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Hardware vs. Manpower Comparability Methodology

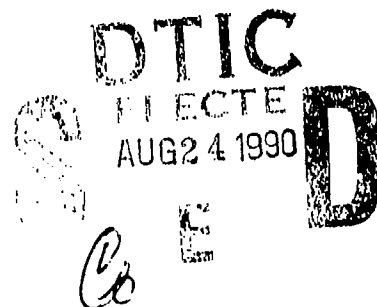
Step 5: Impact Analysis
Volume 6

May 1990

Manned Systems Group
Systems Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

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A Field Operating Agency Under the Jurisdiction
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Research accomplished under contract for
the Department of the Army

Dynamics Research Corporation

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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 ---			5. MONITORING ORGANIZATION REPORT NUMBER(S) ARI Research Product 90-19F		
4. PERFORMING ORGANIZATION REPORT NUMBER(S) ---			7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute Manned Systems Group		
6a. NAME OF PERFORMING ORGANIZATION Dynamics Research Corporation		6b. OFFICE SYMBOL (If applicable) ---		7b. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600	
6c. ADDRESS (City, State, and ZIP Code) 60 Concord Street Wilmington, MA 01887			9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER MDA903-86-C-0298		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences		8b. OFFICE SYMBOL (If applicable) PERI-S		10. SOURCE OF FUNDING NUMBERS	
8c. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600			PROGRAM ELEMENT NO. 63007A	PROJECT NO. 793	TASK NO. 121
			WORK UNIT ACCESSION NO. C1		
11. TITLE (Include Security Classification) Hardware vs. Manpower Comparability Methodology (Step 5: Impact Analysis) (Volume 6 of 7)					
12. PERSONAL AUTHOR(S) Herlihy, David; Bondaruk, Jane; Nicholas, Guy; Guptill, Robert; Park, John (Dynamics Research Corporation)					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM 86/09 TO 88/03		14. DATE OF REPORT (Year, Month, Day) 1990, May	
15. PAGE COUNT					
16. SUPPLEMENTARY NOTATION ---					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Manpower Front-end analysis MANPRINT		
			Personnel Target audience description HARDMAN		
			Training Life cycle costs		
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
The Army Hardware vs. Manpower (HARDMAN) Comparability Methodology (HCM) is a six-step process for determining a weapon system's manpower, personnel, and training (MPT) requirements. It provides a structured approach for early MPT estimation based on comparability analysis, an analytic system that uses knowledge about similar existing systems and technological growth trends to project the MPT requirements of proposed new systems. The HCM's six interrelated steps are Systems Analysis, Manpower Requirements Analysis, Personnel Pipeline Analysis, Training Resource Requirements Analysis, Impact Analysis, and Tradeoff Analysis. The HCM has been successfully applied to a range of weapons systems, including air, armor, artillery, infantry, air defense, command and control, and intelligence systems. The Product Improvement Program for HCM made major revisions to the existing HCM Guide. The scope has been expanded to include several new areas; existing (Continued)					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Uldi Shvera			22b. TELEPHONE (Include Area Code) (202) 274-8914		22c. OFFICE SYMBOL PERI-SM

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

ARI Research Product 90-19F

19. ABSTRACT (Continued)

procedures have been revised, refined, and clarified; and the entire Guide has been rewritten to achieve greater clarity, consistency, and completeness.

This volume deals with the review of the HCM analysis results and the assessment of their impact on the Army's resources. Methods of tracing unexpected results to their sources to verify or correct the findings are explained. Valid results that impose excessive demands on Army resources identify candidates for tradeoff analysis to reduce MPT costs.

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Research Product 90-19F

Hardware vs. Manpower Comparability Methodology

Step 5: Impact Analysis

Volume 6

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Department of the Army**

May 1990

**Army Project Number
2Q263007A793**

**Human Factors in Training
and Operational Effectiveness**

Approved for public release; distribution is unlimited.

FOREWORD

The goal of the Army HARDMAN methodology is to provide timely information on the manpower, personnel, and training (MPT) resource requirements of emerging weapon systems. This information supports decisions on the research, development, and acquisition issues affecting emerging systems, as well as planning required for effective supportability of these systems in MPT and logistics areas. HARDMAN is a key element of the Army MANPRINT program.

This guide consists of seven volumes, a manager's guide and one volume for each of the six steps of the HARDMAN methodology. The manager's guide is intended for the use of the manager in the planning, scoping, and costing of the HARDMAN analysis. The other six volumes are for the analysts who will perform the analytic procedures in each step of the methodology.

This volume is the manager's guide. It deals with the planning and conducting of the HARDMAN analysis and the estimation of the resource requirements for the analysis. Development of the quality assurance plan and the consolidated database are explained. The relationship of HARDMAN results to various Army MPT documents is also discussed.

This guide is a major revision and expansion of the existing five-volume HARDMAN guide. The scope has been altered to include procedures for assessing combat damage workload and depot-level manpower requirements, and estimating training resource requirements associated with new training concepts and other procedures not included previously. Existing procedures have been clarified, simplified, or expanded to make them more useful to the analyst and to make HARDMAN a more effective tool for the Army.

The development of the guide was part of the System Research Laboratory's Third Generation MANPRINT Estimation Research Task. Most of the expansion and enhancement of the HARDMAN method has been based on recommendations of the Soldier Support Center, National Capital Region (SSC-NCR), which has overseen application of the method to numerous Army weapon systems. Staff from the SSC-NCR attended all the in-progress reviews for this effort and have been briefed on the final product. In addition, personnel from the TRADOC Analysis Command, White Sands Missile Range, TRADOC Headquarters, the U.S. Army Human Engineering Laboratory, and other Army agencies have been briefed on the revised HARDMAN guide to make them aware of its enhanced capability to provide MPT information for emerging systems.



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Technical Director

HARDWARE VS. MANPOWER COMPARABILITY METHODOLOGY (STEP 5: IMPACT ANALYSIS)
(VOLUME 6 OF 7)

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HARDWARE VS. MANPOWER COMPARABILITY METHODOLOGY
(STEP 5: IMPACT ANALYSIS)
(VOLUME 6 OF 7)

INTRODUCTION

"Impact Analysis" is the fifth step in the Army HARDMAN Comparability Methodology (HCM). The HCM is a Manpower and Personnel Integration (MANPRINT) tool that addresses manpower, personnel, and training (MPT) issues associated with new or improved weapon systems.

This document is one of seven documents that contain the steps necessary to conduct an HCM analysis:

- "Overview and Manager's Guide"
- "Step 1: Systems Analysis"
- "Step 2: Manpower Requirements Analysis"
- "Step 3: Personnel Pipeline Analysis"
- "Step 4: Training Resource Requirements Analysis"
- "Step 5: Impact Analysis"
- "Step 6: Tradeoff Analysis"

How this Document is Organized

An HCM step consists of an overview and substeps. A substep contains an overview and action steps. Each action step includes a discussion of what the analyst will accomplish in the action step; procedures that describe, step-by-step, how to accomplish the action step; and examples that feature actual Army systems. The table on the following page summarizes the procedures a manpower analyst must undertake to accomplish this HCM step.

Worksheets are used extensively throughout the guide. These worksheets help the analysis team organize and format information and serve as an audit trail of the analysis. Blank copies of these worksheets are located at the end of each substep.

Each HCM step has its own unique appendices. These appendices include articles that provide additional information about the step; a list of acronyms; a glossary; a crosswalk between the HCM and the Man Integrated Systems Technology (MIST); and a crosswalk between the HCM and MPT-related Army documents, for example, Basis of Issue Plans (BOIPs) and the Qualitative and Quantitative Personnel Requirements Information (QQPRI). (Each step's appendix section does not include a list of references. The "Overview and Manager's Guide" includes a complete list of references for all seven volumes).

Step 5's Substeps and Action Steps

In this Substep	The Analyst Will	By Completing this Action Step
5.1	Perform Impact Analysis for Systems Analysis (Step 1) Results	Review Systems Analysis Results
5.2	Perform Impact Analysis for Manpower Requirements Analysis (Step 2) Results	Review Manpower Analysis Results Assess the Impact of the New System's Quantitative Manpower Requirements on the Army's Personnel System
5.3	Perform Impact Analysis for Personnel Pipeline Analysis (Step 3) Results	Review Personnel Analysis Results Assess the Impact of the New System's Qualitative Manpower Requirements on the Army's Personnel System
5.4	Perform Impact Analysis for Training Resource Requirements Analysis (Step 4) Results	Review Training Analysis Results

STEP 5

IMPACT ANALYSIS

Overview

In this step the HCM analysis team reviews analysis results and assesses their impact on the Army's resources. Figure 5-1 is an overview of this step. Figure 5-2 shows how Step 5 relates to the other HCM steps.

The analysts review the results of the engineering, manpower, personnel, and training analyses to identify unexpected results. An unexpected result is an analysis result or value that does not appear to reflect system/subsystem design, concepts, or assumptions. For example, the New System may have a component that has higher reliability than the corresponding Predecessor System component. The engineering analyst should expect this increased reliability to be reflected in a lower New System maintenance ratio for that component.

The analysts must determine whether the unexpected results were caused by an HCM assumption, the New System's design, or an inaccurate calculation. Table 5-1 provides examples of unexpected results and questions that each analyst must answer to find the cause of the result. The analysts use the HCM audit trail to determine the source of the unexpected results. If necessary, the analysts recalculate any erroneous results. They then record their findings in the audit trail.

After the analysts have verified the results, they assess the impact of the New System design and New System concepts on available Army resources. (Table 5-2 lists questions raised by the New System's concepts.) The engineering analyst does not conduct this type of impact analysis on the Systems Analysis results because they do not affect the Army's resources directly. The manpower, personnel, and training analysts compare the New System's MPT requirements with those of the Predecessor System to assess the impact on the Army. The analysts do not compare the BCS with the New System because the BCS does not exist and therefore has no MPT resources that could satisfy the New System's requirements.

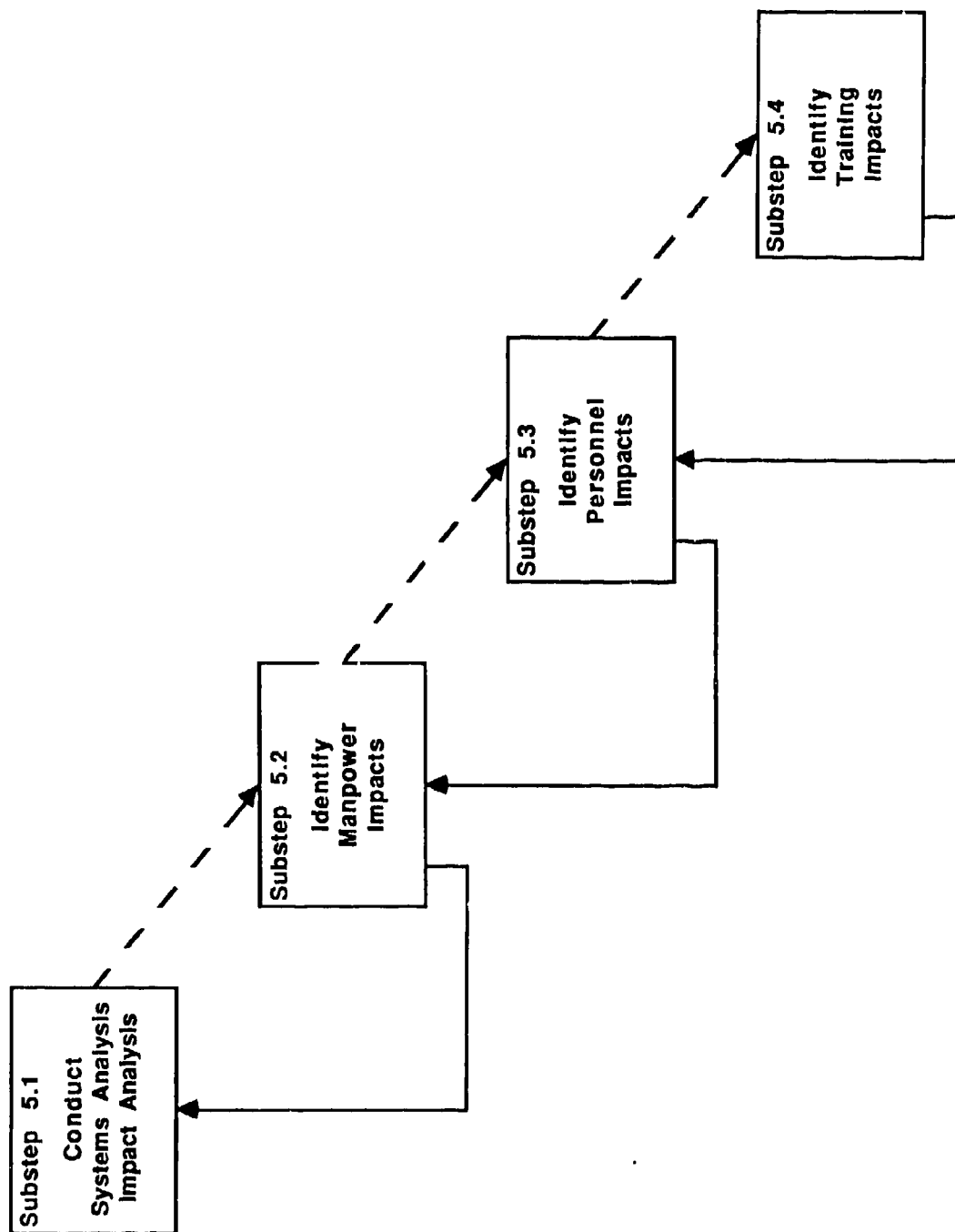


Figure 5-1. Overview of Step 5, Impact Analysis.

Table 5-1. Questions that May Uncover Unexpected Results

Unexpected Result	STEP 1: Systems Analysis	STEP 2: Manpower Analysis	STEP 3: Personnel Pipeline Analysis	STEP 4: Training Analysis
Unexpected maintenance requirements by component	- What maintenance level(s) service this component? - What is the maintenance ratio (MR) for this component by maint. level? - Is the MR caused by high frequency of maintenance actions (i.e., poor reliability)? - Is the MR caused by high MMH per maint. action (i.e., poor maintainability)? - What test equipment is involved? Is test equipment repair included in the component's MR? - Has all indirect workload been removed in the computation of the MR? - Does an ambitious operating tempo result in equipment usage rates that cause increased frequency of reliability failures? - Were the BCS equipment choices good ones on the basis of Questions 1-3 through 1-5? - Were the calculations of the MR correct? - Check the Reliability-Centered Adjustment Factor (RCAF) and Maintainability-Centered Adjustment Factor (MCAF) used to extrapolate New System MRs from BCS MRs.	- What is the TMMH* by maintenance level for this component? - What test equipment is involved? Is test equipment repair included in the maintenance burden of the component? - Are the proper maintenance actions assigned to the appropriate maintenance level? - Are the proper MOSs performing the required maintenance actions?	Does the MOS description specify this MOS for the duties he is performing?	- Does the MOS's training provide the soldier with the skill and knowledge required to perform the maintenance? - Is there a corresponding unexpected training requirement associated with the component? (e.g., amount of formal school training, number of training products, etc.)

Table 5-1. (Continued).

Unexpected Result	STEP 1: Systems Analysis	STEP 2: Manpower Analysis	STEP 3: Personnel Pipeline Analysis	STEP 4: Training Analysis
Unexpected manpower requirements for an MOS	Examine maintenance ratios to provide answers to previous Questions.	- Examine the high manpower requirements to provide answers to previous Questions. - and - - Have the standards of grade been appropriately applied? - What rounding factors were used? - Do the rounding factors inflate/overstate the manpower requirement? - Would a change in the fielding concept or maintenance concept reduce the impact of these rounding factors? - Were the appropriate Available Productive Maintenance Man-Hours (APMH) applied? - Is this manpower requirement policy driven or workload driven? - Was it necessary to assume a comparable MOS for the manpower analysis? If so, was this examined in light of Questions 2-3 through 2-9? - Were the manpower and force structure calculations correct?	- Examine the manpower requirement to provide an answer to the previous Question. - What do AR611-201 and AR570-2 specify as assignment policy?	Examine the manpower requirement to provide an answer to the previous Question.

Table 5-1. (Continued)

Unexpected Result	STEP 1: Systems Analysis	STEP 2: Manpower Analysis	STEP 3: Personnel Pipeline Analysis	STEP 4: Training Analysis
Unexpected personnel requirement by MOS and paygrade	Examine the maintenance ratios that drive workload and personnel to provide answers to previous Questions.	Examine the manpower requirements that drive personnel requirements to provide answers to previous Questions.	- Are the promotion, migration, attrition, and TTHS rate data accurate and current? - Are these rate data properly averaged? - Do these rate data reflect a specific anomaly? (I.e., MOS problem) - Is this MOS stable or do the rate data reflect an unstable MOS? (I.e., a new MOS being phased in or an old MOS being phased out?) - Was it necessary to assume the rates from a comparable MOS? Was this choice of MOS a good one on the basis of Questions 3-4 through 3-6? - Has the HCM personnel algorithm been properly computed?	- Did errors made in personnel analysis inflate the annual student input to training? - Is the annual student input to training properly computed?

Table 5-1. (Continued)

Unexpected Result	STEP 1: Systems Analysis	STEP 2: Manpower Analysis	STEP 3: Personnel Pipeline Analysis	STEP 4: Training Analysis
Total annual training man-day requirements Total annual instructor contact hours (ICH) Total annual training device requirement Total annual requirement for classroom space Total annual training course cost	Examine the maintenance ratios that drive workload, manpower, personnel, and annual student input requirements to provide answers to previous Questions.	Examine the manpower requirements that drive personnel and annual student input requirements to provide answers to previous Questions.	Examine the personnel requirements that drive annual student input requirements to provide answers to previous Questions.	- Is the source of high annual training man-days, instructors, and course costs caused by excessive manpower and personnel pipeline requirements? - Are the high number of annual training man-days, annual ICH, course costs, etc., due to training tasks and course modules associated with a specific piece of equipment or a specific mission event? - Are the training device and facility requirements due to the training of tasks associated with a specific piece of equipment? - Were the selected comparable tasks, course modules, and courses the most appropriate?

Table 5-2. Questions Raised by the New System's Concepts

<u>Q&O CONCEPT</u> How will the New System and the units it is assigned to be organized? How will they operate? Under what conditions? At what operating tempo? What additional duty positions are required by policy? (i.e., crew chiefs, technical inspectors)	<u>MAINTENANCE CONCEPT</u> Where will the New System be maintained? How will the workload be distributed? How often will the system require maintenance actions? How much maintenance will be required to achieve the desired tempo; what influence does this required usage have on maintenance requirements? What test equipment (TMDE) is required? What is the maintenance burden of the TMDE?	<u>TARGET AUDIENCE DESCRIPTION</u> Who will operate and maintain the New System? Which soldiers (by MOS) are available to operate and maintain the system? What are the current skills and knowledge of these soldiers?	<u>TRAINING CONCEPT</u> What new skills and knowledge will soldiers need in order to operate and maintain the New System? How much of the Predecessor System's training tasks and course content is appropriate to support the New System? How many of the available soldiers have the aptitude and mental category required? What will the New System training concept require in terms of instructors, training time, training products, facilities, training resources, and training devices/equipment? What are the aptitude and mental categories of the soldiers available to operate and maintain the New System? What is the most cost/effective institutional and unit training strategy? What is the most cost effective mix of training devices and training equipment? * Note: Resolution of these questions would require analysis of several alternative training concepts.
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Substep 5.1: Conduct Systems Analysis Impact Analysis

Overview

In this substep the engineering analyst conducts a quality assurance review of the Systems Analysis results, primarily maintenance ratios. The analyst identifies unexpected results and uses the audit trail to find the cause of each result. After Substeps 5.2, 5.3, and 5.4 are completed, the analyst also determines whether an unexpected MPT result was caused by a Systems Analysis result. Figure 5.1-1 is an overview of this substep.

After the manpower, personnel, and training impact analyses have been completed, the engineering analyst may be asked to determine whether changes to the New System's design or concepts would alter subsequent MPT results. The engineering analyst should not alter the New System's design, Organizational and Operational (O&O) concept, or maintenance concept without the TAG's approval. Tradeoffs designed to reduce these impacts will be analyzed in Step 6, Tradeoff Analysis.

Because system design is driven by the system's missions, the analyst cannot alter the design without considering whether the Army can accept a system design with more conservative performance and still successfully complete its mission. Changes to the O&O concept can frequently change the operator tasks. Changes to the O&O would change the usage rates, which in turn affect the R&M values used to compute maintenance ratios. Changes to the O&O may also include the addition of system/subsystem automation, which will reduce or simplify operator requirements. These changes to the O&O may reduce operator manpower requirements and frequently reduce training requirements.

A change to the maintenance concept may shift workload from one maintenance level to another. This shift will reduce the workload for one MOS and increase it for another. Built-In-Test (BIT) or Built-In Test Equipment (BITE) will also alter the maintenance concept, but can effectively reduce complex maintenance tasks. The addition of BIT/BITE can be particularly successful in reducing the number of troubleshooting tasks that are frequently high drivers of manpower and training. The engineering analyst can use his or her expertise to help the TAG decide whether BIT/BITE or automated test sets would reduce the system's maintenance burden. The analyst must ensure that the TAG understands that the addition of BIT/BITE will include the addition of maintenance associated with the BIT/BITE. Consideration of the system's impact on MPT resources will help the TAG focus on issues to be considered as tradeoffs.

Although the HCM System's Analysis results do not affect the Army's resources, these results are frequently the source of impacts. The engineering sources of high MPT drivers must be clearly presented to the TAG for consideration by Army decision makers. This information is helpful early in the New System's acquisition before the New System's design becomes fixed.

The engineering analyst presents the Systems Analysis impacts in comparative tables. These tables compare the workload of similar subsystems/equipment in the Predecessor System's design and comparable equipment (from other systems like those used in the BCS) to the New System's subsystems/equipment.

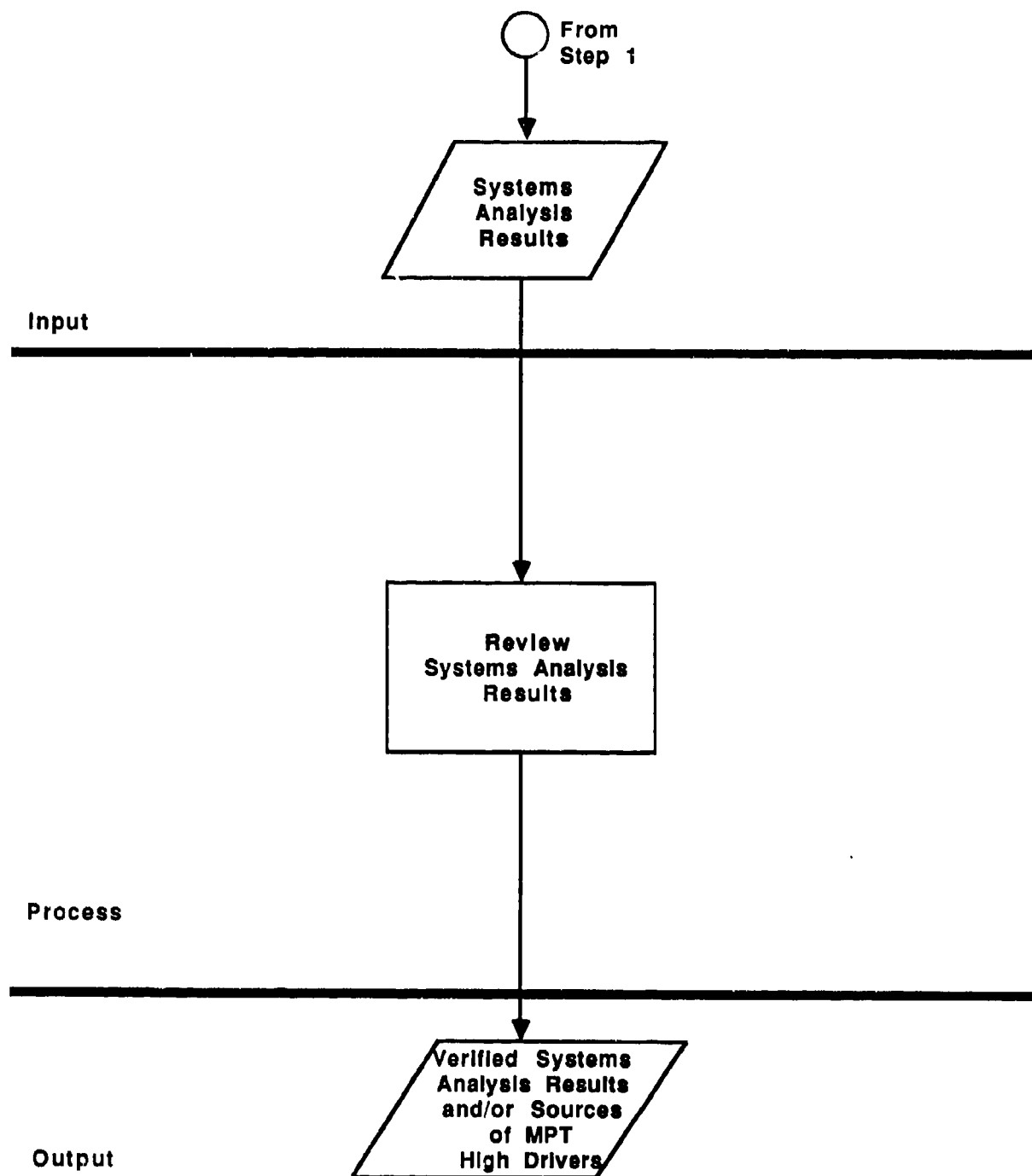


Figure 5.1-1. Overview of Substep 5.1, Conduct Systems Analysis Impact Analysis.

Action Step 1: Review Systems Analysis Results

Discussion

The engineering analyst has three objectives in this action step. First, the analyst conducts a quality assurance review by comparing the maintenance ratios (MRs) of the components in the Predecessor System, BCS, and New System to identify any unexpected results. The analyst performs this comparison by ranking the MRs and studying any significant differences among the system configurations.

The analyst's second objective is to trace the unexpected results through the audit trail to determine their causes. The cause of an unexpected result may be a mathematical error, a data source error, an analysis assumption, or a legitimate difference among the Predecessor System, the BCS, and the New System. The analyst must correct any mathematical or data errors and notify the manpower analyst so that he or she can recalculate workload and manpower.

The analyst's third objective is to determine whether an unexpected manpower, personnel, or training result was caused by a Systems Analysis result. The analyst performs this activity only if the manpower, personnel, or training analyst discovers an unexpected result for which he or she cannot find a cause.

Procedures

1. Rank Maintenance Ratios to Identify Unexpected Results.
 - Obtain from Substep 1.9 the MR for each component in the Predecessor System, BCS, and New System.
 - Sort the MRs by component, subsystem/system, maintenance level, and MOS.
 - Rank the MRs from the highest to the lowest.
 - For each sort, compare the New System's MRs with those of the BCS and Predecessor System. Identify any unexpected results.

2. Identify the Source of the Unexpected Result.

- Check relevant data and data sources. Be sure they accurately reflect equipment R&M characteristics.
- Check the allocation of R&M data to maintenance levels. Be certain the maintenance data are assigned to the appropriate maintenance level.
- Ensure that indirect workload has been removed from the R&M data.
- Investigate the derivation of the Mean Time To Repair (MTTR).
- Investigate the derivation of each Mean [Metric] Between Maintenance Actions (MMBMA).
- Investigate the required number of maintainers per maintenance action.
- Check for test equipment repair/service being included in the equipment MR.
- Check the operating tempo of the Predecessor System and BCS equipment used as an R&M data source. If the operating tempo is extremely high, investigate possible links to high frequency of reliability failures. If the operating tempo is extremely low, investigate possible links to low frequency of reliability failures.
- Check the BCS equipment to be certain that the best (most comparable) equipment was chosen.
- Check assumptions used in the development of Reliability-Centered Adjustment Factors (RCAF) and Maintainability-Centered Adjustment Factors (MCAF). Ensure that the RCAF and MCAF accurately reflect (mathematically) the BCS design differences and deficiencies. Ensure that engineering data to support the RCAF and MCAF are available.
- Recalculate any results that were based on erroneous data, calculations, assumptions, or improper application of procedures.

3. Document Explanations of the Unexpected Results in the HCM Audit Trail.

- Record the equipment characteristics that produced the unexpected results (e.g., abnormally high or low MTTR, MMBMA, etc.).
- Record other explanations that justify the unexpected result.

Procedure 1, 2, and 3 Examples

The analyst sorts the maintenance ratios for an aircraft's subsystems. These MRs are for the AVIM maintenance level and are associated with MOSs 68J and 39B.

<u>EIC</u>	<u>Equipment Nomenclature</u>	<u>BCS AVIM MR</u>	<u>New System AVIM MR</u>
303	TADS/PNVS Subsystem	0.3946	0.4025
306	Area Weapon Subsystem	0.3031	0.3031
302	Fire Control Subsystem	0.1189	0.1189
301	Armament Control Subsystem	0.1040	0.1040
304	Aerial Rocket Subsystem	0.1010	0.0606
305	HELLFIRE Subsystem	<u>0.0054</u>	<u>0.0054</u>
		1.0270	0.9945

The analyst investigates the high BCS and New System MRs for the TADS/PNVS. The analyst determines that the BCS MR is correct. The MR is caused by the subsystem's MTTR. The analyst then verifies that the New System's MR has been correctly derived by checking the magnitude, direction, and application of the Reliability-Centered Adjustment Factors (RCAFs) and Maintainability-Centered Adjustment Factors (MCAFs).

The analyst investigates the high BCS and New System MRs for the Area Weapon Subsystem and discovers that indirect maintenance time was not removed from the R&M data. The analyst removes the indirect maintenance time, corrects the MRs, and informs the manpower analyst.

The analyst investigates the improvement in the New System's MR for the Aerial Rocket Subsystem and discovers that it is due to an anticipated increase in reliability. This increase in reliability is reflected by an RCAF of .4. The analyst checks this RCAF value and concludes that it is a supportable New System assumption.

The analyst then investigates the low BCS and New System MRs for the HELLFIRE Subsystem. The analyst discovers that some of the AVIM tasks and associated maintenance times were included in the AVUM MR. The analyst corrects this, updates the BCS and New System MRs, and notifies the manpower analyst.

The analyst records the information from these investigations and updates the report as shown below.

(continued)

Procedure 1, 2, and 3 Examples (continued)

<u>EIC</u>	<u>Equipment Nomenclature</u>	<u>BCS AVIM MR</u>	<u>New System AVIM MR</u>
303	TADS/PNVS Subsystem	0.3946	0.4025
306	Area Weapon Subsystem	0.1521*	0.1521*
302	Fire Control Subsystem	0.1189	0.1189
301	Armament Control Subsystem	0.1040	0.1040
304	Aerial Rocket Subsystem	0.1010	0.0606
305	HELLFIRE Subsystem	<u>0.0098*</u>	<u>0.0098*</u>
		0.8804	0.8479

* Corrected MRs

Substep 5.2: Identify Manpower Impacts

Overview

In this substep the manpower analyst reviews the Manpower Requirements Analysis results and assesses the New System's impact on the Army's personnel supply. Figure 5.2-1 is an overview of this substep.

The analyst identifies unexpected results and determines their cause. After Substep 5.3 and 5.4 are completed, the analyst may have to examine the manpower results to determine whether they are the cause of an unexpected personnel or training result.

The analyst compares the Predecessor System's manpower requirements with the New System's manpower requirements to estimate the New System's impact on the Army's resources. The analyst develops "versions" of possible manpower allowances that satisfy the New System's manpower needs at various support levels.

The analyst compares authorized strengths and operating strengths at the system (i.e., Predecessor System to New System) level and at the total force level (i.e., current force to new force where the current force includes the Predecessor System and the new force includes the New System).

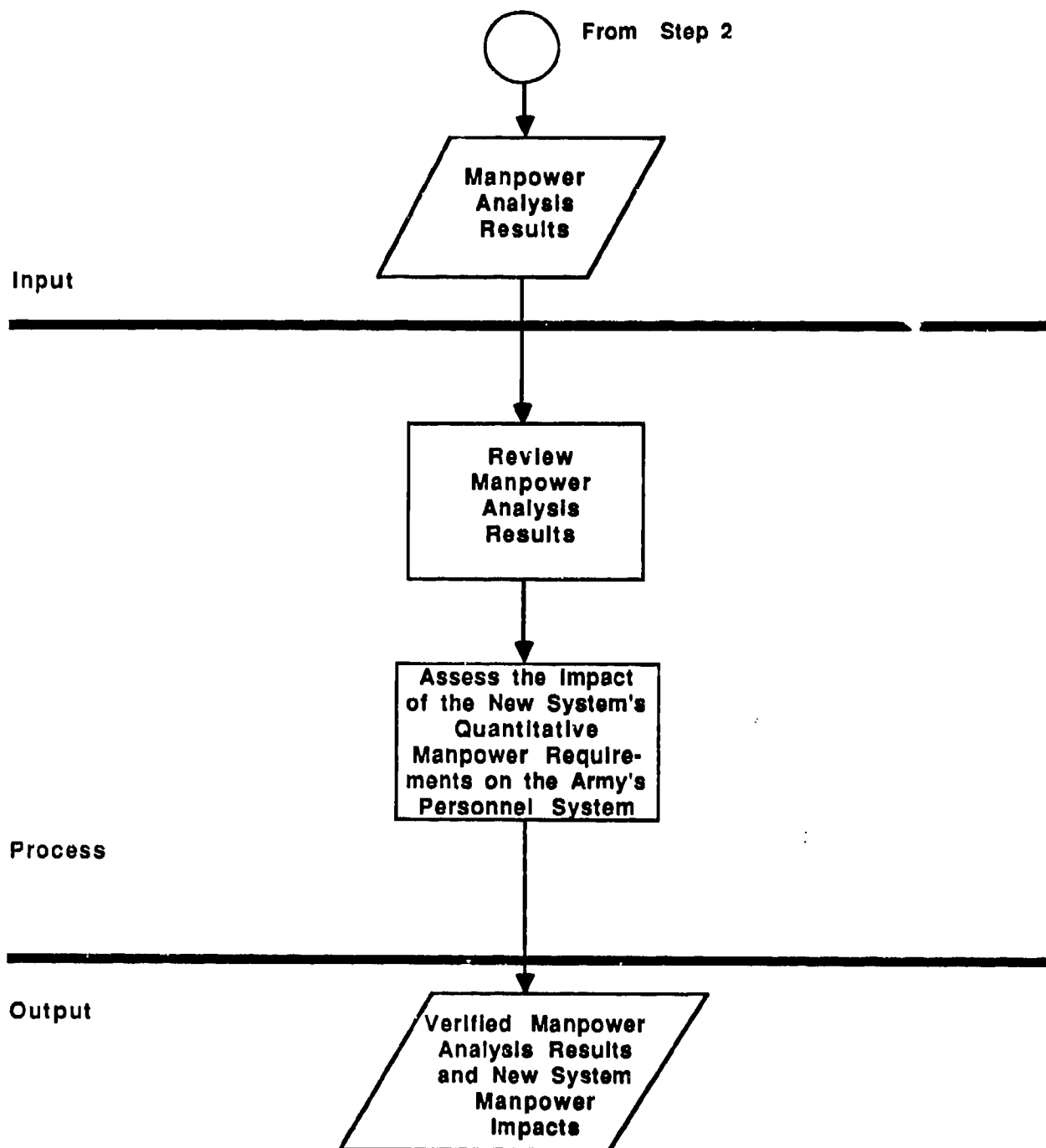


Figure 5.2-1. Overview of Substep 5.2, Identify Manpower Impacts.

Action Step 1: Review Manpower Requirements Analysis Results

Discussion

The manpower analyst has three objectives in this action step. First, the analyst conducts a quality assurance review by comparing the manpower requirements of the Predecessor System, BCS, and New System to identify any unexpected results. The analyst performs this comparison by ranking the manpower results and studying any significant differences among the system configurations.

The analyst's second objective is to trace the unexpected results through the audit trail to determine their causes. The cause of an unexpected result may be a mathematical error, a data source error, an analysis assumption, or a legitimate difference among the Predecessor System, the BCS, and the New System. The analyst must correct any mathematical or data errors and notify the personnel and training analysts so that they can recalculate the personnel and training requirements.

The analyst's third objective is to determine whether an unexpected personnel or training result was caused by a manpower result. The analyst performs this activity only if the personnel or training analyst discovers an unexpected result for which he or she cannot find a cause.

Procedures

1. **Rank Workload and Manpower Requirements to Identify Unexpected Results.**
 - Obtain workload and manpower requirements from Substeps 2.2, 2.3, 2.4, and 2.5 for the Predecessor System, BCS, and New System.
 - Sort the workload by component, MOS, maintenance level, and unit.
 - Sort the manpower by MOS, maintenance level, and unit.
 - Rank the workload and manpower from the highest value to the lowest value.
 - Compare the New System's workload and manpower requirements with those of the BCS and Predecessor System. Identify any unexpected results.

2. Identify the Source of the Unexpected Result.

- Check all mathematical computations used in the derivation of workload and manpower requirements.
- Check relevant data and data sources. Ensure that the data accurately reflect workload and manpower requirements.
- Ensure that indirect workload has been removed from the R&M data.
- Check the derivation of equipment workload.
- Ensure that all maintenance tasks have been assigned to the correct maintenance level.
- Ensure that the correct MOSs are performing the required maintenance.
- Ensure that test equipment maintenance has not been embedded in the maintenance workload.
- Check the development of system densities used in the manpower equation.
- Check the Available Productive Man-Hours (APMH) used in the manpower equation for their currency and applicability to the MOS and unit.
- Check the rounding procedures and assumptions that were applied to the manpower results.
- Check for partial manpower requirements that have been rounded up to the nearest whole person.
- Check policy-driven manpower requirements.
- Check that the Standards of Grade have been properly applied to the manpower requirements.
- Recalculate any results that were based on erroneous data, calculations, assumptions, or the improper application of HCM procedures.

3. Document Explanations of Unexpected Results in the HCM Audit Trail.

- Record detailed explanations of unexpected results, e.g., high workload values, prescribed distribution of workload across maintenance levels, etc.

Procedure 1, 2, and 3 Examples

In an HCM analysis of a notional attack helicopter, the analyst sorts workload by MOS and maintenance level for the Predecessor System*, BCS, and New System. The workload is based on a one-year period and includes total system equipment (total helicopter workload).

Sort 1: AVUM workload

<u>MOS</u>	<u>Predecessor</u>	<u>BCS</u>	<u>New</u>
67R/Y	*	1071.1**	1881.8
68J		1065.7	1044.7
35K		769.0	739.6
68M		433.8	433.8
66R/Y		277.5	277.5
68F		259.2	259.2
66J		224.9	221.8
68G		124.1	174.7
68B		121.2	90.1
68D		71.9	71.9
		<u>4418.4</u>	<u>5195.1</u>

Sort 2: AVIM workload

<u>MOS</u>	<u>Predecessor</u>	<u>BCS</u>	<u>New</u>
68F	*	841.2	841.2
68J		475.7	455.3
68M		342.8	342.8
68G		341.3	311.3
66R/Y		246.3	246.3
68H		281.6	209.5
39B		205.9	205.9
68B		199.1	199.1
35L		226.6	155.6

* The Predecessor System manpower requirements in this example were determined using the TDE.

** Value was found to be in error. Replaced with 2082.1.

(continued)

Procedure 1, 2, and 3 Examples (continued)

<u>MOS</u>	<u>Predecessor</u>	<u>BCS</u>	<u>New</u>
35M		129.3	128.7
66J		122.8	119.7
68D		81.8	81.8
29S		10.1	10.1
67R/Y		6.0	6.0
		<u>3723.5</u>	<u>3454.6</u>

The analyst investigates the workload values for the following MOSs:

67R/Y at AVUM (BCS and New)
68J at AVUM (BCS)
68M at AVUM and AVIM (New)

The analyst discovers an error in the BCS workload calculation for the 67R/Y. The analyst corrects the error and derives the correct workload value of 2082.1.

The analyst investigates the BCS workload for 68J at AVUM and determines the workload value is due to the complexity of the AVUM maintenance requirement for the Fire Control Computer. The analyst documents this for later presentation at an IPR.

The analyst investigates the New System workload for MOS 68M at both AVUM and AVIM and determines that the workload value is due to the high maintenance requirements of the 30mm gun system. The analyst documents this for later use.

The analyst then sorts the manpower requirements for the Predecessor System, BCS, and New System by MOS, maintenance level, and unit. The manpower requirements in the example are based on total system equipment.

(continued)

Procedure 1, 2, and 3 Examples (continued)

Sort 1: AVUM Manpower
Unit: Attack Battalion III (ATKH BN III) (AVUM)
Predecessor Aircraft Density: 21
BCS/New Aircraft Density: 18
APMH: 1,241 hours

<u>MOS</u>	<u>Predecessor</u>	<u>BCS</u>		<u>New</u>	
67R/Y	33	30.2	(30)	27.3	(27)
68J	21	15.5	(16)	15.1	(15)
35K	8	11.2	(11)	10.7	(11)
68M	7	6.3	(6)	6.3	(6)
66R/Y	3	4.0	(4)	4.0	(4)
68F	1	3.8	(4)	3.8	(4)
66J	6	3.3	(3)	3.2	(3)
68G	3	1.8	(2)	2.5	(3)
68B	1	1.8	(2)	1.3	(1)
68D	1	1.0	(1)	1.0	(1)

Sort 2: AVIM Manpower
Unit: III Corps (AVIM)
Predecessor Aircraft Density: 63
BCS/Proposed Aircraft Density: 54
APMH: 1,423 hours

<u>MOS</u>	<u>Predecessor</u>	<u>BCS</u>		<u>Proposed</u>	
68F	7	31.9	(32)	31.9	(32)
68J	32	18.1	(18)	17.3	(17)
68M	23	13.0	(13)	13.0	(13)
68G	4	13.0	(13)	11.8	(12)
66R/Y	5	9.3	(9)	9.3	(9)
68H	2	10.7	(11)	8.0	(8)
39B	0	7.8	(8)	7.8	(8)
68B	8	7.6	(8)	7.6	(8)
35L	15	8.6	(9)	5.9	(6)
35M	15	8.1	(8)	5.4	(5)
35R	23	4.9	(5)	4.9	(5)
66J	13	4.7	(5)	4.5	(5)
68D	8	3.1	(3)	3.1	(3)
29S	0	.4	(1)	.4	(1)
67R/Y	1	.2	(1)	.2	(1)

The analyst again investigates the unexpected results and documents their source. Unexpected results are revealed by shifts in ranking. The question the analyst must ask is: "Why did this component's maintenance load increase or decrease so dramatically?"

Action Step 2: Assess the Impact of the New System's Quantitative Manpower Requirements on the Army's Personnel System

Discussion

In this action step the analyst determines the New System's impact on the Army's resources. The analyst compares the New System's manpower requirements with the current and projected personnel system.

The analyst will use the following four terms in this action step:

- Required strength is the minimum manpower needed to accomplish the wartime mission(s) of an MOS (or a unit).
- Authorized Strength is the manpower the Army can afford to assign to an MOS (or a unit) during peacetime.
- Operating Strength is the actual number of soldiers assigned to an MOS (or a unit).
- End Strength is the total Active Army manpower. It is currently set at 780,900 Officers and Enlisted. Of this 780,900 individuals, 4,550 are West Point Cadets, and 108,120 are Warrant, Commissioned, and General Officers. This leaves an Enlisted end strength of 668,230, and of this number, 82,500 soldiers are in Transient, Trainee, Holdee, and Student (TTHS) status, leaving 585,730 soldiers for the force structure allowance. These 585,730 soldiers can be used to fill the spaces in each of the MOSs. The 585,730 soldiers are also used to build each of the units in the force structure. The introduction of a New System to the force must be accommodated by this force structure allowance.

The analyst makes the following assumptions when performing this action step:

- Authorized strength may be equal to, but cannot exceed, required strength¹.
- Operating strength may be equal to, but cannot exceed, authorized strength².

¹AR310-49, *The Army Authorization Documents System (TAADS)*, Paragraph 3-4

²AR600-200, *Enlisted Personnel Management System (Chapter 3)*. The analyst should note that although these regulations reflect Army policy, personnel managers are sometimes not able to maintain these stated requirements.

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- Personnel data and personnel projections from Government sources are valid for the purposes of HCM Impact Analysis.
 - New System manpower requirements are valid estimates for purposes of Impact Analysis.
 - The system-specific approach of an HCM analysis requires the assumption that no soldiers are shared with other systems. This assumption frequently leads to the "rounding-up" of manpower requirements to the nearest "whole body."
 - The current Army "End Strength" totals will continue at the same levels.

The analyst compares the current personnel assets to the New System's quantitative manpower requirements. The basic question to be answered by this comparison is: "Will the available personnel assets satisfy the New System's quantitative manpower needs?"

NOTE

The procedures in this action step deal with quantities of soldiers by MOS. An MOS is a qualitative label. However, Substep 5.3 deals more specifically with the New System's qualitative demands.

Procedures

1. **Identify Manpower High Drivers.**
 - Obtain from Step 2 the Predecessor System manpower requirements (PSR) and the New System manpower requirements (NSR) by MOS. Record the PSR and the NSR on Worksheet 5.2-1.
 - Compare the PSR with the NSR and determine manpower high drivers and extreme differences in manpower requirements.
2. **Obtain Army Personnel Supply Data.**
 - Obtain the Current Required Strength (CRS) and the Current Authorized Strength (CAS) by MOS from The Army Authorization Document System (TAADS).
 - Obtain from the TAPA Force Management Books I and II the Current Operating Strength (COS), the Projected Authorized Strength (PAS), and the Projected Operating Strength (POS) by MOS.
 - Record these data on Worksheet 5.2-2.

3. Determine Current Force Levels of Support.

- List the CRS and the COS on Worksheet 5.2-3.
- Use the following formula to calculate the current force levels of support (A):

$$LSA = \frac{COS}{CRS}$$

Where:

LSA = Version A Levels of Support

CRS = Current Required Strength

COS = Current Operating Strength

4. Determine the New Force Required Strength (NRS).

- List on Worksheet 5.2-4 the CRS, the PSR, and the NSR for each MOS.
- Subtract the PSR from the CRS, then add the NSR. Record the New Force Required Strength (NRS) on Worksheet 5.2-4.
- Compare the CRS with the estimated NRS to determine potential new force personnel shortfalls and excesses. Record these new force differences on Worksheet 5.2-4.
- Examine the results obtained for the total MOS populations and the new force differences. Identify MOS high drivers that have emerged as a result of the New System's manpower requirements.

5. Determine the New System's Manpower Shortfalls and Excesses Based on Current Levels of Support.

- List the NSR and LSA by MOS on Worksheet 5.2-5.
- Multiply the NSR by the LSA to determine the Estimated New System Operating Strength (Version A).
- Compare the NSR with the Estimated New System Operating Strength (A). Record the New System's potential manpower shortfalls and excesses on Worksheet 5.2-5.

6. Determine the Estimated New Force Levels of Support.

NOTE

This procedure assumes that the current operating strength will be the future operating strength.

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- List the NRS and the Current Operating Strength (COS) on Worksheet 5.2-6.
 - Use the following formula to calculate the Estimated New Force Levels of Support (B):

$$LSB = \frac{COS}{NRS}$$

Where:

LSB = Version B Levels of Support

NRS = New Force Required Strength

COS = Current Operating Strength

7. Determine the New System's Manpower Shortfalls and Excesses Based on Estimated New Force Levels of Support.

- List the NSR and LSB on Worksheet 5.2-7.
- Multiply the NSR by the LSB to determine the Estimated New System Operating Strength (Version B).
- Compare the NSR with the Estimated New System Operating Strength (B). Record the New System's potential manpower shortfalls and excesses on Worksheet 5.2-7.

NOTE

The New System's potential manpower shortfalls and excesses are based on the assumption that the Current Operating Strength will not change.

8. Determine the New Force Projected Levels of Support.

- List the NRS and the Projected Operating Strength (POS) on Worksheet 5.2-8.
- Use the following formula to calculate the new force projected levels of support (C):

$$LSC = \frac{POS}{NRS}$$

Where:

LSC = Version C Levels of Support

POS = Projected Operating Strength

NRS = New Force Required Strength

9. Determine the New System's Manpower Shortfalls and Excesses Based on the New Force Projected Levels of Support.

- List the NSR and the LSC on Worksheet 5.2-9.

-
- Multiply the NSR by the LSC to determine the Projected New System Operating Strength (Version C).
 - Compare the NSR with the Projected New System Operating Strength (C). Record the New System's potential manpower shortfalls and excesses on Worksheet 5.2-9.
10. **Format Findings for Presentation to Army Decision Makers.**
- List on Worksheet 5.2-10 the NSR and the Version A, B, and C levels of support.
11. **Develop Current Levels of Authorized Support.**
- List the CRS and CAS, by MOS, on Worksheet 5.2-11.
 - Use the following formula to calculate the current levels of authorized support (D):
$$LSD = \frac{CAS}{CRS}$$

Where:

LSD = Version D Levels of Support
CAS = Current Authorized Strength
CRS = Current Required Strength
12. **Determine the New System's Authorized Strength Based on the Version D Current Levels of Authorized Support.**
- List the NSR and the LSD on Worksheet 5.2-12.
 - Multiply the NSR by the LSD to determine the Projected New System Authorized Strength (Version D).
 - Compare the NSR with the Projected New System Authorized Strength (D). List the New System's potential manpower shortfalls and excesses on Worksheet 5.2-12.
13. **Develop Projected Levels of Support.**
- List the NRS and PAS on Worksheet 5.2-13.
 - Use the following formula to calculate the Version E levels of support:
$$LSE = \frac{PAS}{NRS}$$

Where:

LSE = Version E Levels of Support
NRS = New Force Required Strength
PAS = Projected Authorized Strength

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14. **Determine the New System's Authorized Strength Based on the Version E Projected Levels of Authorized Support.**
 - List the NSR and the LSE on Worksheet 5.2-14.
 - Multiply the NSR by the LSE to determine the Projected New System Authorized Strength (Version E).
 - Compare the NSR with the Projected New System Authorized Strength (E). List the New System's potential manpower shortfalls and excesses on Worksheet 5.2-14.
 15. **Format Additional Manpower Impacts for Presentation to Army Decision Makers.**
 - List on Worksheet 5.2-15 the NSR, the New System's Projected Authorized Strength (Version D), and the New System's Projected Authorized Strength (Version E).

Procedure 1 Example

The analyst obtains the Predecessor System and New System manpower requirements from Step 2.

<u>MOS</u>	<u>Predecessor Manpower Requirements (PSR)</u>	<u>New System Manpower Requirements (NSR)</u>
29S	15	15
35K	224	286
35L	93	56
35M	93	52
35R	215	47
39B	0	75
66J	187	131
66R	0	127
66Y	121	0
67R	0	771
67Y	1092	0
68B	56	103
68D	65	56
68F	47	411
68G	56	196
68H	15	75
68J	877	574
68M	411	289

The analyst compares the Predecessor System's manpower requirements with the New System's manpower requirements and learns the following:

- Manpower requirements have been created for 39B, 66R, and 67R.
- Manpower requirements have been eliminated for 66Y and 67Y.
- Manpower requirements have increased for 35K, 68B, 68F, 68G, and 68H.
- Manpower requirements have decreased for 35L, 35M, 35R, 66J, 68D, 68J, and 68M.

The analyst investigates the cause of manpower high drivers and of results that reflect great differences between the Predecessor System and New System requirements.

Procedure 2 Example

The analyst obtains the required and authorized strengths of each MOS from TAADS.

<u>MOS</u>	<u>Current Required Strength (CRS)</u>	<u>Current Authorized Strength (CAS)</u>
29S	1024	909
35K	696	668
35L	380	331
35M	254	206
35R	337	271
39B	353	233
66J	187	165
66R	93	84
66Y	181	184
67R	673	618
67Y	1421	1450
68B	697	658
68D	578	539
68F	489	478
68G	846	778
68H	209	191
68J	968	896
68M	507	483

The analyst obtains the Current Operating Strengths from the TAPA Force Management Books. The analyst also obtains the Projected Authorized and Operating Strengths of each MOS in the force.

<u>MOS</u>	<u>Current Operating Strength (COS)</u>	<u>Projected Authorized Strength (PAS)</u>	<u>Projected Operating Strength (POS)</u>
29S	883	941	1016
35K	689	711	756
35L	287	390	417
35M	234	242	262
35R	196	382	357
39B	159	230	209

(continued)

Procedure 2 Example (continued)

<u>MOS</u>	<u>Current Operating Strength (COS)</u>	<u>Projected Authorized Strength (PAS)</u>	<u>Projected Operating Strength (POS)</u>
66J	142	143	147
66R	61	107	134
66Y	214	183	254
67R	510	790	989
67Y	1866	1656	1586
68B	910	636	751
68D	535	651	646
68F	571	511	547
68G	1168	836	829
68H	220	190	175
68J	1004	975	983
68M	508	534	585

Procedure 3 Example

The analyst uses the CRS and COS to calculate the current levels of support for each MOS. The analyst calculates a ratio of Current Operating Strength to Current Required Strength.

MOS	Current Required Strength (CRS)	Current Operating Strength (COS)	Current Levels of Support Version A (LSA)	
			<u>COS</u> <u>CRS</u>	
29S	1024	863	(.843)	84%
35K	696	689	(.990)	99%
35L	380	287	(.755)	76%
35M	254	234	(.921)	92%
35R	337	196	(.582)	58%
39B	353	159	(.450)	45%
66J	187	142	(.759)	76%
66R	93	61	(.656)	66%
66Y	181	214	(1.182)	118%
67R	673	510	(.758)	76%
67Y	1421	1866	(1.313)	131%
68B	697	910	(1.306)	131%
68D	578	535	(.926)	93%
68F	489	571	(1.168)	117%
68G	846	1168	(1.381)	138%
68H	209	220	(1.053)	105%
68J	968	1004	(1.037)	104%
68M	507	508	(1.002)	100%

Procedure 4 Example

The analyst determines the new force required strength using the required strength data from TAADS and the HCM Predecessor System and New System manpower requirements.

MOS	Current Required Strength (CRS)	Minus (-) the Predecessor System Requirements (PSR)	Plus (+) the New System Requirements (NSR)	New Force Required Strength (NRS)	New Force Differences
29S	1024	15	15	1024	FS
35K	696	224	286	758	+62
35L	380	93	56	343	-37
35M	254	93	52	213	-41
35R	337	215	47	169	-168
39B	353	NR	75	428	+75
66J	187	187	131	131	-56
66R	93	NR	127	220	+127
66Y	181	121	NR	60	-121
67R	673	NR	771	1444	+771
67Y	1421	1092	NR	329	-1092
68B	697	56	103	744	+47
68D	578	65	56	569	-9
68F	469	47	411	853	+364
68G	846	56	196	986	+140
68H	209	15	75	269	+60
68J	968	877	574	665	-303
68M	507	411	289	386	-122

- indicates manpower savings

+ indicates manpower increase

FS indicates MOS at full strength

NR indicates no requirement

The analyst examines the results and identifies the MOSs that are significantly affected by the New System's requirements.

Procedure 5 Example

The analyst determines the estimated New System operating strength. This strength assumes that the Army will continue to support each MOE at the current levels of support (i.e., the same ratio of operating strength to required strength).

MOS	New System Requirements (NSR)	Current Levels of Support (Version A)	Estimated New System Operating Strength (A)	New System Manpower Shortfalls (-) and Excesses (+)(A)
		<u>COS</u> <u>CRS</u>		
29S	15	84%	13	-2
36K	286	99%	283	-3
36L	56	76%	43	-13
35M	52	92%	48	-4
35R	47	58%	27	-20
39B	75	45%	34	-41
66J	131	76%	100	-31
66R	127	66%	84	-43
66Y	0	NR	NR	NR
67R	771	76%	586	-185
67Y	0	NR	NR	NR
68B	103	131%	135	-32
68D	56	93%	52	-4
68F	411	117%	481	+70
68G	196	138%	270	+74
68H	75	105%	79	+4
68J	574	104%	597	+23
68M	289	100%	289	FS

Procedure 6 Example

The analyst uses the New Force Required Strength (NRS) and the Current Operating Strength (COS) from the TAPA Force Management Books to estimate new force levels of support.

MOS	New Force Required Strength (NRS)	Current Operating Strength (COS)	Estimated New Force Levels of Support Version B (LSB)	
			COS NRS	
29S	1024	863	(.843)	84%
35K	758	689	(.909)	91%
35L	343	287	(.837)	84%
35M	213	234	(1.099)	110%
35R	169	196	(1.160)	116%
39B	428	159	(.371)	37%
66J	131	142	(1.084)	108%
66R	220	61	(.277)	28%
66Y	60	214	(3.567)	357%
67R	1444	510	(.353)	35%
67Y	329	1866	(5.672)	567%
68B	744	910	(1.223)	122%
68D	569	535	(.940)	94%
68F	853	571	(.669)	67%
68G	986	1168	(1.185)	118%
68H	269	220	(.818)	82%
68J	665	1004	(1.510)	151%
68M	385	508	(1.319)	132%

Procedure 7 Example

The analyst determines that if the Army supports each MOS at the Version B levels of support (assumes Current Operating Strength will not change) the operating strengths of the soldiers assigned to the New System will be the Estimated New System Operating Strength (B) shown below.

<u>MOS</u>	<u>New System Requirement (NSR)</u>	<u>Version B Levels of Support (LSB)</u>	<u>Estimated New System Operating Strength (B)</u>	<u>New System Manpower Shortfalls and Excesses (L)</u>
29S	15	84%	13	-2
35K	286	91%	260	-26
35L	56	84%	47	-9
35M	52	110%	57	+5
35R	47	116%	55	+8
39B	75	37%	28	-47
66J	131	108%	141	+10
66R	127	28%	36	-91
66Y	NR	357%	NR	NR
67R	771	35%	270	-501
67Y	NR	567%	NR	NR
68B	103	122%	126	+23
68D	56	94%	53	-3
68F	411	67%	275	-136
68G	196	118%	231	+35
68H	75	82%	62	-13
68J	574	151%	867	+293
68M	289	132%	381	+92

Procedure 8 Example

The analyst uses the HCM projection of new force requirements and Army projections from the TAPA Force Management Books to determine projected levels of support.

<u>MOS</u>	<u>New Force Required Strength (NRS)</u>	<u>Projected Operating Strength (POS)</u>	<u>Projected Levels of Support Version C</u>	
			<u>POS</u>	<u>NRS</u>
29S	1024	1016	(.992)	99%
35K	758	756	(.997)	98%
35L	343	417	(1.216)	122%
35M	213	262	(1.230)	123%
35R	169	357	(2.112)	211%
39B	428	209	(.488)	49%
66J	131	147	(1.122)	112%
66R	220	134	(.609)	61%
66Y	60	254	(4.233)	423%
67R	1444	989	(.685)	69%
67Y	329	1586	(4.821)	482%
68B	744	751	(1.009)	101%
68D	569	645	(1.134)	113%
68F	863	647	(.641)	64%
68G	986	829	(.841)	84%
68H	269	175	(.651)	65%
68J	665	983	(1.478)	148%
68M	385	585	(1.519)	152%

Procedure 9 Example

The analyst determines that if the Army supports each MOS at the Version C levels of support, the operating strength of the soldiers available for assignment to the New System will be the Projected New System Operating Strength (C) shown below.

<u>MOS</u>	<u>New System Requirements (NSR)</u>	<u>Projected Levels of Support (C) POS NRS</u>	<u>Projected New System Operating Strength (C)</u>	<u>New System Manpower Shortfalls (-) Excesses (+) (C)</u>
29S	15	99%	15	FS
35K	286	98%	280	-6
35L	56	122%	68	+12
35M	52	123%	64	+12
35R	47	211%	99	+52
39B	75	49%	37	-38
66J	131	112%	147	+16
66R	127	61%	77	-50
66Y	NR	NR	NR	NR
67R	771	69%	532	-239
67Y	NR	NR	NR	NR
68B	103	101%	104	+1
68D	56	113%	63	+7
68F	411	64%	263	-148
68G	196	84%	165	-31
68H	75	65%	49	-26
68J	574	148%	850	+276
68M	289	152%	439	+150

Procedure 10 Example

The analyst displays the Version A, B, and C operating strengths.

<u>MOS</u>	<u>New System Requirements (NSR)</u>	<u>Estimated New System Operating Strength (Version A)</u>	<u>Estimated New System Operating Strength (Version B)</u>	<u>Projected New System Operating Strength (Version C)</u>
29S	15	13	13	15
35K	286	283	260	280
35L	56	43	47	68
35M	52	48	57	64
35R	47	27	55	99
395	75	34	28	37
66J	131	100	141	147
66R	127	84	36	77
66Y	NR	NR	NR	NR
67R	771	586	270	532
67Y	NR	NR	NR	NR
68B	103	135	126	104
68D	56	52	53	63
68F	411	481	275	263
68G	196	270	231	165
68H	75	79	62	49
68J	574	597	867	850
68M	289	289	381	439

The Army's Technical Advisory Group (TAG) may request that the analyst use the Version A, B, or C estimates of the New System's operating strength to generate personnel pipeline requirements in Step 3. Because HCM manpower requirements are generated for a wartime maintenance tempo, projections of peacetime operating strength are more appropriate for generating the personnel pipeline. The "intake to paygrade" used to generate student input for the Training Resource Requirements Analysis (Step 4) should also be the peacetime operating strength.

Procedure 11 Example

The analyst calculates the Version D levels of support to show the current ratio of authorizations to requirements.

MOS	Current Required Strength (CRS)	Current Authorized Strength (CAS)	Version D Levels of Support	
			<u>CAS</u> <u>CRS</u>	
29S	1024	909	(.888)	89%
35K	696	668	(.960)	96%
35L	380	331	(.871)	87%
35M	254	206	(.811)	81%
35R	337	271	(.804)	80%
39B	353	233	(.660)	66%
66J	187	165	(.882)	88%
66R	93	84	(.903)	90%
66Y	181	184	(1.017)	102%
67R	673	618	(.918)	92%
67Y	1421	1450	(1.020)	102%
68B	697	658	(.944)	94%
68D	578	539	(.933)	93%
68F	489	478	(.978)	98%
68G	846	778	(.920)	92%
68H	209	191	(.914)	91%
68J	968	896	(.926)	93%
68M	507	483	(.953)	95%

Procedure 12 Example

The analyst determines that if the Army supports each MOS at the Version D levels of support, the authorized strength of the soldiers available for assignment to the New System will be the Projected New System Authorized Strength (D) shown below.

<u>MOS</u>	<u>New System Requirements (NSR)</u>	<u>Version D Levels of Support CAS CRS</u>	<u>Projected New System Authorized Strength (D)</u>	<u>New System Manpower Shortfalls (-) Excesses (+)(D)</u>
29S	15	89%	13	- 2
35K	286	96%	275	-11
35L	56	87%	49	- 7
35M	52	81%	42	-10
35R	47	80%	38	- 9
39B	75	66%	50	-25
66J	131	88%	115	-16
66R	127	90%	114	-13
66Y	NR	102%	NR	NR
67R	771	92%	709	-62
67Y	NR	102%	NR	NR
68B	103	94%	97	- 6
68D	56	93%	52	- 4
68F	411	98%	403	- 8
68G	196	92%	180	-16
68H	75	91%	68	- 7
68J	574	93%	534	-40
68M	289	95%	275	-14

Procedure 13 Example

The analyst calculates the Version E levels of support using the NRS and Army projections from the TAPA Force Management Books.

MOS	New Force Required Strength (NRS)	Projected Authorized Strength (PAS)	Version E Projected Levels of Support	
			PAS NRS	
29S	1024	941	(.919)	92%
35K	758	711	(.938)	94%
35L	343	390	(1.137)	114%
35M	213	242	(1.136)	114%
35R	169	382	(2.260)	226%
39B	428	230	(.537)	54%
66J	131	143	(1.092)	109%
66R	220	107	(.486)	49%
66Y	60	183	(3.050)	305%
67R	1444	790	(.547)	55%
67Y	329	1656	(5.033)	503%
68B	744	636	(.855)	86%
68D	569	651	(1.144)	114%
68F	853	511	(.599)	60%
68G	986	836	(.848)	85%
68H	269	190	(.706)	71%
68J	665	975	(1.466)	147%
68M	385	534	(1.387)	139%

Procedure 14 Example

The analyst determines that if the Army supports each MOS at the Version E levels of support, the Projected Authorized Strength of the soldiers available for assignment to the New System will be the Projected New System Authorized Strength (E) shown below.

MOS	New System Requirements (NSR)	Version E Projected Levels of Support PS NSR	Projected New System Authorized Strength (E)	New System Manpower Shortfalls (-) Excesses (+) (E)
29S	16	92%	14	-1
35K	286	94%	269	-17
35L	56	114%	64	+8
35M	52	114%	59	-7
35R	47	226%	106	+59
39B	75	54%	41	-34
66J	131	109%	143	+12
66R	127	49%	62	-65
66Y	NR	305%	NR	NR
67R	771	55%	424	-347
67Y	NR	503%	NR	NR
68B	103	86%	89	-14
68D	56	114%	64	+8
68F	411	60%	247	-164
68G	196	85%	167	-29
68H	75	71%	53	-22
68J	574	147%	844	+270
68M	289	139%	402	+113

Procedure 15 Example

The analyst displays the Projected Authorized Strengths (D and E).

<u>MOS</u>	<u>New System Requirements (NSR)</u>	<u>Projected New System Authorized Strength (Version D)</u>	<u>Projected New System Authorized Strength (Version E)</u>
29S	15	13	14
35K	286	275	289
35L	56	49	64
35M	52	42	59
35R	47	38	106
39B	75	50	41
66J	131	115	143
66R	127	114	62
66Y	NR	NR	NR
67R	771	709	424
67Y	NR	NR	NR
68B	103	97	89
68D	56	52	64
68F	411	403	247
68G	196	180	167
68H	75	68	53
68J	574	534	844
68M	289	276	402

The summary results should be presented to the Army's Technical Advisory Group (TAG) and to Army personnel managers. The HCM analysts and HCM manager should ask the TAG which of these manpower versions (i.e., Versions A, B, C, D, or E) should be used as input to Step 3. The HCM New System manpower requirements (NSR) are wartime requirements. To assume that the New System would be manned to its wartime requirements during peacetime would be erroneous. Wartime requirements would produce high HCM personnel pipeline results because the HCM personnel model uses peacetime flow rates.

The analyst should also compare the New System Required Authorized and Operating Strength manpower values with those of the Predecessor System. The analyst can then provide the Army with an indication of the New System's impact on the available personnel supply.

**SUBSTEP 5.2
WORKSHEETS**

WORKSHEET 5.2-1

Use this worksheet to identify manpower high drivers.

MOS	Predecessor System Manpower Requirements (PSR)	New System Manpower Requirements (NSR)	Manpower High Drivers

WORKSHEET 5.2-2

Use this worksheet to list the Army personnel system data.

MOS	Current Required Strength (CRS)	Current Authorized Strength (CAS)	Current Operating Strength (COS)	Projected Authorized Strength (PAS)	Projected Operating Strength (POS)

WORKSHEET 5.2-3

Use this worksheet to determine the current force levels of support (LSA).

MOS	CRS	COS	Current Levels of Support Version A (LSA)

WORKSHEET 5.2-4

Use this worksheet to determine the new force required strength (NRS).

MOS	CRS - PSR + NSR = New Force Required Strength (NRS)	New Force Differences

WORKSHEET 5.2-5

Use this worksheet to determine the New System's manpower shortfalls and excesses based on current levels of support.

MOS	NSR	LSA	Estimated New System Operating Strength (A)	New System Manpower Shortfalls and Excesses

WORKSHEET 5.2-6

Use this worksheet to determine the estimated new force levels of support (LSB).

MOS	NRS	COS	Estimated New Force Levels of Support Version B (LSB)

WORKSHEET 5.2-7

Use this worksheet to determine the New System's manpower shortfalls and excesses if the Army were to provide the new force levels of support.

MOS	NSR	LSB	Estimated New System Operating Strength (B)	New System Manpower Shortfalls and Excesses (B)

WORKSHEET 5.2-8

Use this worksheet to determine the new force projected levels of support (LSC).

MOS	NSR	POS	Projected Levels of Support (C)

WORKSHEET 5.2-9

Use this worksheet to determine the New System's manpower shortfalls and excesses based on the projected levels of support.

MOS	NSR	LSC	Projected New System Operating Strength (C)	New System Manpower Shortfalls and Excesses (C)

WORKSHEET 5.2-10

Use this worksheet to display levels of support findings.

MOS	NSR	Version A	Version B	Version C

WORKSHEET 5.2-11

Use this worksheet to determine the current levels of authorized support (LSD).

MOS	CRS	CAS	Current Levels of Authorized Support (D)

WORKSHEET 5.2-12

Use this worksheet to determine the New System's Authorized Strength based on the current levels of authorized support (D).

MOS	NSR	LSD	Projected New System Authorized Strength (D)	New System Manpower Shortfalls and Excesses (D)

WORKSHEET 5.2-13

Use this worksheet to determine projected levels of support (LSE).

MOS	NRS	PAS	Projected Levels of Support (E)

WORKSHEET 5.2-14

Use this worksheet to determine the New System's Authorized Strength based on the projected levels of authorized support (E).

MOS	NSR	LSE	Projected New System Authorized Strength (E)	New System Manpower Shortfalls and Excesses (E)

WORKSHEET 5.2-15

Use this worksheet to display levels of support findings.

MOS	NSR	Version D	Version E

Substep 5.3: Identify Personnel Pipeline Impacts

Overview

In this substep the personnel analyst performs the personnel pipeline impact analysis. The analyst has two objectives: review the results of the personnel pipeline analysis conducted in Step 3 and assess the impact of the New System's qualitative manpower requirements on the existing personnel supply. Figure 5.3-1 is an overview of this substep.

In Action Step 1 the analyst reviews the promotion, migration, attrition, and transients, trainees, holdees, and students (TTHS) rates to ensure their accuracy, currency, and applicability. The analyst checks the manpower values (from Step 2 or from Substep 5.2). He or she then checks the personnel results to verify that the personnel flow has been accurately calculated. The analyst also checks the validity and applicability of HCM assumptions.

The HCM personnel pipeline is based on "system-specific" manpower needs. The pipeline for system-specific MOSs is accurate. However, the pipeline for non-system-specific MOSs includes only the New System's share of each MOS. This situation can produce misleading results because an overstrength in the pipeline relates only to the system being analyzed. These soldiers may actually be satisfying other system's manpower needs and may not actually represent an overstrength. However, this information remains hidden to HCM analysts.

In Action Step 2 the analyst compares the qualitative aspects of existing soldiers to the qualitative requirements of the New System. The analyst studies the impact of the New System's training man-days, aptitude requirements, and Target Audience Description (TAD).

Training man-days and soldier aptitude requirements are really personnel issues. The personnel analyst studies these training results within personnel impact analysis because training man-days affect the MOSs' share of the TTHS account and because soldier aptitude requirements affect the personnel pool available to satisfy the New System's requirements.

The analyst compares the Revised Target Audience Description with the Current TAD and assesses the difference between the revised descriptions of the soldiers required to operate and maintain the New System and the personnel available as they were described in the Current TAD.

As the HCM analysis progresses more and more becomes known about the skills the New System's MOS must have. This is critical information for Army decision makers. Any requirement the New System has for skills or knowledge beyond those the MOS currently has is a potential problem for the Army. These requirements can mean impacts on the training base. The Army can also use this information to place additional demands on system designers requiring them to reduce these soldier impacts.

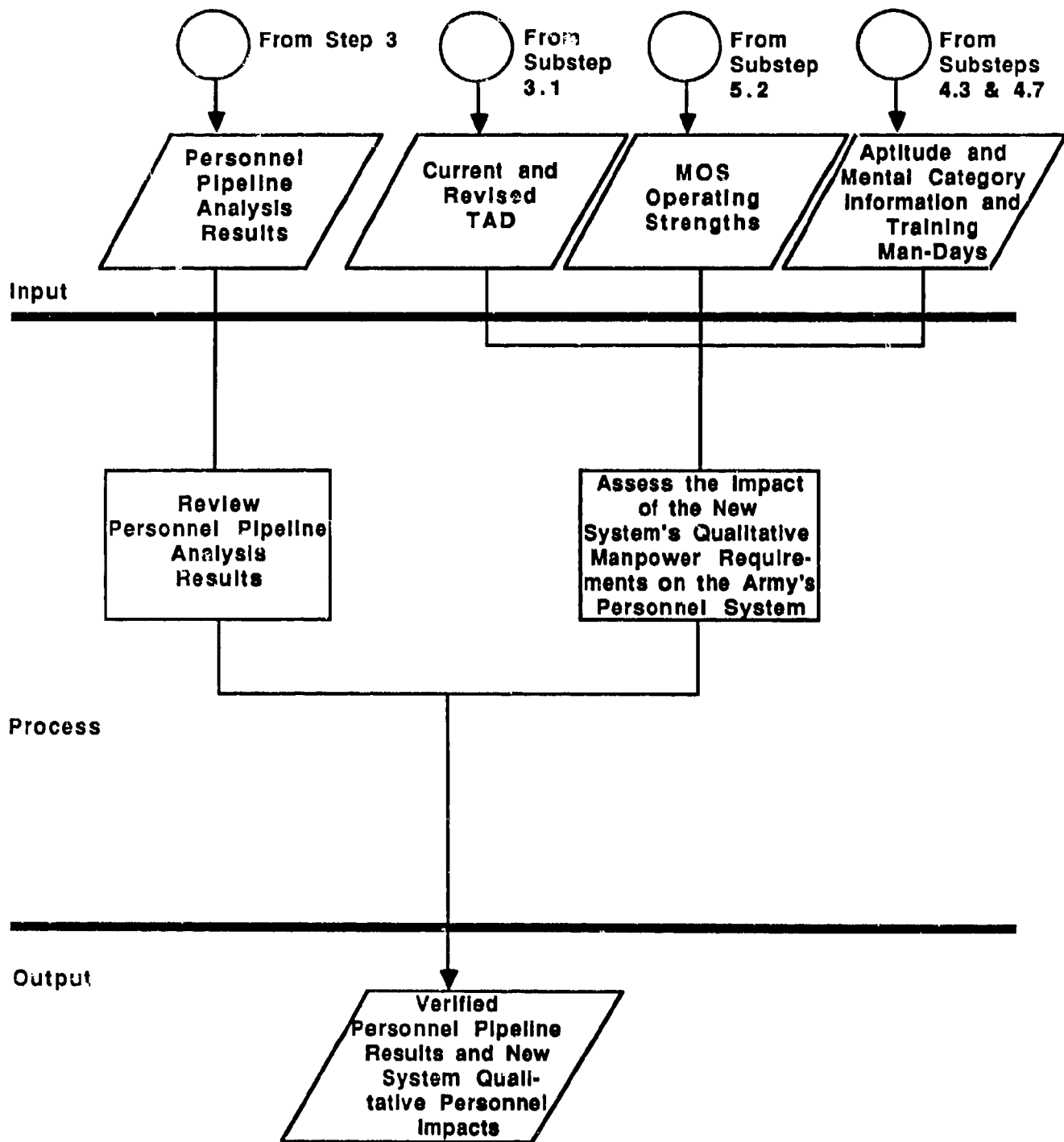


Figure 5.3-1. Overview of Substep 5.3, Identify Personnel Pipeline Impacts.

Action Step 1: Review Personnel Pipeline Analysis Results

Discussion

In this action step the personnel analyst reviews the personnel results to identify unexpected results. The analyst then investigates the source of the unexpected result. In most cases input data (flow rates and/or manpower needs) are the source of an unexpected result. The analyst records data adjustments and the reasoning behind these adjustments in the HCM audit trail.

The personnel analyst can input different manpower requirements to the personnel algorithm. The analyst can use the manpower needs from Substep 5.2 or manpower needs that are based on changes in assignment policy, maintenance concept, or standards of grade.

NOTE

In Step 3 the personnel analyst generates a personnel pipeline for the Predecessor System and BCS because the training analyst needs the intake-to-paygrade value to calculate student input. The personnel analyst does not use these pipelines to identify differences between the New System's personnel requirements and the Predecessor System's requirements because the Predecessor System's pipeline is theoretical and confuses HCM information users.

Procedures

1. Identify Unexpected Personnel Results.
 - Obtain each New System MOS's flow rates, manpower needs, and personnel requirements from Step 3.
 - Compare the personnel requirements with the manpower needs. Investigate significant overstrengths in personnel requirements.
2. Identify the Sources of the Unexpected Results.
 - Check the derivation of the promotion, migration, attrition, and TTHS rates.

-
- Check the calculations used to derive personnel pipeline results.
 - Check the promotion, attrition, and migration rates (and TTHS rates if used) to determine whether they reflect a specific anomaly (i.e., flow problems within an MOS).
 - Check the promotion, migration, and attrition rates (TTHS rates if used) to determine whether they reflect an unstable MOS (i.e., an MOS being phased out of or into the force).
 - Check the promotion, migration, and attrition rates (TTHS rates if used) to determine whether they portray anticipated flow rates.
 - Reconsider the flow rates used for MOSs with unstable flow rates (i.e., "comparable MOSs").
 - Check the manpower requirements (by MOS and paygrade) from Step 2 and/or Substep 5.2.
 - Check the distribution of manpower requirements across paygrades.
3. **Adjust the Personnel Pipeline Input Data and Recalculate Results.**
- Recalculate any results that were based on erroneous data, calculations, assumptions, or improper application of HCM procedures.
 - Modify the manpower requirements to reflect various manpower needs.
 - Determine the personnel pipeline requirements using the different manpower requirements.
4. **In the HCM Audit Trail Document Explanations of the Unexpected Results.**
- Record the sources and explanation of unexpected results e.g., flow rates or the distribution of manpower requirements.

Procedure 1 and 2 Examples

The analyst obtains from Step 3 the flow rates, manpower requirements, and personnel pipeline results for each New System MOS. (In this example MOS 68F is assumed to have no migration rates).

MOS: 68F

<u>Paygrade</u>	<u>Attrition</u>	<u>Promotion</u>	<u>Manpower Requirement</u>	<u>Personnel Requirement</u>
E1	0.3769	1.7131	0	108.1
E2	0.1291	1.4337	0	118.5
E3	0.1189	1.5214	132	132.0
E4	0.7618	0.2794	88	192.9
E5	0.1347	0.1914	132	165.3
E6	0.0859	0.1891	88	115.1

The analyst examines the flow rates and notices a high E3 promotion rate and a high E4 attrition rate. The analyst checks with the MOS manager at the proponent school and learns that actions have been taken to improve these rates. The last three quarters of rate data reflect a significant improvement in these rates. The analyst and MOS manager agree that the current rates are not indicative of the future promotion and attrition rates. The analyst alters the rates and recalculates the personnel requirements.

<u>Paygrade</u>	<u>Attrition</u>	<u>Promotion</u>	<u>Manpower Requirement</u>	<u>Personnel Requirement</u>
E1	0.3769	1.7131	0	108.1
E2	0.1291	1.4337	0	118.5
E3	0.1189	1.0000*	132	132.0
E4	0.4500*	0.2794	88	188.0**
E5	0.1347	0.1914	132	155.1**
E6	0.0859	0.1891	88	107.9

* Indicates a change.

**Indicates a new result.

(continued)

Procedure 1 and 2 Examples (continued)

The analyst notices that the personnel requirements have decreased favorably for paygrades E5, E6, and E7. However, undesirable overstrengths still exist. The analyst examines the distribution of the manpower requirements across paygrades. The analyst confirms that the Standards of Grade Authorization (SGA) was used to distribute manpower requirements to the various paygrades. The analyst again contacts the MOS manager and suggests the use of the MOS Structure Design Norms (from the Soldier Support Center-National Capital Region) to distribute the manpower requirements across paygrades. The MOS manager accepts this approach, and the analyst recalculates the personnel requirements.

<u>Paygrade</u>	<u>Attrition</u>	<u>Promotion</u>	<u>Manpower Requirement</u>	<u>Personnel Requirement</u>
E1	0.3769	1.7131	0	82.3**
E2	0.1291	1.4337	0	90.2**
E3	0.1189	1.0000	115*	115.6**
E4	0.4500	0.2794	158*	158.5**
E5	0.1347	0.1914	99*	135.8**
E6	0.0859	0.1891	68*	94.5**

* Indicates change.

**Indicates a new result.

The analyst observes that the personnel requirements have improved and more favorably reflect the manpower requirements. The analyst notes that an overstrength still exists in Paygrades E5 and E6. This overstrength is not an error and accurately reflects the personnel requirements based on the flow rates and manpower needs (particular distribution across paygrades) used in the calculations. The analyst assumes that the overstrength in Paygrade E6 can be utilized to support the instructor requirements and other Table of Distribution and Allowances (TDA) assignments.

Action Step 2: Assess the Impact of the New System's Qualitative Manpower Requirements on the Army's Personnel System

Discussion

In this action step the analyst conducts a qualitative assessment of the New System's impact on the Army's personnel system. The analyst studies the impact of five HCM results: the New System's aptitude, mental category, and reading grade level requirements; training man-days; and Target Audience Description (TAD).

The analyst uses the Current and Revised TADs from Substep 3.1; aptitude, mental category, and reading grade level information from Substep 4.3; and training man-days from Substep 4.7. The analyst also uses each MOS's current operating strength from Substep 5.2.

NOTE

The analyst should review Substep 3.1 and Substep 4.3. Action Step 4, before completing this action step.

The analyst compares the qualitative aspects of existing soldiers with the New System's qualitative soldier demands to determine whether available personnel assets will satisfy the New System's qualitative requirements. The analyst must study each target MOS identified in Substep 4.3 and each of its source MOSs.

The analyst must understand the interaction among the New System's design, organizational and operational (O&O) concept, maintenance concept, training concept, training requirements, and personnel pipeline. This knowledge will enable the analyst to grasp the potential decision-making opportunities presented by examination of training man-days and soldier aptitude impacts. The analyst can then assist the Army's Technical Advisory Group (TAG) in selecting HCM tradeoff analyses that can demonstrate how the Army could minimize these potential impacts.

The New System's design, O&O concept, and maintenance concept drive the need for new soldier skills. These requirements lead to new training requirements and sometimes new aptitude requirements.

The New System's training concept can lead to an increase in training course length. A change in course length will result in an increase in training man-days, thus increasing the trainee portion of the TTHS account. An increase in course length could also increase training course costs, instructor contact hours, and other training resources (these impacts on training resources are analyzed in Substep 5.4).

The New System's aptitude and mental category requirements may differ from those of the available personnel. Either the New System's design or training concept must be changed if different aptitudes are required.

If the HCM training analysis indicated a potential increase in the aptitude requirements for a program of instruction, the analyst could present three options to Army decision makers. The Army could then decide to explore the implications of one or all of these options in Step 6, Tradeoff Analysis. The Army could:

- increase the aptitude requirements of the MOS in question;
- require the MOS's proponent school to change the New System's training concept to enable the present population to learn the more demanding skills; or
- change the New System's design, O&O concept, or maintenance concept.

The problem with the first option is that the number of soldiers with high aptitude and mental category scores is limited. The second option is more realistic; however, a change to the training concept may increase the course length, thereby increasing the training man-days. Increases in course length may affect the time remaining for service, thereby reducing the available personnel pool (AR 614-200, *Selection of Enlisted Soldiers for Training and Assignment*). Changing the training concept may also increase training course costs and other training resource requirements.

If the Army does not want to consider the second option, then the analyst can assume that the New System's training would require soldiers with higher aptitude scores. In this case it is important for the analyst to determine how many soldiers in the source MOS(s) will meet the New System's aptitude requirements.

The analyst can assume that the only soldiers available to operate and maintain the New System will be those soldiers currently dedicated to the Predecessor System(s). The analyst cannot assume that soldiers assigned to other systems will be assigned to the New System unless he or she is directed to do so by the TAG. Neither the analyst nor the TAG can assume that soldiers currently in another branch will be assigned to the New System.

The Army could also choose the last option. The analyst must provide the TAG and other Army decision makers with an understanding of this option and its relationship to manpower, personnel, and training. The Army could change the New System's design (ideally, without reducing mission capability) by removing a subsystem that the HCM analysis has shown to be a source of personnel impacts. The design and maintenance concept could be modified to accommodate built-in-test equipment, thereby reducing the complexity of certain maintenance tasks with associated reductions in training requirements. The New System's design, mission, and O&O concept could be modified to reduce the system's impact on the operator MOS. The system and its training concept could also be redesigned to include embedded training or exportable training products to reduce the institutional training burden. However, all of these solutions presume that a tradeoff analysis to reduce the impact can be conducted in Step 6.

Procedures

1. **For Each Target MOS, Determine the Number of Source MOSs With Aptitude Scores Higher Than the Target MOS's.**
 - Obtain from Substep 5.2 the current operating strength of each source MOS and the estimated operating strength of the target MOS. Record this information on Worksheet 5.3-1.
 - Obtain from Substep 4.3 the percentage of soldiers in each source MOS that are above the target MOS's projected aptitude score. Record this information on Worksheet 5.3-1.
 - If the target MOS requires modules of instruction with multiple aptitude scores, select the score that is most restrictive (i.e., the aptitude score with the smallest percentage of soldiers in the source MOSs with scores above the target MOS's highest prerequisite score).
 - Multiply each source MOS's current (or projected) operating strength by the percentage of soldiers above the target MOS's most restrictive score. Record on Worksheet 5.3-1 the number of soldiers in the source MOSs with the aptitude required to be successful in the target MOS's training course.

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2. **For Each Target MOS, Determine the Percentage of Each Source MOS with a Mental Category or Reading Grade Level Higher Than the Target MOS's.**
 - Obtain from Substep 4.3 the percentage of soldiers in each source MOS above the average mental category (MC).
 - Determine the percentage of soldiers in each source MOS that are above the average MC of the most restrictive mental category (i.e., highest MC of the comparable MOSs used to develop the target MOS's training). Use a less restrictive cutoff if it is appropriate.
 - Obtain from Substep 4.3 each source MOS's minimum reading grade level.
 - Determine the percentage of soldiers with a reading grade level above the average reading grade level of the most restrictive reading grade level (i.e., the highest reading grade level score of the comparable MOSs used to develop the target MOS's training).
 3. **Assess the Impact of an Increase or Decrease in Training Man-Days.**
 - Obtain from Substep 4.7 the training man-day requirements for the Predecessor System and New System. Record the training man-days on Worksheet 5.3-2.
 - Compare the New System's training man-day requirements with the Predecessor System's training man-day requirements. Record any increases or decreases in training man-day requirements on Worksheet 5.3-2.
 - Investigate the causes of the increases or decreases in training man-days and record them on Worksheet 5.3-2.
 - Use AR 614-200, *Selection of Enlisted Soldiers for Training and Assignment*, to determine the impact that the increase or decrease in training man-days will have on the remaining service time.
 4. **Assess the New System's Impact on the TAD.**
 - Obtain from Step 3 the Current and Revised TADs. The changes described in the Revised TAD are possible qualitative impacts on the MOS.
 - Discuss these impacts with subject-matter experts at the MOS proponent school.

Procedure 1 Example

The analyst must determine the qualitative impact of MOS 13X (the target MOS) on the available personnel supply. The 13X is the notional operator MOS for the Remotely Piloted Vehicle (RPV).

The Field Artillery (FA) Center and School is the proponent for the RPV. The source MOSs could be any of several FA MOSs, but 13F is the leading candidate. The Intelligence Center and School is also interested in the RPV as an intelligence gathering platform. If the Army shifts proponentcy from FA to Intelligence, the source MOSs could come from CMF 96.

The analyst investigates whether the MOSs listed in Figure 4.3-1 are still potential sources of personnel for MOS 13X. The Army's TAG directs the analyst to drop 72E, Tactical Telecommunications Center Operator, from consideration. The analyst is told to center his or her analysis on MOS 13F.

The analyst determines that the HCM manpower estimate for the 13X is 923 soldiers. The analyst then determines the source MOSs' current operating strength. The analyst lists the percentage of soldiers currently in each source MOS with aptitude area (AA) scores above the most restrictive score from the aptitude analysis conducted in Substep 4.3. The analyst multiplies each source MOS's current operating strength by the percentage of soldiers above the most restrictive cutoff score.

<u>MOS</u>	<u>Current Operating Strength</u>	<u>% of Soldiers Above AA Cutoff</u>	<u>Number of Soldiers in Source MOS Above Cutoff</u>
13C	1072	.64	686
13F	5864	.64	3753
13R	732	.53	388
82C	1612	.61	983
96B	2746	.85	2334
96D	721	.74	534
96H	146	.84	123

The analyst reports to the TAG that MOS 13F has 3,753 soldiers with the aptitude required to be successful in the 13X's projected training. This number satisfies the New System's requirement for 923 13Xs. The analyst must point out to the TAG that only 4,891 soldiers would be left to perform MOS 13F duties.

(continued)

Procedure 1 Example (continued)

NOTE

The Army specifies only aptitude requirements for entry level (Skill Level 1) training. The Army does not specify aptitude requirements for Additional Skill Identifiers (ASIs) or upper-skill-level soldiers. Unless he or she is directed otherwise, the analyst must therefore assume that the aptitude requirements for this additional training are the same as for the entry level training.

The analyst also reports that MOS 96D, which could also be a source MOS if Intelligence becomes the RPV's proponent, currently has only 534 soldiers with the aptitude required to be successful in the 13X's training. These 534 soldiers would not satisfy the New System's requirement and would leave a shortfall of 439 soldiers. This also assumes that the remaining 177 soldiers in MOS 96D can fill the remaining positions for that MOS. The analyst also reports that 2,334 soldiers in MOS 96B would be qualified for the 13X's training. Intelligence could easily meet the New System's manpower requirements with the qualified people from either one or both of these MOS if the existing 96D and 96B positions could be reduced to accommodate the New System's requirements.

Procedure 2 Example

The analyst obtains the percentage of soldiers in each source MOS that are above the average mental category (MC) of all the source MOSs.

<u>MOS</u>	<u>% of Soldiers Above the Source MOSs' Average MC</u>
13C	.44
13F	.42
13R	.37
82C	.39
96B	.62
96D	.59
96H	.63

The analyst reports to the TAG that only 42 percent of the soldiers in MOS 13F are in an MC at or above the average of the MOS with the highest MC. This percentage indicates that the learning skills of the majority of 13F soldiers (56 percent) are below those of the soldiers currently taking the programs of instruction from which some modules of the 13X program of instruction was built. Although this finding is not definitive, it does indicate that the 13F soldiers may find some of the modules of instruction, particularly those from 96B, 96D, and 96H, challenging.

(continued)

Procedure 2 Example (continued)

Next, the analyst obtains the minimum reading grade level scores for each source MOS.

<u>MOS</u>	<u>Minimum Reading Grade Level for 95% of the MOS</u>
13C	6.9
13F	6.9
13R	6.9
82C	7.2
96B	8.3
96D	7.9
96H	8.6

The analyst reports to the TAG that the soldiers currently in MOSs 96B, 96D, and 96H have reading abilities that are stronger than those of MOSs 13C, 13F, and 13R. Again, this situation indicates that written material from the modules of instruction from the 96 series MOS could be challenging for the 13F soldiers.

The analyst informs the TAG that subject-matter experts at the FA school should review the training materials currently in use in the various modules of instruction from which the 13X's training was derived. The SMEs should carefully review the reading content and the pace of instruction. Instruction for soldiers with strong learning skills (i.e., high MCs and good reading ability) can be conducted at a fast pace. The SMEs must review the training time and the student-to-instructor ratio of each module of instruction. This SME review would establish whether the current instruction's training concept would be appropriate for the soldiers in the target MOS (13X). As a result of this review, the HCM analyst may be asked to consider another training concept, perhaps one with different training lengths, instructor ratios, and training devices.

If the TAG selects a source MOS that differs from the MOS that the personnel analyst used as a comparable MOS in Step 3, the personnel analyst must determine whether he or she must recalculate the 13X personnel pipeline using another set of comparable flow rates. That is, if the personnel analyst originally calculated the 13X's personnel pipeline using 13F flow rates and the TAG decides to use the 96D, the personnel analyst must recalculate the 13X's personnel pipeline using 96D flow rates or comparable flow rates that better represent MOS 13X's rates. The personnel analyst should also consider the size of the MOS when selecting comparable flow rates. In this example, the 13F has an operating strength of 5,864 soldiers. The manpower requirement for 13X is only 923 soldiers (without adjustment for those in TTHS status). The flow rates for an MOS with less than 1,000 soldiers might be very different from an MOS with a pool of almost 6,000 soldiers.

Procedure 3 Example

The analyst obtains the annual training man-day requirements for the avionics suite of a notional helicopter system's MOSs and the component values to generate these training man-days from Step 4. The analyst then generates three tables. The first table lists the training man-days by course.

Table 1

<u>MOS</u>	<u>Predecessor System</u>	<u>New System</u>	<u>Differences</u>
29S	1107	1107	0
35K	27752	42772	15020
35L	11426	10458	- 968
35M	10637	5960	- 4677
35R	33239	8912	-24327
39B	0	6237	6237

The analyst develops two more tables to help determine the sources of increases in training man-days. The second table lists the course length in days.

Table 2

<u>MOS</u>	<u>Existing Course Length*</u>		<u>HCM Projected Course*</u>		<u>Difference</u>
	<u>in weeks</u>	<u>in days</u>	<u>in weeks</u>	<u>in days</u>	
29S	18.6	93	18.6	93	NC
35K	23.0	116	25.8	129	+14
35L	25.4	127	25.4	127	NC
35M	24.8	124	25.6	128	+ 4
35R	22.8	114	28.0	140	- 26
39B	21.8	109	21.8	109	NC

NC indicates no change

* Note that peacetime conversion of weeks to days assumes a five-day week. The analyst must determine whether weekend exercises are included in the course lengths used.

(continued)

Procedure 3 Example (continued)

The third table lists the student input by MOS.

Table 3

<u>MOS</u>	<u>Predecessor System Student Input</u>	<u>New System Student Input</u>	<u>Difference</u>
29S	8	8	NC
35K	169	232	+ 63
35L	59	54	- 5
35M	61	33	+ 28
35R	202	44	+158
39B	0	37	+ 37

The analyst notes that MOS 35K shows a significant increase in training man-days. The analyst sees that in Table 2 the training length for MOS 35K has increased. The analyst then notes that the 14-day increase in course length is due in part to the increase in training man-days. The analyst also refers to AR 614-200 to determine how the 2.8-week increase in training length will affect the service time remaining requirements for this MOS.

Finally, the analyst reviews Table 3 and notes that the student input for 35K has increased by 72% from 169 students per year to 232 students per year. The analyst reports that the training man-days will increase by 15,020, which can be thought of as 7.5 man-years per year of nonavailable time. This increase in nonavailable time is due in part to the New System's training requirements but the larger part of this increase is due to increases in student input that are related to the personnel pipeline and to the New System's increased manpower requirements.

Procedure 4 Example

The analyst obtains the Current and Revised Target Audience Descriptions from Substep 3.1.

The analyst points out impacts on MOS 98G (i.e., qualitative changes in the soldier's job). In this example the 98G must be qualified for flight duty. This change in the 98G's job description has several implications. The soldiers assigned to this duty must have a flight physical, which may decrease the number of eligible soldiers. They would also receive flight pay, which may increase retention and consequently improve the personnel pipeline. The soldiers assigned to this duty would also have to receive several weeks of additional training to qualify for flight status.

**SUBSTEP 5.3
WORKSHEETS**

WORKSHEET 5.3-1

Use this worksheet to determine the number of soldiers in each source MOS that are above the target MOS's prerequisite AA score.

Target MOS: _____ Operating Strength: _____

Source MOSs	Current Operating Strength	Percentage of Soldiers Above Highest AA Score	Number of Soldiers Above AA Score

WORKSHEET 5.3-2

Use this worksheet to compare the training man-days of the Predecessor System and New System MOSSs.

Source MOSS	Predecessor System Training Man-Days	New System Training Man-Days	Cause of Increase or Decrease

Substep 5.4: Identify Training Resource Impacts

Overview

In this substep the training analyst conducts training impact analysis. The analyst first reviews the training analysis results from Step 4 to determine their accuracy. The analyst compares the New System's training requirements with those of the Predecessor System and the BCS to identify unexpected results. Figure 5.4-1 is an overview of this substep.

Next, the analyst determines the source or cause of the unexpected result. The analyst uses the HCM analysis audit trail to determine whether the unexpected result was caused by an assumption made during the analysis or whether the training data or student input data were faulty. If the analyst detects an error he or she makes the correction, recalculates the results, and records both the new value and the corrected data or assumption in the audit trail. Most often the unexpected result will not be an error. The unexpected result will reflect an expense or a cost savings that can be attributed to the New System's training requirements.

Two training issues affect the personnel pipeline: training man-days and soldier aptitude requirements. The training analyst does not study these issues. The personnel analyst studies the impact of training man-days and soldier aptitudes because training man-days can affect an MOS's TTHS account and soldier aptitudes can affect the personnel pool available to satisfy the New System's requirements.

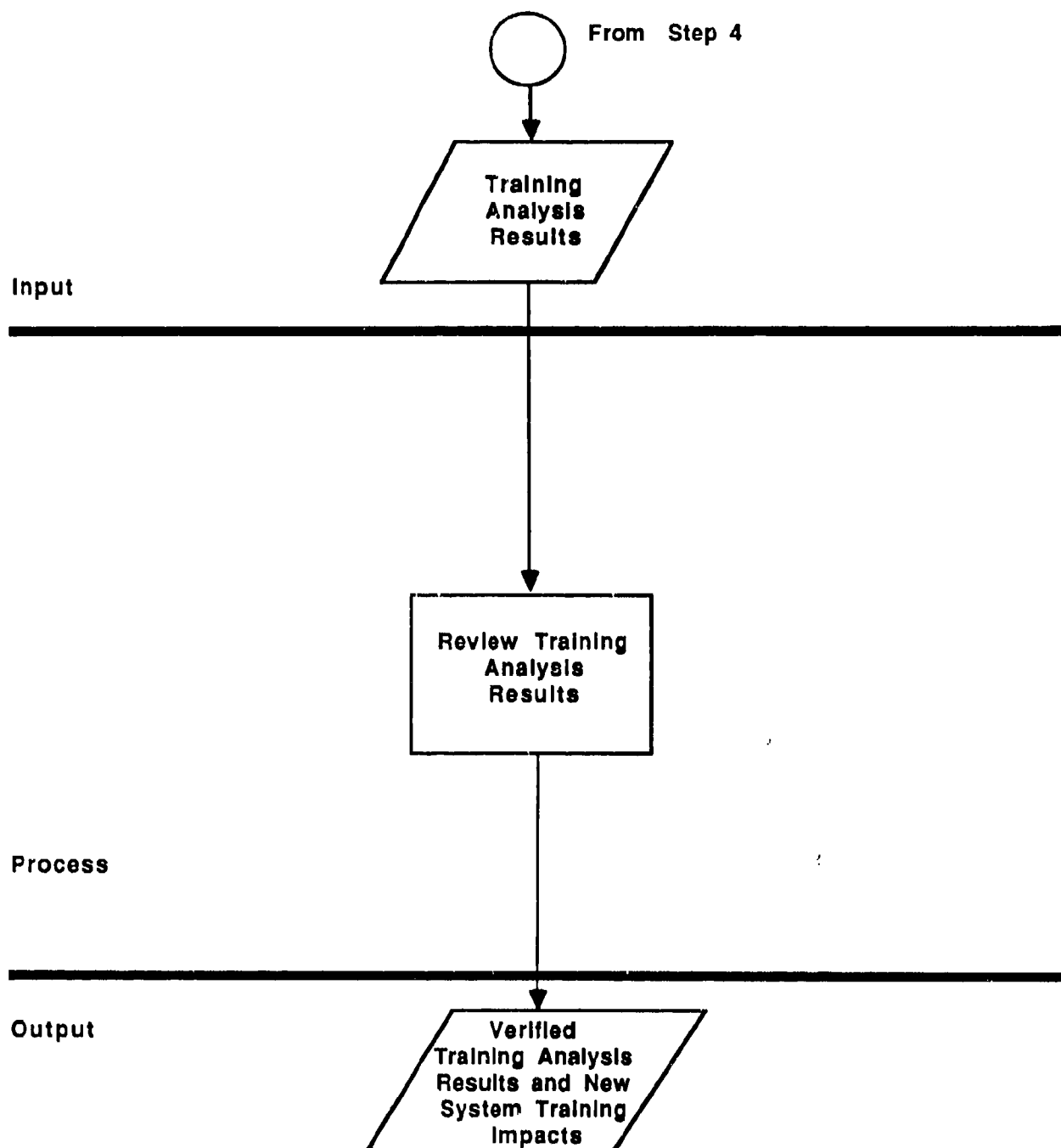


Figure 5.4-1. Overview of Substep 5.4, Identify Training Resource Impacts.

Action Step 1: Review Training Analysis Results

Discussion

In this action step the training analyst sorts and ranks the HCM training analysis results to identify unexpected results. The analyst identifies unexpected results by comparing the training requirements of the New System with the Predecessor System and the BCS.

Procedures

1. Rank Training Analysis Results to Identify Unexpected Results.

- From Step 4 obtain the training man-days, instructor requirements, course costs, training devices, training equipment, simulators, and facilities for the Predecessor System, the BCS, and the New System.

NOTE

The analyst may have difficulty assessing the Predecessor System's share of instructors and other training resources because the TRADOC schools manage these resources as department assets. That is, an instructor in the Target Acquisition Department is not specifically an AN/TPQ-36 radar instructor. He or she may teach modules of instruction in a number of different courses for different weapon systems.

- Use Worksheet 5.1-1 to sort and rank each resource by MOS, course, cost, and training devices.
 - Compare the New System's resources with those of the Predecessor System and the BCS. Identify any unexpected results.
- #### 2. Identify the Source of the Unexpected Results.
- Check each course module's student-instructor ratio.
 - Check the computation of instructor contact hours (ICH) and number of instructors.
 - Check the calculations of training devices, training equipment, simulators, and facilities.

-
- Check the computation of student input. Check the intake to paygrade used. Check the course attrition rate used. Ensure that the course attrition rate represents only the students recycling through the course, not losses to an MOS through attrition or migration.
 - Consult the personnel analyst to determine whether errors in the personnel pipeline calculations could be inflating the intake to paygrade.
 - Ensure that the comparable tasks and comparable training modules best represent the New System's tasks, skills, and training concept.
 - Recalculate any results that were based on inaccurate data, calculations, assumptions, or improper application of HCM procedures.
3. Document Explanations of Unexpected Results in the HCM Audit Trail.
4. Determine Impact on Army Resources.
- Compare the Predecessor System's instructor requirements with the New System's instructor requirements. Record the differences on Worksheet 5.4-1.
 - Compare the Predecessor System's training devices, equipment, simulators, and facilities with the New System's requirements. Record the differences on Worksheet 5.4-1.
 - Compare the Predecessor System's course costs with the New System's course costs. Investigate the detailed cost elements for any New System course cost that is significantly higher or lower than the Predecessor System course cost. Record the differences on Worksheet 5.4-1.

Procedure 1, 2, and 3 Examples

The analyst sorts the training resources by MOS and course.

Sort 1: Total Training Man-Days

<u>MOS</u>	<u>Course</u>	<u>Predecessor System</u>	<u>BCS</u>	<u>New System</u>
68F	602-68F10	45,545	45,545	45,545
35K	102-35K10	11,157	14,830	16,027
35L	102-35L10	6,783	7,154	7,154
35M	102-35M10	5,406	5,580	5,500
35P	102-35P10	2,673	2,894	2,894
35R	102-35R10	4,928	2,540	2,540

The analyst decides to investigate the 35R's decrease in training man-days from 4,928 to 2,540. The analyst determines that the course length did not increase; the man-days decreased because of a decrease in the student input to the course. The analyst checks the student input calculation and determines that it is accurate and that the high student input is caused by a high intake-to-paygrade value from Step 3. The analyst asks the personnel analyst to check this value.

Sort 2: Instructors

<u>MOS</u>	<u>Course</u>	<u>Predecessor System</u>	<u>BCS</u>	<u>New System</u>
68F	602-68F10	47	47	47
35K	102-35K10	9	11	9
35R	102-35R10	6	6	6
35L	102-35L10	6	6	4
35M	102-35M10	4	4	4
35P	102-35P10	2	2	2

The analyst investigates the 35K's instructor requirement. The analyst determines that he or she made an error in the instructor contact hour (ICH) calculations. The analyst corrects this error and changes the instructor requirement from 9 to 12.

(continued)

Procedure 1, 2, and 3 Examples (continued)

The analyst investigates the decrease in the 35L's instructor requirement from 6 to 4. The analyst determines that the result is correct because the addition of computer-aided instruction decreases the instructor requirement.

Sort 3: Cost

<u>MOS</u>	<u>Course</u>	<u>Predecessor System</u>	<u>BCS</u>	<u>New System</u>
68F	602-68F10	2,886,954	2,886,954	2,886,954
35K	102-35K10	1,003,476	1,313,640	1,398,368
35L	102-35L10	700,000	725,165	876,426
35P	102-35P10	756,760	753,737	753,737
35M	102-35M10	511,717	526,752	525,103
35R	102-35R10	499,050	257,401	257,401

The analyst investigates the increase in the 35L's course cost. He or she determines that the increase is due to the addition of computer-aided instruction. The 35R's course cost decreases because the training man-days decreased.

Sort 4: Training Devices

MOS/ASI: 35KW6

	<u>Predecessor System</u>	
<u>Device</u>	<u>Quantity</u>	<u>Cost</u>
Mock-up AN/APR-39	3	\$2,791.50
Mock-up AN/ALQ-136	3	\$2,791.50
Mock-up AN/ALQ-156	3	\$2,791.50
Mock-up M-130	3	\$2,791.50
Mock-up AN/ALQ-144	3	\$2,800.00
Mock-up AN/APR-44	3	\$2,800.00

(continued)

Procedure 1, 2, and 3 Examples (continued)

New System		
<u>Device</u>	<u>Quantity</u>	<u>Cost</u>
Mock-up AN/APR-39	3	\$2791.50
Mock-up AN/ALQ-136	3	\$2791.50
Mock-up AN/ALQ-166	3	\$3500.00*
Mock-up M-130	3	\$2791.50
Mock-up AN/ALQ-144	3	\$2800.00
Mock-up AN/APR-44	3	\$2800.00
Laser Warning AN/XXX	6	\$4200.00*
Test Sets AN/ALM-166A	6	\$ 850.00
AN/ALM-178	6	\$ 850.00

* Estimated Costs.

Procedure 4 Example

The analyst determines the differences between the Predecessor System's and New System's instructor requirements.

<u>MOS</u>	<u>Course</u>	<u>Predecessor System</u>	<u>New System</u>	<u>Difference</u>
68F	602-68F10	47	47	—
35K	102-35K10	9	12	+3
35R	102-35R10	6	6	—
35L	102-35L10	6	4	- 2
35M	102-35M10	4	4	—
35P	102-35P10	2	2	—

(continued)

Procedure 4 Examples (continued)

The analyst determines the differences between the Predecessor System's and New System's course costs.

<u>MOS</u>	<u>Course</u>	<u>Predecessor System</u>	<u>New System</u>	<u>Difference</u>
68F	602-68F10	2,886,954	2,886,954	—
35K	102-35K10	1,003,476	1,398,368	+394,892
35L	102-35L10	700,000	876,426	+176,426
35P	102-35P10	756,760	753,737	- 3,023
35M	102-35M10	511,717	525,103	+ 13,386
35R	102-35R10	499,050	257,401	-241,649

Next, the analyst determines the differences between the New System's and the Predecessor System's training devices, equipment, and simulator requirements.

Laser Warning AN/XXX	6	\$4,200.00
Test Sets AN/ALM-166A	6	\$ 850.00
AN/ALM-178	6	\$ 850.00

**SUBSTEP 5.4
WORKSHEETS**

WORKSHEET 5.4-1

Use this worksheet to sort and rank each training resource and document the differences between the Predecessor System and the New System.

MOS	Course Number	Predecessor System	BCS	New System	Differences between Predecessor System and New System

APPENDIX A: ACRONYMS AND ABBREVIATIONS

AA	Aptitude Area
APMH	Annual Productive Man-Hours
AVIM	Aviation Intermediate Maintenance
AVUM	Aviation Unit Maintenance
BCS	Baseline Comparison System
BIT/BITE	Built-In Test/Built-In Test Equipment
CAS	Current Authorized Strength
COS	Current Operating Strength
CRS	Current Required Strength
EIC	Equipment Identification Code
FA	Field Artillery
HCM	Hardware versus Manpower (HARDMAN) Comparability Methodology
ICH	Instructor Contact Hours
IPR	In-Process Review
MC	Mental Category
MCAF	Maintainability-Centered Adjustment Factor
MOS	Military Occupational Specialty
MPT	Manpower, Personnel, and Training
MMBMA	Mean [Metric] Between Maintenance Actions
MR	Maintenance Ratio
MTTR	Mean Time to Repair
NRS	New System Required Strength
NSR	New System Requirements
O&O	Organizational and Operational
PAS	Projected Authorized Strength
POI	Program of Instruction
POS	Projected Operating Strength
PSR	Predecessor System Requirements
RCAF	Reliability-Centered Adjustment Factor
R&M	Reliability and Maintainability
RPV	Remotely Piloted Vehicle
SME	Subject-Matter Expert
TAADS	The Army Authorization Document System
TAD	Target Audience Description
TAG	Technical Advisory Group
TAPA	Total Army Personnel Agency

TDA	Table of Distribution and Allowances
TRADOC	Training and Doctrine Command
TRAMEA	TRADOC Management Engineering Activity
TTHS	Transients, Trainees, Holdees, and Students

APPENDIX B: GLOSSARY

Audit Trail - A systematic mechanism for tracking development of MPT requirements and monitoring changes to the data, assumptions, or procedures that produce the MPT requirements.

Authorized Strength - The manpower the Army can afford to assign to an MOS (or a unit) during peacetime.

Baseline Comparison System (BCS) - A current operational system, or a composite of current operational subsystems that most closely represents the design, operational, and support characteristics of the New System (MIL-STD-1388-1A).

Comparability Analysis - The process by which estimates of an emerging weapon system's human-resource requirements are derived from the known requirements of similar operational systems and subsystems.

Comparable MOS - An MOS used in the HCM comparability process. The personnel flow rates and/or training requirements of an existing MOS are assumed to be "comparable" to those of a New System or revised MOS.

End Strength - The total active Army manpower.

Footprint - The resources of an earlier system(s) within which a new system must fit or closely match.

Force Structure - The composition, by numbers and types of units, of an existing, planned, or programmed force, or of the entire Army (AR 310-25).

Hardware versus Manpower (HARDMAN) Comparability Methodology (HCM) - A six-step process for determining a weapon system's manpower, personnel, and training requirements.

High Driver - A system element that consumes a large portion of MPT resources.

Impact Analysis - Analysis of the effect of the New System's projected MPT requirements on available MPT resources.

In-Process Review - A meeting between the HCM analysis team and the Technical Advisory Group. The purpose of the meeting is to review results and resolve problems.

Levels of Support - The level or percentage at which the Army supports a given manpower requirement.

Manpower - The total demand, expressed in terms of the number of individuals, associated with a system (MIL-STD-1388-1A). That is, the number of individuals in each MOS, ASI, skill level, and paygrade required to operate and maintain a system.

New System - (1) The system that is replacing the Predecessor System, and (2) the system being studied in a HARDMAN Comparability Methodology (HCM) analysis.

Operating Strength - The actual number of soldiers assigned to an MOS (or a unit).

Overstrength - Personnel who are carried in the personnel system to sustain manpower requirements. Personnel in paygrades E1 and E2 rarely satisfy a manpower requirement, but they must be carried in the personnel pipeline so they can sustain manpower requirements at higher paygrades in the future.

Personnel Pipeline - The personnel structure that must be maintained to ensure that manpower requirements are met.

Predecessor System - An existing system that is performing a mission or missions that will eventually be performed by the New System. The Proposed System may be an actual system construct offered by a contractor or a notional system assumed by the HCM to represent possible New System constructs.

Proposed System - An analytical construct used to determine the functional requirements of a New System. It incorporates technological advances likely to exist before the system's projected initial operational capability date. The Proposed System may be an actual system construct offered by a contractor or a notional system assumed by the HCM to represent possible New System constructs.

Required Strength - The minimum manpower needed to accomplish the wartime mission(s) of an MOS (or a unit).

Source MOS - An existing MOS that may serve as a source of manpower to fill the manpower requirement of a new MOS.

Student Input - The number of students that must enter a program of instruction to ensure the required number of trained soldiers.

Systems Analysis - An orderly approach to helping a decision maker choose a course of action. Its basis is a model or idealized description of the situation under analysis.

Target MOS - A new or modified MOS required to satisfy New System requirements.

Technical Advisory Group - The Army group with interest in the HCM analysis.

Tradeoff Analysis - An analysis conducted among a number of system alternatives. In an MPT front-end analysis, the goal is to determine the alternative that has the least impact on MPT, while still providing performance and availability rates required by the system to accomplish its missions.

Training Resource Requirements Analysis (TRRA) - A process used to estimate the New System's training requirements. These estimates include specification of the system's task, course, and resource requirements.

Unexpected Result - A result or value that does not appear to reflect system/subsystem design, concepts, or assumptions.