs should be afforded practice (with evaluation and feedback) in following such techniques in stressful scenarios." (Ref. 16, PP. 14-15)

APPENDIX A

(Description) Usually this is a list of the documents used in the MPT analysis. Each entry supplies sufficient information to uniquely identify the document and the source from which it may be obtained. Rapid retrieval of a document may be important to the analysis team for justifying and supporting the MPT input at some later stage of the MANPRINT Assessment review process. Further, this facilitates location of the correct document by other agencies who may desire to review it in connection with the MANPRINT Assessment or for a completely unrelated purpose of their own. Basic information includes the title, or, if untitled, a specific description, date, authors, originating organization and its location. For documents that have been published and are in the public domain, the reference should include the publisher or document distribution center and location.

References to letters include the full subject, date, and the name of the sending organization; organizational file symbols should be included but are insufficient alone. The references are numbered to facilitate referrals thereto in the text of the report.

(Example - For brevity, the example which follows is limited to the first portion of an Appendix A which ran more than three pages.)

APPENDIX A

NAVSTAR Global Positioning System (GPS) References

1. Army Regulation 602-1. Human Factors Engineering Program. Headquarters, Department of the Army. Washington, DC, February 1983.

2. US Army Human Engineering Laboratory. Letter: SUBJECT: Human Factors Engineering Analysis (HFEA) for Global Positioning System (GPS). Aberdeen Proving Ground, MD, 23 July 1985.

3. Military Specification, MIL-H-46855B: Human Engineering Requirements for Military Systems, Equipment, and Facilities. US Naval Publications and Forms Center, Philadelphia, PA, 31 Jan 1979 with Amendment 2, 5 April 1984.

4. Data Item Description, DI-H-7053. Human Engineering Test Plan. US Naval Publications and Forms Center, Philadelphia, PA, 1 June 1979.

APPENDIX B

(Description) List here the personnel contacted in the course of the MPT analysis. Give sufficient specific information such that contact could be reestablished with the individual. This may be desirable, or even essential, for reconfirming information, double checking interpretations, or inquiring about changes should specific details of the MPT data and analysis thereof come into question during final preparation of the MANPRINT Assessment or following its promulgation. Include name, rank, title or position, office file symbol, telephone number and complete agency address for each individual.

(Example of Illustrative format for Appendix B)

APPENDIX B

PERSONNEL CONTACTED FOR (Materiel name)

Agency formal name
Complete agency address and zip code

B1. Mr/military rank, full name, title or position, office file symbol, autovon and commercial telephone numbers

APPENDIX C

Briefing Materials

(Description) This appendix consists of hard copies of viewgraphs, handouts or other materials prepared for briefing the MPT analysis to the MANPRINT Assessment Working Group or to other Assessment review groups. The briefing materials are prepared only as required and are not routinely included in every MPT analysis report. The content and formality of the briefing materials will, of course, depend upon the purpose of the briefings and the level and state of knowledge of the audience.

(This specificity, coupled with the likelihood of briefing experience on the part of the reader, suggested that example briefing materials would not be particularly useful, hence their omission here.)