Research Product 85-21

HARDMAN

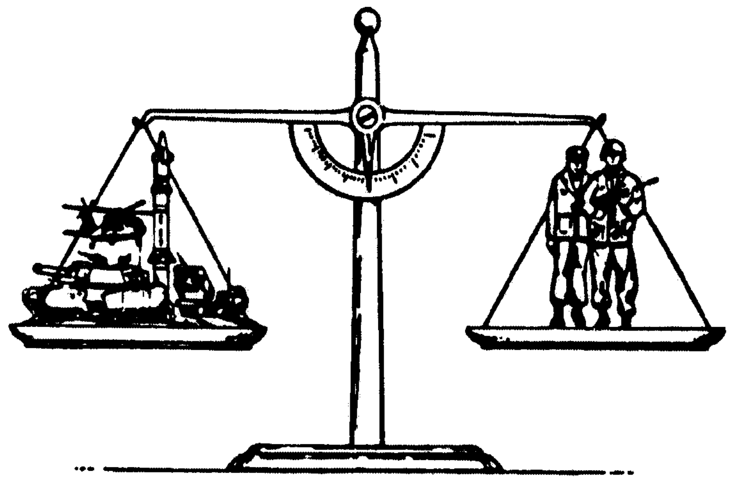
Comparability Analysis Methodology Guide

AD-A156 789

Volume III

Requirements Analysis

Step 2 – Manpower Requirements Analysis
Step 3 – Training Resource Requirements Analysis
Step 4 – Personnel Requirements Analysis



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is the first edition of the Army HARDMAN Comparability Analysis Methodology Guide. The five volumes constitute a detailed specification of the methodology as applied to major materiel systems. HARDMAN is a structured approach to the determination of the Manpower, Personnel and Training (MPT) requirements of a weapon system in the earliest phases of its development. The basic analytic approach is comparability analysis, that is, the use of knowledge about similar existing systems to project the MPT requirements of proposed (new) systems. The

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Army HARDMAN Methodology Guide attempts to satisfy the requirements of the Army by 1) providing details of analytic procedures to a level which permits analysts to execute the HARDMAN Methodology in an actual operational environment, 2) providing a stand-alone guide with maximum flexibility to appeal to different types of users, 3) incorporating field-tested procedures which have proven to reflect actual MPT costs, 4) incorporating lessons learned with the Army data environment to reflect the real constraints in that area and 5) contributing to the Logistics Support analysis performed in accordance with MIL-STD-1388-1A (Logistics Support Analysis Data Element Definitions).

FOREWORD

This is the first edition of the Army HARDMAN Comparability Analysis Methodology Guide. It was compiled jointly under the auspices of the Army Research Institute (ARI) and the Soldier Support Center-National Capital Region (SSC-NCR).

The five volumes constitute a detailed specification of the Army HARDMAN Methodology as applied to major materiel systems. The Guide is intended to provide the Army with a basis for competitive HARDMAN contracting, conducting "in-house" Army HARDMAN applications, and providing HARDMAN training for Army personnel. In the future, many of you may become involved in the process and/or with the products of an Army HARDMAN Analysis. These volumes have been provided as an aid to your understanding of this analytical tool.

It should be noted that the HARDMAN procedures described herein are not expected to remain forever unchanged. Rather, it is desired that HARDMAN evolve over time to better meet the Army's changing information needs on newly emerging systems. You are invited to participate in this evolutionary process by providing your comments on, and recommended improvements to, the Methodology. Such comments concerning the Army HARDMAN Guide or the Army HARDMAN Methodology should be mailed to:

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Alexandria, VA 22332-0400

Additional copies of the HARDMAN Comparability Analysis Methodology Guide will be available through the Defense Technical Information Center (DTIC) in the near future.

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To the Analyst

Volumes II through IV are intended to be used by individual engineers and MPT analysts who have been tasked with conducting the HARDMAN analysis. These volumes provide detailed descriptions of each HARDMAN step, substep group, and substep. The analyst is referred to the preface of Volume I for an overall description of these volumes and a description of the organizational format of each step.

The analysis flow diagrams depict, at a high level, the general flow of data and the interrelationship of the individual HARDMAN substeps (see Volume I, Figures 1.2-3 and 1.2-4). The descriptions of these substeps provide the detailed procedures, algorithms, and rules required to conduct the analysis as well as examples of products that represent the results of the analysis.

In essence, these flow diagrams and substep descriptions provide the analyst with guidance on how to conduct the discrete methodology steps. However, the diagrams and descriptions do not capture much of the dynamics of a study application.

Throughout the substep descriptions, the analyst is directed to interface with other analysts and other data. In most instances, these directions are not intended to reflect formal, one-time meetings, where the output of one substep is passed on as input to the next. Instead, they reflect an ongoing give-and-take between analysts.

In light of that, it cannot be overemphasized to the individual analyst that the HARDMAN methodology is a highly interactive process that is, by necessity, conducted by a multi-disciplinary study team of engineers and analysts. The magnitude and complexity of the factors that are necessary to capture the total operational and maintenance requirements of a weapon system are such that no one analyst or analysis manager can be expected to have a total grasp of the whole.

Each analyst must contribute not just the formal output of his or her discipline's analytical substeps but must participate in partnership with other analysts in system definition. This is especially true in Step 1 (Systems Analysis), where the decisions about the system's scope and its mission, functional, task, and equipment requirements provide the basis upon which much of the subsequent analysis is conducted.

Finally, the requirement for early identification and collection of data must be stressed. Results obtained from using the substep procedures described in this handbook reflect the quality and completeness of the data that are input. Every analyst must regard as crucial the need to identify data at the earliest possible time and to see to it that data requests are pursued in a timely manner.

Alternative or second-best data may have to be obtained if it appears that initial data requests will not be received in time. The analyst must continuously keep the analysis manager informed of data collection problems, as delays will have a negative impact on study milestones. Accordingly, the analyst should give special attention to the guidance presented in Appendix A (Data Operations) of Volume V.

STEP 2

Manpower Requirements Analysis

Purpose

The Manpower Requirements Analysis enables analysts to determine an emerging weapon system's qualitative and quantitative manning needs. Qualitative needs are expressed in terms of Military Occupational Specialty (MOS), Additional Skill Identifier (ASI), duty position, skill level, and paygrade assignment. Quantitative needs are stated in terms of numbers of people needed to operate and maintain the system.

Early determination of system manpower requirements serves to identify and document manning needs for system-design tradeoff decisions. This information also satisfies manpower input requirements for the Qualitative and Quantitative Personnel Requirements Information (QQPRI) and the Table of Organization and Equipment (TOE).

Within the HARDMAN analysis, manning requirements and the duty position task assignments developed as part of those requirements constitute the principal input to Step 3 (Training Resource Requirements Analysis) and Step 4 (Personnel Requirements Analysis). Input and products are discussed in detail at the beginning of each substep.

Objectives

The four major objectives of the Manpower Requirements Analysis are:

- To provide decision makers with estimates of manning requirements (listed by MOS/ASI and paygrade) for use in design decision-making

- To provide program managers with input to new weapon-system manning documents in addition to personnel and training processes such as the QQPRI and Individual and Collective Training Plan (ICTP)

- To provide training resource analysts with early and continuous updates of operator and maintainer military occupational specialty requirements, duty position requirements, skill level requirements, and the system manpower tasks for which personnel will have to be trained

- To provide personnel analysts with the number of system position requirements to be filled by MOS/ASI and paygrade for each echelon of the Army's force structure

Manpower requirements are a critical factor in a system's design because they determine how many and what types of MOSs the system will need. This has a direct bearing on two principal cost factors: (1) cost of the people to operate and maintain a system in the field and (2) cost of providing properly trained soldiers in correct quantities to permit the system to carry out its assigned missions.

HARDMAN MOS/ASI and paygrade requirements determinations are based on a system's workload requirements. Consequently, they provide an accurate estimate of system skill and skill level needs for each position. This permits an accurate and early analysis of a system's fit within the acceptable manpower footprint. If a mismatch is found, design changes can be investigated and options which would bring the requirements back into the footprint can be evaluated.

Interrelationships

Figure 2-1 presents an overview of the relationships between Manpower Requirements Analysis and other HARDMAN steps. This analysis requires input from Step 1 (Systems Analysis) and provides output to Steps 3 (Training Resource Requirements Analysis), 4 (Personnel Requirements Analysis), and 5 (Impact Analysis).

Feedback information is exchanged interactively with Step 3 and, if necessary, Step 6 (Tradeoff Analysis) to refine system manning requirements.

Assumptions/ Constraints

The following assumptions and constraints apply to a Manpower Requirements Analysis.

- Manpower Analysis is influenced by six key factors:

  —System configuration
  —Force structure
  —Maintenance concept
  —Organizational and operational concept
  —Skill level requirements
  —Manpower workload capacity

- Comparability analysis assumptions have been satisfied, and the baseline system equipment constitutes the most representative composite, having mature and nearly complete workload task data.

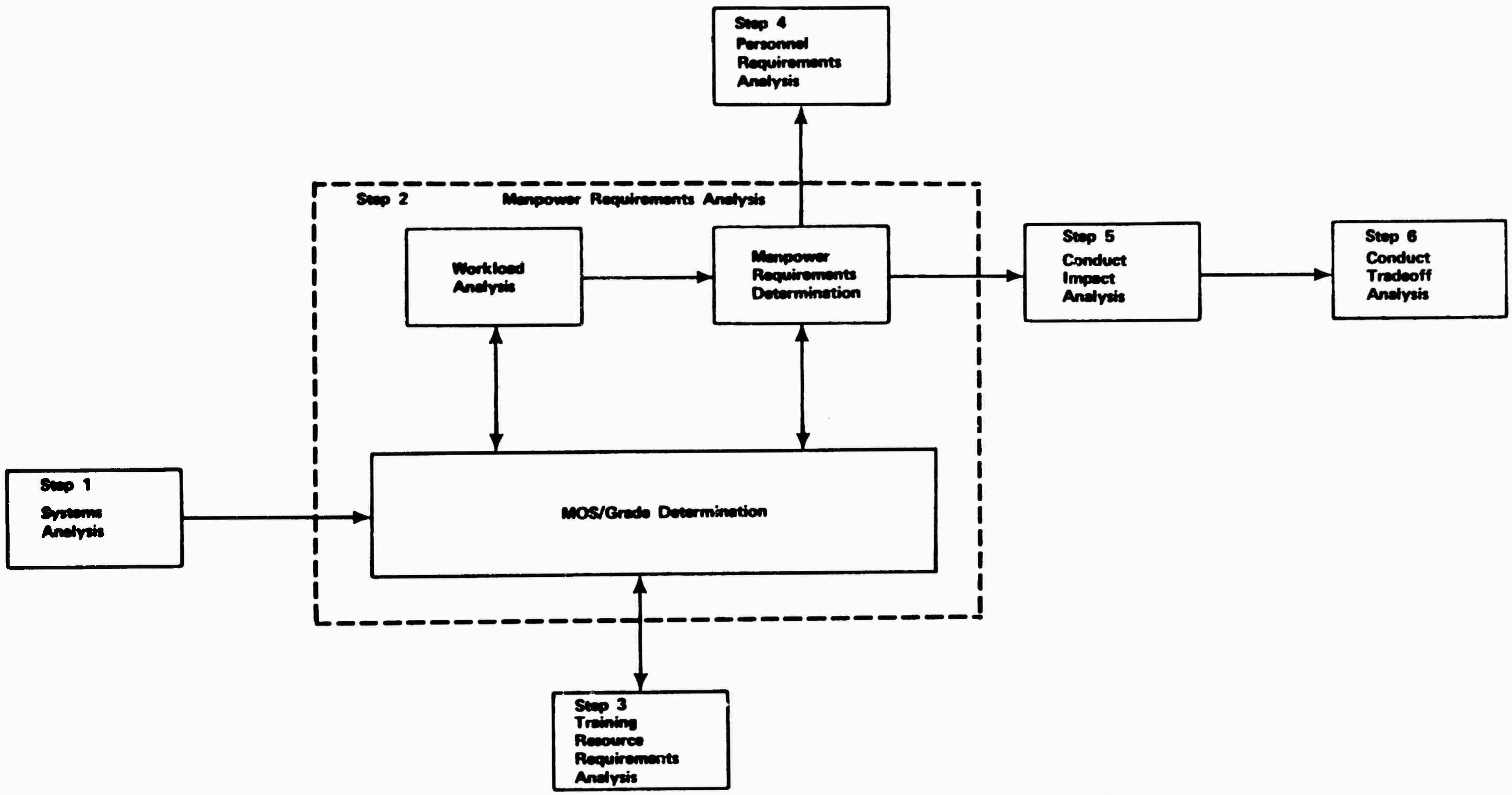

Figure 2.1. Relationships of Manpower Requirements Analysis to other HARDMAN steps.

- The scenario developed in HARDMAN Substep 1.2 (Identify Detailed Mission Requirements) can be modeled to develop workload task frequencies.

- Workload capacities developed by use of criteria found in the TOE Manpower Requirements Criteria (MARC) chapter of AR 570-2 (Manpower and Equipment Control Organization and Equipment Tables Personnel) are valid when applied to emerging systems.

- All positions developed are based on the capabilities of a soldier who is fully trained, qualified, and motivated. To insure consistency of manpower analysis results, two supporting assumptions are made. First, one MOS cannot perform another's work. Second, a senior skill level can perform a junior level's tasks but never vice versa.

- Workload tasks are only identified at the level needed to identify the time required to accomplish a specific work function (e.g., fly three-hour mission, replace electrical contact, etc.).

- Manpower estimates are generally provided only for operator and maintainer duty positions assigned to the system(s) under analysis.

- Functional and equipment similarities between the Baseline Comparison and Proposed Systems will result in a close skill and knowledge match. That match should be the least resource-demanding because it will result in the least new training and personnel overhead requirements for the Proposed System(s).

Substep Groups

Comparability analysis in the Manpower Requirements Analysis is conducted in three phases: MOS/Grade Determination, Workload Analysis, and Manpower Requirements Determination.

These three substep groups represent separate but interrelated analytical subtask groups necessary to establish a system's qualitative and quantitative manpower requirements. MOS/Grade Determination (Substeps 2.1 through 2.3) establishes qualitative needs by position and task.

Task workload requirements and position descriptions based on task assignment are identified in Workload Analysis (Substeps 2.4 through 2.7). In Manpower Requirements Determination (Substeps 2.8 and 2.9), the number of positions by individual system and total Army force structure are determined. These total manpower requirements are determined on the basis of workload assignments, staffing standards, and the results of Substep 2.3.

Levels of Application

Two levels of analysis can exist within a system's manpower analysis, with level of analysis depending on level of workload task detail examined. At the macro level, positional workload tasks such as operate, conduct fire mission, or repair can be used to outline requirements and positional assignments. However, the ability to conduct impact and trade-off analyses (Steps 5 and 6) is extremely limited.

Micro analysis of workload tasks (e.g., enter target data, patch fuel bladder, set fuse, test repaired radio, etc.) permits workload analysis and MOS/grade analysis to be conducted in an iterative manner with Steps 3 (Training Resource Requirements Analysis), 5 (Impact Analysis), and 6 (Trade-off Analysis). The iterations involve reassigning workload to different duty positions, MOSs/ASIs, and paygrades.

For the HARDMAN Manpower Requirements Analysis discussion which follows, note that the same general approach applies to each system in the analysis (Predecessor, BCS, and Proposed). Therefore, unless a specific analytic step is required for one of the systems, or a comment is appropriate, no distinction will be made.

Many of the following processes need not be applied to identify an item of information for the Predecessor System or, often, for the BCS because the information is already available. In those instances, the analysis required represents the least amount described; the analyst may simply record the information and source.

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Substep Group 2A

MOS and Grade Determination

Overview

This substep group determines the qualitative manpower requirements of the operators and maintainers associated with the Predecessor, Baseline Comparison, and Proposed Systems. Results of this substep group provide a framework for the workload analysis conducted in Step 2 (Manpower Requirements Analysis) and the task and course analysis conducted in Step 3 (Training Resource Requirements Analysis).

During performance of the substeps in this group, military occupational specialties (MOSs), additional skill identifiers (ASIs), duty positions, skill levels, and paygrades are determined. These determinations are made in Substep 2.1 by first identifying candidate MOS/ASI and duty positions

The initial identifications rely heavily on precedent. Identifications are made primarily by comparing each system's generic task and equipment requirements with those that already exist in the Army.

The initial "strawman" or trial MOS requirements are next refined in Substep 2.2. Here the results of the training task comparability analysis conducted in Step 3 and the workload task analysis conducted in Subgroup 2B are used to adjust the initial estimates and to reconcile differences.

During Substep 2.3, the final MOS/ASI, duty position, paygrade, and skill level assignments are made. The standards of grade authorization found in AR 611-201 (Army Personnel Selection and Classification: Enlisted Career Management Fields and Military Occupational Specialties) are applied to the initial manpower requirements determined in Substep 2.9. Where indicated, adjustments are made in accordance with the outcome of this assessment. Manpower requirements are recalculated to obtain the final manpower results.

Figure 2A-1 presents an overview of the logic used to determine a system's MOS and grade requirements. This figure shows the major input, processes and output required for the substep group. Input to this group includes: data elements from Step 1, MOS/grade capabilities and feedback from Substeps 2.4 and 2.9, and training task capabilities and feedback from Substep 3.6.

Substeps which comprise Substep Group 2A are:

2.1 Determine Initial MOS Assignments

2.2 Refine MOS and Grade Assignments

2.3 Determine Final MOS and Grade Assignments

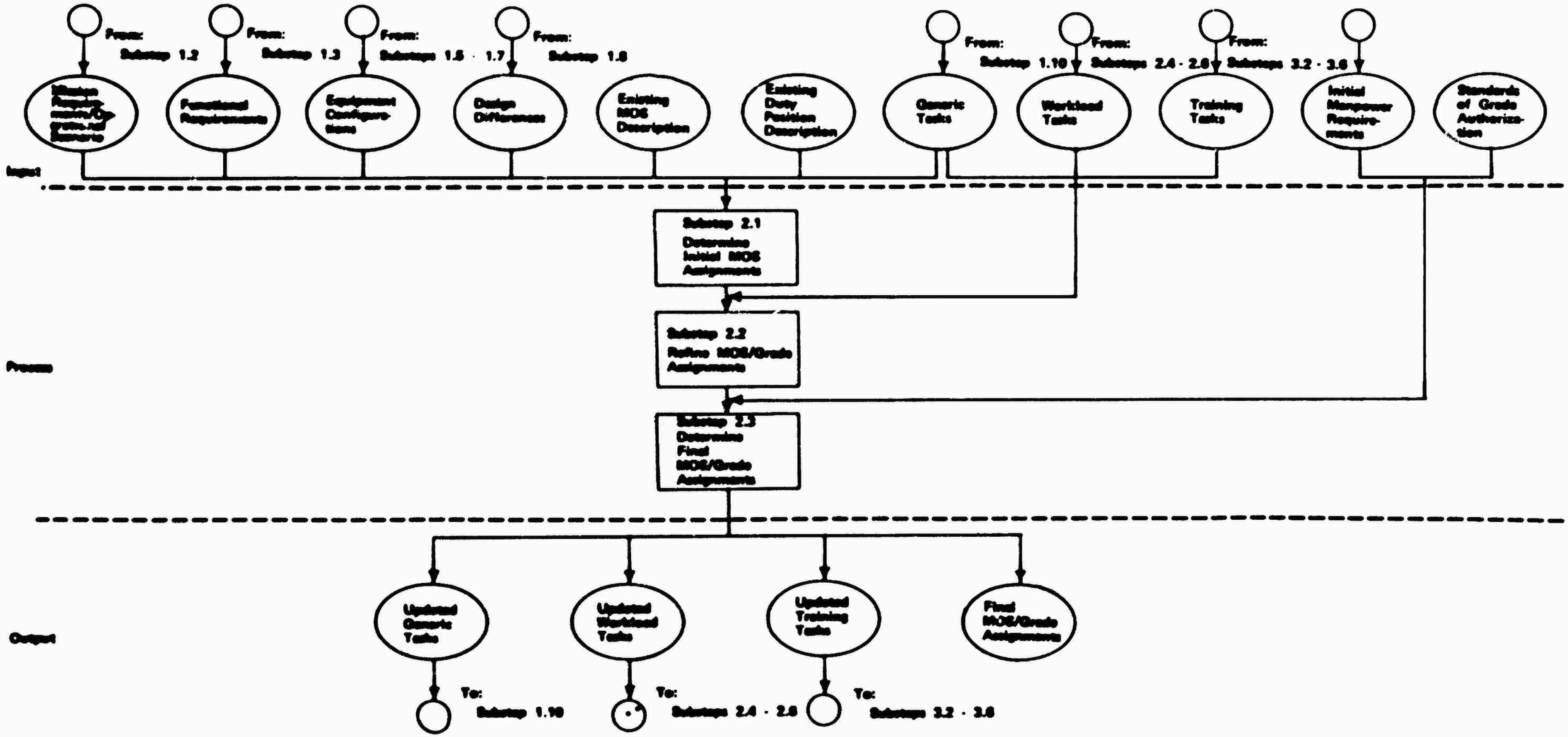

Figure 2A-1. Logic flow for MOS/Grade Determination.

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Determine Initial MOS Assignments

Objectives

In this substep, initial MOS and Additional Skill Identifier (ASI) requirements are determined for the operation and maintenance of each system. Additionally, all operator and maintainer duty position descriptions are tentatively identified.

For the initial estimate, MOS assignments by duty position can be made by estimating the degree of responsibility, authority, span of control, and technical competence associated with the generic task(s). Normally, these will be made at the task level for the BCS and Proposed Systems unless they closely resemble the Predecessor System. In that case, existing duty positions for the Predecessor System can be used without change.

This latter possibility is to be expected in analyzing systems that are product improvements or close derivatives of the Predecessor System. For any system other than a relatively large and complex one, the equipment type and generic function will suggest all or most types of duty positions which will eventually be required.

Input

Step 1 provides the system function (Substep Group B), the mission and operating scenario (Substep Group A), equipment configurations and design differences (Substep Group C), and generic tasks (Substep 1.10).

MOS and skill level characteristics are obtained from a number of sources, including AR 611-201 (Army Personnel Selection and Classification -- Enlisted Career Management Fields and Military Occupational Specialties), trainer's guides, soldier's manuals, Qualitative and Quantitative Personnel Requirements Information (QQPRI), and the Manpower Criteria (MARC) data base. Technical manuals and maintenance documentation specific to the Predecessor System and BCS components are additional sources of MOS data.

Products

Results of this substep are the first cut at BCS and Proposed System(s) MOS/ASI requirements and their operator and maintainer duty positions. Table 2.1-1 gives a sample MOS/ASI summary by equipment for a typical HARDMAN study. This summary is used as an initial input to both the training and manpower analyses. The initial duty position estimates are input to Substep 2.4 (Identify Workload Tasks) and to the Task Comparability Analysis substep group of Training Resource Requirements Analysis (TRRA) when a detailed TRRA is conducted.

Logic

In this substep, initial operational and maintenance MOS/ASI and duty positions are determined. The MOS estimates are made by employing two different approaches, one for operators and one for maintainers. Figure 2.1-1 represents the logic flow for establishing the initial MOS assignments.

Operator MOSs are determined by comparing the characteristics of the generic tasks identified in Substep 1.10

Table 2.1-1. *Summary of MOS/ASI Assignments by Equipment*

Equipment Identification Code	Generic Equipment Name	Predecessor System				Baseline Comparison System				Proposed System			
		C	ORG	DS	GS	C	ORG	DS	GS	C	ORG	DS	GS
ODADG	Ground Data Terminal Control Display	None	None	None	None	13T	13TP9	34Y	34Y	13T	13TP9	34Y	34Y

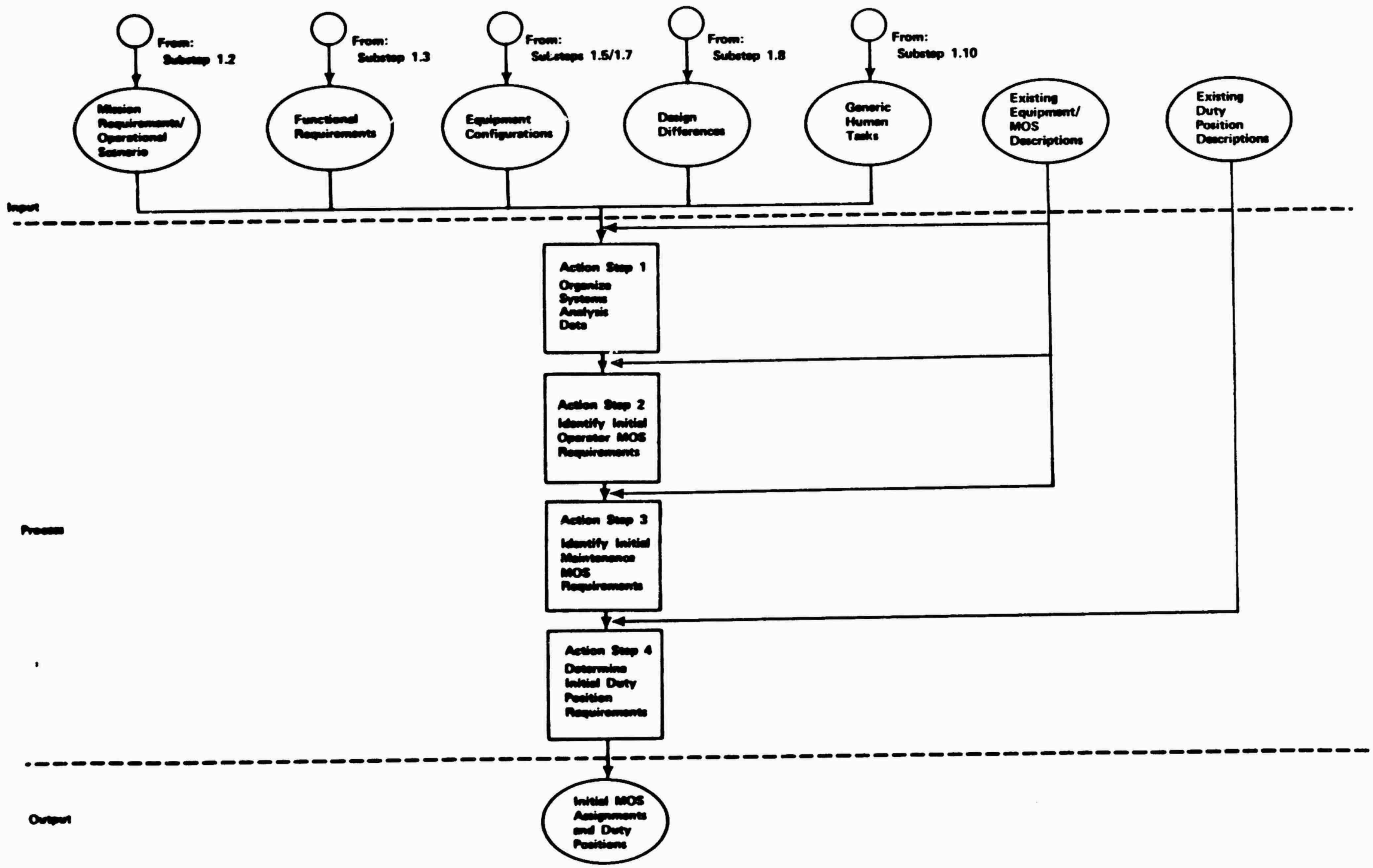

Figure 2.1-1. Logic flow for Determine Initial MOS Assignments.

with those of existing MOSs specified in AR 611-201. If required, technical manuals, trainer's guides, soldier's manuals, new system documentation, etc., are used tc aid in making these comparisons. Maintenance MOSs are determined by comparing the technological and functional characteristics of the generic and system-specific equipment to the MOSs/ASIs identified for this equipment in the MARC data base, AR 611-201, QQPRI, and other sources.

The objective of these comparisons is to make the closest match between each system's equipment and generic tasks and that equipment and its tasks currently in the Army's inventory. When the comparisons are made, a set of candidate MOSs are initially identified. This set will fall into one of the following categories:

- An MOS is found which performs the same tasks on the same equipment and under the same operational conditions as on the system under study.
- MOSs are found which accomplish tasks on a comparable/similar system in a context roughly equivalent to that envisioned for the Proposed System.
- MOSs are found which perform similar tasks on a comparable system but not in a roughly equivalent context.
- Within the current Army MOS structure, no MOS embodies the requisite skills and knowledges.

If the first or second condition exists, MOS determination is straightforward because only one set will exist. When the third situation is encountered, the analyst may identify several MOSs and/or Additional Skill Identifiers (ASIs) which satisfy system requirements. In this case, a best-fit solution will have to be developed.

If the last condition exists, new MOSs and/or ASIs may be needed if the tasks identified cannot be made to fit well within existing MOSs/ASIs. In some cases, a constraint for the development of a new system is the creation of new MOSs/ASIs. The MOS/ASI task discrepancies identified by this type of possibility will provide an important input to the Training Resource Requirements Analysis (Step 3). During this step, a detailed analysis of the new tasks' fit to the MOS can be made from a training standpoint.

Action Steps

Action Step 1: Organize Systems Analysis Data

Requirements

The analyst develops an organizational framework for displaying the Systems Analysis data used in making each system's initial MOS assignments. Two frameworks are configured to display this data and to record the results of MOS/ASI assignments. One framework pertains to the analysis of system operations. The other is for the analysis of system maintenance requirements.

Each framework is different because system operation is based on the functional requirements, operational concept, and equipment requirements of the system. System maintenance, by contrast, depends on the functional and technological characteristics of the equipment as well as on the maintenance concept.

Objective

In this step, input data from Systems Analysis (Step 1) are sorted and arrayed by system for each of the two analysis frameworks. This organization should be able to display the results of the MOS/ASI assignments made in later action steps.

Procedures

For each Predecessor, Baseline Comparison, and Proposed System, the analyst extracts the information listed in Table 2.1-2 from the output of Step 1.

Table 2.1-2. Step 1 Data Elements

Data Element	Step 1 Substep
Functional Requirements	1.3
Mission Requirements/ Scenario	1.2
System/Equipment/ Component Identification	1.5 (Predecessor) 1.6 (BCS) 1.7 (Proposed)
Generic Tasks	1.10
Design Differences	1.8

These data are then arranged by system in a format appropriate for the specific analysis being conducted. Table 2.1-3 gives a sample format for operator analysis, while Table 2.1-4 shows one for maintenance analysis.

Table 2.1-3. Initial MOS Assignment Data: Operator Analysis

System: ______________
(Predecessor, BCS, or Proposed)

Functional Requirement	System Equipment	Generic Tasks	MOS/ ASI	Duty Positions

Table 2.1-4. Initial MOS Assignment Data: Maintenance Analysis

System: ______________
(Predecessor, BCS, or Proposed)

Equip-ment ID Code	Generic Equipmnt Name	System Equipmnt Name	LIN	Generic Tasks	MOS/ASI by Maintenance Category			
					ORG	DS	GS	DEPOT

Action Step 2: Identify Initial Operator MOS Requirements

Requirements

In this action step, an initial identification of Operator MOS requirements is made. This identification is based on the generic workload tasks developed in Substep 1.10 and other data developed in Step 1 (Systems Analysis) that was formatted in the preceding action step. These data, in conjunction with descriptions of existing MOSs, are used to make the MOS identifications.

Objectives

This action step provides an initial estimate of MOSs which are reasonable candidates for accomplishing the operator generic tasks identified in Substep 1.10. Initial MOS identification is not designed to make hard and fast determinations of each system's MOS requirements. Instead, it serves to identify operator MOS for analysis in later substeps and to promote the early identification and collection of MPT data on the relevant MOS.

Procedures

The operator MOS(s) for the Predecessor System (if any) should be determined first. If they are not readily available, AR 611-201 is consulted for the appropriate list of operator MOS by Career Management Field (CMF). Each CMF typically includes either the operator or maintainer MOSs for one functional branch area (e.g., CMF 23—Air Defense Missile Maintenance, CMF 13—Field Artillery [operation], etc.).

The analyst then identifies the proponent branch of the Predecessor System and finds its list of operator MOSs. The correct operator MOS(s) is verified by contacting a subject-matter expert (SME) at the weapon system's proponent school.

For the Proposed System, the operator MOS or MOSs are taken from the QQPRI. If a QQPRI does not exist, the operator MOS(s) of the Proposed System as well as of the BCS must be determined by analysis. Using the data formatted in the previous action step, the analyst completes for each system a task by task comparison with the MOS capabilities described in AR 611-201.

The general process for this initial determination of operator MOS is to:

1. Select each generic operator task and associated equipment(s) for investigation.

2. Estimate the task's general skill and knowledge requirements for the equipment and the operational environment of the system.

3. As was done previously for the Predecessor System, the analyst finds the CMF in AR 611-201 that lists the operator MOSs for the weapon system's functional branch area. All reasonable MOS options are identified within this list which will be able to perform the task based on the task and MOS descriptions in AR 611-201.

If the task descriptions in AR 611-201 are not sufficient to make a match, the trainer's guide, soldier's manual, and technical manuals for the operation of equipment are consulted. Consideration of other MOSs beyond this list is not usually necessary, since other MOSs would not be viewed as operator MOSs of the weapon system's proponent branch.

After all candidate MOSs have been identified for the system tasks, the analyst determines the amount of similarity in the MOSs recommended. Re-evaluations of some task-to-MOS decisions may be necessary to see if greater similarity can be achieved.

For most weapon systems, only one operator MOS will be required. If one (or more) existing MOS does seem to perform a large proportion of the system tasks, it should be considered as the tentative operator MOS. In choosing tentative operator MOSs, system-specific MOSs may be encountered that appear to be capable of performing many of the tasks. Such system-specific MOSs are usually excluded from consideration.

If no single MOS seems to be appropriate, then a new MOS or an ASI to an existing MOS may be required. This requirement cannot be validated until later, but for now, a notional MOS number should be created and used.

Action Step 3: Identify Initial Maintenance MOS Requirements

Requirements

In this action step, an initial identification of maintenance MOS requirements is made. This identification is made for each system's equipment by comparing it with existing equipment and identifying its MOS/ASI requirements. Generic tasks are used, as needed, to refine further the results of this comparison.

Objective

The purpose of Action Step 3 is to provide initial estimates of MOSs which are reasonable candidates for providing system maintenance. As with Action Step 2, this action step identifies MOSs for later substeps and promotes early identification and collection of MPT data on the MOSs to be studied.

Procedures

With the data formatted in Action Step 1 for maintenance analysis (see Table 2.1-4), the analyst identifies all equipment items having Line Item numbers (LINs). The Manpower Requirements Criteria (MARC) data base is searched for those LINs in order to identify all assigned MOSs and their maintenance echelons. This search will result in one of the following situations and its required action.

- The LIN is not found.

  Action: Look at adjacent LINs and note if any of this equipment is similar to the one being researched. If none is found, search the equipment nomenclatures for other candidates. If any similar equipment is found, record (on Table 2.1-4) these MOSs for the system's equipment at their appropriate maintenance echelon.

- For the LIN, one MOS/ASI is indicated in each maintenance category. (Sometimes no MOS is found for the higher maintenance categories. That means no corrective maintenance is required at this level.)

  Action: Record (on Table 2.1-4) these MOSs for the system's equipment at their appropriate maintenance echelon.

- One entry of the LIN is found, but more than one MOS/ASI is indicated at each maintenance category.

  Action: Typically, this means the equipment is a major end-item, such as a helicopter or a vehicle. Consult AR 611-201 for each MOS. From the description provided, determine which subordinate equipment of the end item matches the responsibilities of the listed MOS. For the system's equipment, record the MOS at the appropriate maintenance echelon on Table 2.1-4.

  If the equipment list does not include an appropriate component(s) that this MOS would be responsible for, consult the analyst who constructed the equipment list. Determine whether the component is appropriate and should have been included on the equipment list. If the component is not appropriate for the system under study, disregard the associated MOS.

- For the LIN, more than one MOS/ASI is indicated at each maintenance category.

Action: Typically, this means the equipment is found on different systems and/or in different types of units. For example, LIN P407505, Power Supply PP-6224, is listed three times in MARC with the following MOS and maintenance categories:

MOS/ASI	Description	OS	DS	GS
13TP9	RPV Mechanic	X		
31E	Field Radio Repairer		X	X
36L	Electrical Switch Switch Repairer	X	X	X

Obtain copies of the TOEs that are identified in Substep 1.2 (Identify Detailed Mission Requirements) and determine whether any of these MOSs are usually found in maintenance units which support the weapon system under study. If the MOSs are found in these units, record (on Table 2.1-2) the MOSs for the system's equipment at their appropriate maintenance echelon.

The process just described is most effective for identifying many, but not all of the Predecessor System MOSs/ASIs. A search of MOSs in the various supporting maintenance units of the Predecessor System may identify additional MOSs. TOEs are searched for each supporting maintenance unit, and any additional MOSs/ASIs are identified.

All MOSs/ASIs identified should be compared with the MOS descriptions in AR 611-201 and verified by SMEs at each proponent school. Proponents for individual MOSs can be identified by consulting DA Pam 351-9 (EPMS Master Training Plan). Proponents in general for system-peculiar equipment and functional areas can be identified by referring to TRADOC Cir 351-1 (Common Job and Task Management).

Maintenance MOSs/ASIs for the Proposed System are taken from the weapon system's QQPRI. However, MOSs identified by use of MARC in the QQPRI should be accepted only after critical examination. QQPRIs developed early in the acquisition process may reflect only the MOSs found at that time on the MARC data base. The Direct Productive Annual Maintenance Man-hours section is particularly affected by this.

Often these initial MOS identifications have not been staffed with the proponent schools. Nor have assessments been made regarding their fit to the weapon system's supporting maintenance units. Any discrepancies should be reconciled with the QQPRI's proponent, usually the program manager's office.

The MARC data base is helpful in identifying existing maintenance MOS responsibilities for government furnished equipment (GFE), product improved existing equipment, and new equipment which is a close derivative of existing equipment. However, some new equipment may be very different technologically and functionally from existing equipment.

Generic maintenance tasks for this equipment are compared with the duty and task descriptions of the MOSs in AR 611-201. Maintenance CMFs are identified, and this task matching is made to the MOSs found in the most appropriate CMF. The following criteria should be considered in identifying a comparable maintenance MOS/ASI. The maintenance MOS/ASI:

- —is in the appropriate maintenance CMF
- —is at the same maintenance level

—has a sufficient match of generic tasks to the tasks, duties, and type skills described in AR 611-201

If these criteria are not adequately met, a new MOS/ASI is indicated. This decision is, of course, tentative and subject to later analysis.

When comparable equipment on the BCS is incorporated from other services, the analyst may find the Occupational Conversion Manual helpful. This manual cross-references Navy, Air Force, Marine Corps, and Army occupations to each other. By identifying the occupational code for the other service's maintainer (or operator), the appropriate conversion table in this manual may be consulted to identify its Army counterpart.

Action Step 4: Determine Initial Duty Position Requirements

Requirements

Initial duty position requirements are determined by use of the operator and maintainer generic tasks along with the duty positions associated with MOSs identified for the Predecessor and BCS.

Objective

The purpose of this action step is to establish system candidate or "strawmen" duty positions as a point of departure for workload task and training task analysis. These duty positions and the initial MOS determinations are used as input to later analysis steps. Determining the number of required positions should be not attempted until Substep 2.9 (Compute Manpower Requirements).

Procedures

Duty positions (operator and maintainer) associated with the Predecessor System are established first. For the Predecessor System, existing duty positions as described in AR 611-201 are used without any changes in description or MOS assignment.

Duty positions for the Proposed System (especially for operators) are taken directly from the duty position description sections of the QQPRI. If the weapon system does not have a QQPRI, duty positions for existing MOSs identified for the Proposed System as well as for the BCS are used as candidates.

These candidate duty positions are evaluated further by comparing the generic tasks of each MOS to the tasks with duty and type skills and described for the MOS in AR 611-201. Those existing duty positions that fit closely to the performance of the generic tasks are listed as "strawmen" duty positions to each MOS.

Typically, nearly all generic tasks can be assigned to an existing duty position. However, if a large number of tasks do not fit, then an additional duty position is identified. It is helpful to incorporate the name of the new weapon in the new duty position title.

For new MOSs, duty position requirements are determined by identifying a comparable, existing MOS and making the same comparison as described in the preceding paragraph. Of course, descriptions of the duty positions identified on the comparable MOS will have to be altered to reflect the new weapon system. In identifying a comparable MOS for this purpose, the MOS should come closest to matching the following criteria, with the physical size of the system being the most important criterion to match.

—in similar/same career management field
—same maintenance level
—similar/same type of weapon system
—similar/same physical size of weapon system (e.g., similar size shelter with similar number of consoles, etc.)

These duty positions identified are also listed for each new MOS.

Refine MOS/Grade Assignments

Objectives

During this substep, the generic tasks developed in Substep 1.10 are updated, and paygrades and/or skill levels are assigned to them. Additionally, the initial MOS/ASI and duty position assignments made in Substep 2.1 are updated and refined.

These refinements are based on the updated generic tasks and on new data generated by workload and training task analyses conducted in separate HARDMAN substeps. Because reassignments made in this substep are collectively determined, they require the analytical input and expert judgments of training and manpower analysts alike.

Input

Input from other HARDMAN substeps includes the generic tasks from Substep 1.10 (Determine Generic Tasks), the initial MOS and duty assignments from Substep 2.1 (Determine Initial MOS Assignments), the training tasks from Substep Group 3A (Task Comparability Analysis), and the workload tasks from Substep Group 2B (Workload Analysis).

Input from sources other than HARDMAN depends on the extent of the discrepancies between the results of the training task analysis and those of the workload task analysis. This input may come from every source used in Step 1 (Systems Analysis).

Products

The results of this substep include:

- Updated generic tasks
- Updated MOS/ASI and duty positions
- Skill level/paygrade assignments to generic tasks, workload tasks, training tasks, MOSs/ASIs, and duty positions

The MOS/ASI and duty position updates are made to Tables 2.1-1, 2.1-3, and 2.1-4.

Logic

Figure 2.2-1 shows the logic flow for refining system MOS/ASI, duty position, and paygrade/skill level assignments. The results of the initial MOS and duty position analysis (Substep 2.1) were input to the workload analysis (Subgroup 2B) and to the task comparability analysis (Subgroup 3A) of the Training Resource Requirements Analysis.

These results, along with the generic tasks and the system equipment configurations, provide the ingredients for the unique analyses conducted in workload and training requirements determination. In this interactive substep, the results of these two analyses are reconciled, and all results thus far are updated and normalized.

Action Step

Requirements

Until this point, the training analysis and workload analysis are conducted independently. However, both are based on the same initial generic tasks, MOSs/ASIs, and duty positions. In this action step, the qualitative elements of manpower requirements are refined, and both analyses are updated.

Objective

The objective of this action step is to: (1) update and refine previous MOS/ASI and duty positions decisions; (2) update generic tasks; and (3) assign skill levels/paygrades to generic tasks, MOSs/ASIs, and duty positions.

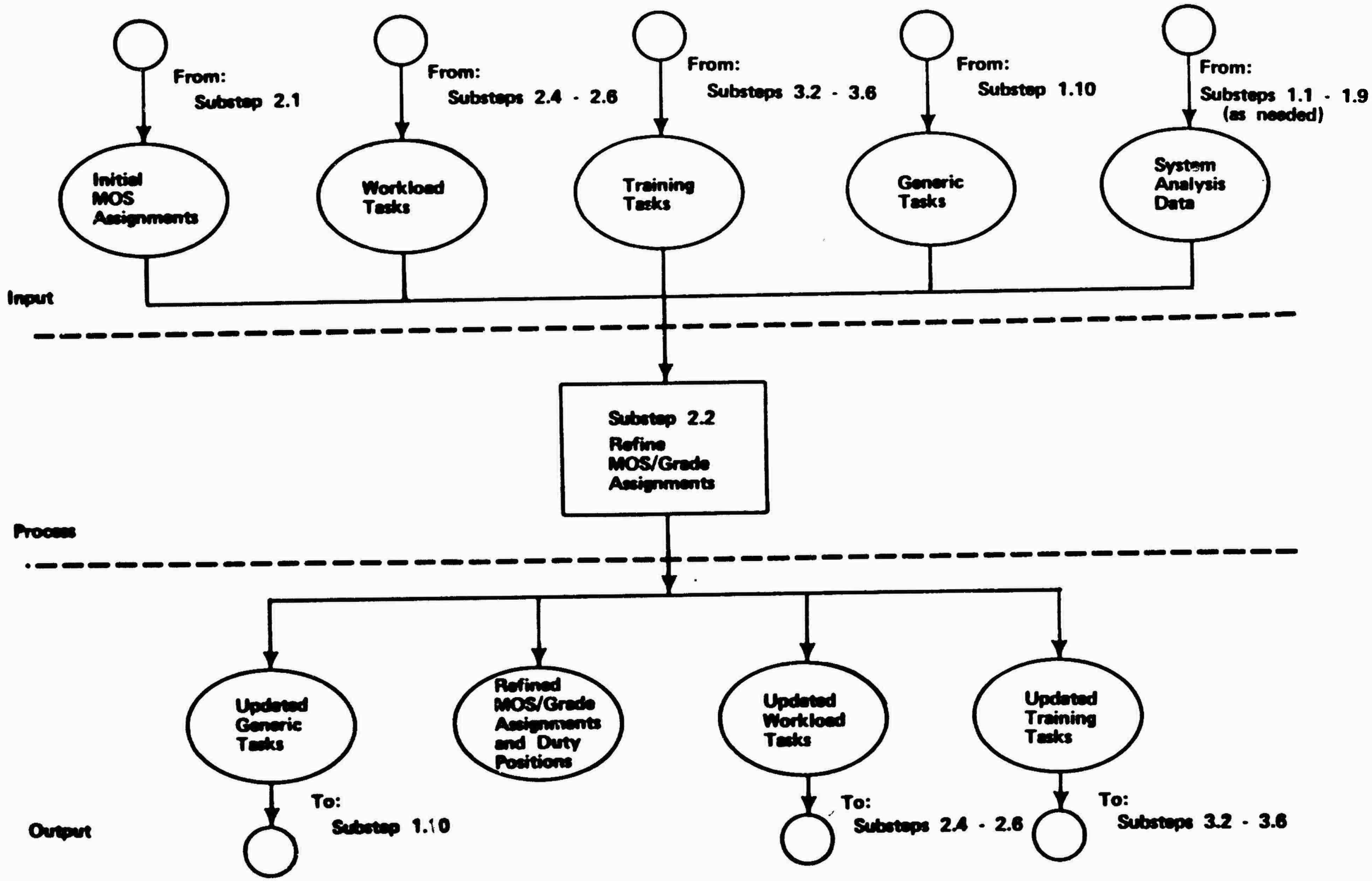

Figure 2.2-1. Logic flow for Refine MOS/Grade Assignments.

Procedures

To refine MOS/grade assignments, the analyst carries out the following procedures:

1. Obtain the initial MOS assignment data formatted in Substep 2.1 for operator (Table 2.1-2) and maintainer (Table 2.1-3) analysis. Use these formats as a focal point for updating and refining the MOS/ASI and duty position results of Substep 2.1 and for determining skill level and paygrade requirements.

2. For refining operator assignments, begin with the Baseline Comparison System and compare operator workload tasks (Substep 2.4) as well as quantitative workload and qualitative manpower requirements (Substep 2.6) to BCS training tasks (Substep 3.4). Compare the individual updates made by the respective analyses to the generic tasks and reconcile any differences. Update the generic tasks to reflect the consensus achieved.

3. Compare the BCS-specific tasks generated by the two different analyses and reconcile their differences. Tasks identified on one task list may indicate the need for additional analysis on the other. Conversely, after further analysis, tasks found on one list may need to be deleted.

BCS task descriptions on both lists should be edited to reflect consistent terminology. More important are individual generic task differences that are noted in (1) paygrade for the workload task and in (2) skill level for the training task. Such differences indicate that a task is performed in the field at one paygrade but is trained at a different paygrade.

Differences of this type should be noted by the respective analysts and used as evidence to make changes in the comparable Proposed System task. Differences in paygrade/skill level should be maintained in the respective analyses, as they were derived using comparability analysis from their respective mature, fielded data sources.

4. Compare the Proposed System-specific tasks for the two analyses and reconcile their differences in the same manner as for the BCS. As noted above, change the skill level for the Proposed System training task to reflect the lowest paygrade found in the comparable BCS workload task. The implication of this change is that the task, as evidenced by historical R&M data, is presently performed at a lower skill level and that it need not be trained at the higher level.

5. Final refinement consists of updating the assignment of tasks to MOSs/ASIs and duty positions. The same basic approach employed for comparing the two sets of tasks is again taken here. Differences in assignment between the two analyses are reconciled, and updates are made.

Typically, the training analysis contributes little input to the assignment of tasks to duty positions. While duty position is often used as a major criterion in determining whether a task should be trained, the relationship between task and duty position is often difficult to assess from fielded training documentation.

Therefore, the results of this assignment of task to duty positions are input to the training task comparability analysis (Substep Group 3B). The basic criteria for assigning tasks to duty positions consist of estimating the degree of responsibility, authority, span of control, and technical competence required.

Determine Final MOS/Grade Assignment

Objectives

In Substep 2.3, final MOS and paygrade requirements are determined for each system. For system workload tasks that are a function of the number of positions either managed or led, the final MOS/grade determination is made and the task annotated to reflect the span of positions controlled.

Up to this point in the analysis, the staffing requirements for workload tasks and system positions derived from workload have been developed without referring to the MOS Standards of Grade Authorization contained in AR 611-201 (Enlisted Career Management Fields and Military Occupational Specialties). This has been done in order to obtain a measure of direct workload-driven manpower requirements which is not influenced by the aggregating effect of staffing tables.

Input

Initial input to this substep includes the MOS, skill level, paygrade, and duty positions which were refined in Substep 2.2. Substep 2.9 provides the number of workload-driven manpower requirements. These requirements are provided by MOS and paygrade. The primary input required by this substep is from the MOS Standards of Grade Authorization tables in AR 611-201.

Products

The results of this substep are the final MOS and paygrade assignments for each system's operator and maintainer duty positions. The final MOS assignments are made on Table 2.1-1, while the final paygrade and duty position decisions are incorporated into the workload tasks, training tasks, and the final manpower requirements results, where appropriate.

Logic

Figure 2.3-1 shows the logic flow for calculating final MOS and paygrade assignments.

Action Steps

Action Step 1: Determine Final MOS/Grade Assignments by System Workload Task

Requirements

For system tasks which are a function of the number of positions either managed or led, the final MOS/paygrade determination comparison is made against AR 611-201. The task is then annotated to reflect the span of positions controlled. Changes are provided to Substep 2.9 for workload assignment, reanalysis, and duty position determination before proceeding to Action Step 2.

Objective

The objective of this action step is to complete the analytic process necessary to determine the full range of MOS and paygrade requirements of each system.

Procedures

Using output from Substeps 2.2 and 2.9 and AR 611-201 MOS Standards of Grade Authorization tables, the analyst establishes appropriate paygrades associated with the system-specific technical leadership and supervisory

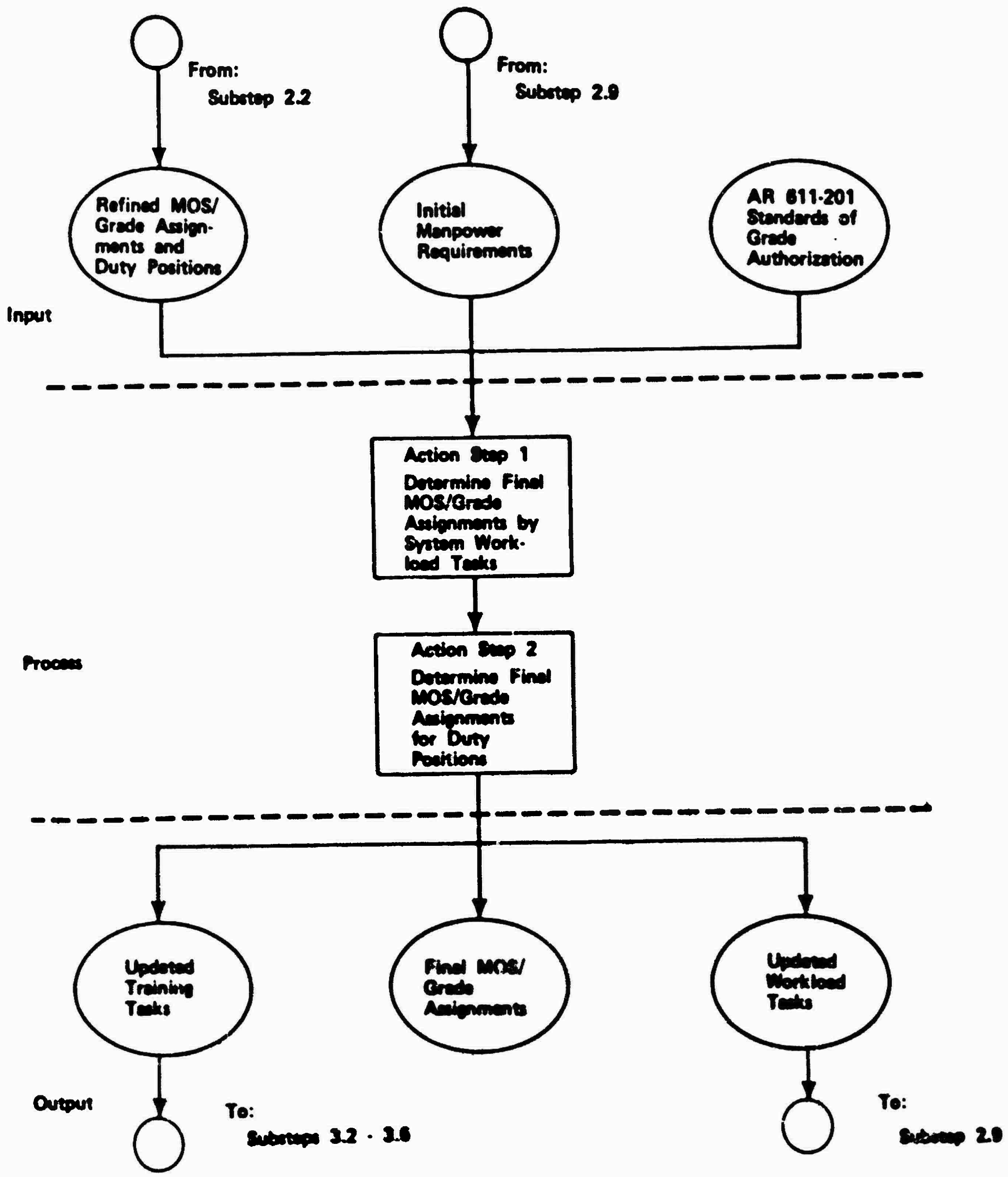

Figure 2.3-1. Logic flow for Determine Final MOS/Grade Assignment.

tasks which are a function of the span of positions and/or equipment directly controlled or maintained. If an MOS changes as a result of grade assignment, the change is recorded at this time. Both the duty position and task associated with that MOS are updated accordingly.

When a new MOS has been previously determined, the analyst searches the Standards of Grade Authorization tables for MOSs in the same career management field (CMF) as the new MOS. Similarities in staffing requirements and policies are noted. The median is used to estimate staffing standards which will be applied to the new MOS.

After all tasks have been updated, a check is made to insure that individual task changes have not affected workload-driven positions. If they have, then the Substep 2.9 workload distribution and the resulting positions are re-evaluated before proceeding with the analysis.

Example

For a particular weapon system, the system maintenance workload at the organizational level includes a maintenance supervision task. That task was assigned to 63Y20 (Track Vehicle Mechanic/E-5) in Substep 2.2.

Substep 2.9 determined that a manpower requirement exists for four 63Y maintainers (three E-3s and one E-5) in each organizational maintenance unit. Review of the 63 CMF indicates that MOS 63Y folds into MOS 63B at Skill Level 3/Paygrade E-6.

Both MOSs' Standards of Grade Authorization tables are examined and compared with the supervision task. The result is a position upgrade to E-6 and a change in MOS to 63B in accordance with the 63B staffing table guidance. This task assignment change also results in a workload reassignment which must be fed back to Substep 2.9 for reanalysis of workload-driven manpower requirements. Thus, the workload reanalysis results in the following workload position requirements:

1 - 63B30/E-6
1 - 63Y20/E-5
2 - 63Y10/E-3

Action Step 2: Determine Final MOS/Grade Assignments for Duty Positions

Requirements

In this action step, the final system-specific, qualitative assignments of MOS and paygrade to each duty position are made. Any changes in MOS or paygrade determined from the previous action step are recalculated in Substep 2.9 and compared to the results derived from the AR 611-201 staffing tables.

Objective

The purpose of this action step is to complete the analytical process which will determine fully supportable MOS and paygrade assignments for all system-specific operator and maintainer positions.

Procedures

Using the output from Substeps 2.2 and 2.9 and the AR 611-201 MOS Standards of Grade Authorization tables, the analyst establishes appropriate paygrades associated with the system-specific, workload-derived positions of Substep 2.9.

AR 611-201 staffing requirements are determined for an MOS by consulting its Standards of Grade Authorization table. The determination is based on the MOS's number of positions and assignments. Paygrade distributions from the table and from the Substep 2.9 analysis are then compared. The senior distribution is selected, becoming the final paygrade distribution by MOS for the system.

If an MOS does not exist, Standards of Grade Authorization tables are examined for MOSs in the CMF to which the new MOS will belong. Similarities in staffing standards are noted, and the median is used to estimate staffing standards which will be applied to the new MOS. Workload and the estimated staffing standard are then compared to establish the senior staffing requirement. After all MOSs are analyzed, final MOS and paygrade assignments are returned to Substep 2.9 for distribution to the other areas of analysis.

To continue with the example from Action Step 1:

1 - 63B30/E-6
1 - 63Y20/E-5
2 - 63Y10/E-3

No staffing change for MOS 63B is indicated. However, in the case of 63Y, workload requirements are different from AR 611-201 for three position staffings. The tabular requirements are:

1 - 63Y20/E-5
1 - 63Y10/E-4
1 - 63Y10/E-3

Comparing the two ahd using the selection criterion of "Senior Staffing Determinates," the final MOS and paygrade assignments become:

1 - 63B30/E-6
1 - 63Y20/E-5
1 - 63Y10/E-4
1 - 63Y10/E-3

These assignments are passed on to Substep 2.9 for inclusion in the final Manpower Requirements results.

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Substep Group 2B

Workload Analysis

Overview

The question, "What must people do to properly operate and maintain the system?" is central to any HARDMAN manpower analysis. The Workload Analysis substep group answers this question by providing the following information for each BCS and Proposed System alternative:

- Required human workload tasks
- Temporal relationship of the tasks (i.e., which tasks are sequential, which ones overlap)
- Time needed to accomplish each task
- Number of times a task must be accomplished within a fixed period of time
- Task type (i.e., operator or maintainer)
- Task assignment (e.g., grouped by specific position or assigned freely)
- Number of people needed to accomplish a task
- MOS, skill level, and paygrade required by each task for a specific system

In this context, a workload task is defined as an activity in which a person exerts strength (skill) and/or faculties (knowledge). The activity must be performed over time, and the results must be quantifiable.

Task descriptions for the Baseline Comparison System tend to have high fidelity since BCS components are chosen from mature, fielded systems. For the Proposed System, task detail is limited initially due to a lack of specific design details of system operation and maintenance. As the system is further defined, subsequent applications or iterations of the analysis permit a more detailed examination of the system's workload requirements.

Unless noted otherwise, all analyses in this substep group are performed on one element of the BCS and Proposed System equipment structures. When each element of each structure has been subjected to Workload Analysis, the total workload for each alternative can be obtained through simple aggregation.

Logic

The logic of obtaining workload is illustrated in Figure 2B-1. Workload may be defined as labor expended over some period of time.

$$\text{ACTIVITY} \times \text{FREQUENCY} \times \text{QUANTITY} = \text{WORKLOAD}$$

$$\frac{\text{Use}}{\text{Period}} \times \frac{\text{Actions}}{\text{Use}} \times \frac{\text{Labor}}{\text{Action}} = \frac{\text{Labor}}{\text{Period}}$$

Figure 2B-1. Obtaining workload.

As the figure shows, workload is the product of three separate factors: (1) the usage or activity, over time, of the item for which workload is being derived; (2) the frequency with which the task occurs; and (3) the quantity of labor expended on each action or task.

In HARDMAN, this logic pertains to both operator and maintainer workload. However, while it always applies to the determination of maintainer workload, the degree to which it applies in determining operator workload depends on the particular characteristics of the system under analysis. Not all operator work situations require a detailed analysis prior to determining workload.

Figure 2B-2 presents an overview of the logic in determining system-specific workload requirements by operator and maintainer area. This figure shows the major input, processes, and output required for Substep Group B.

Included as general input to this group are: (1) information and data elements generated in other HARDMAN substeps and (2) system-specific manpower task data/information. On the basis of this input, three substeps analyze and determine workload results:

2.4 Identify Workload Tasks

2.5 Determine Maintainer Workload

2.6 Determine Operator Workload

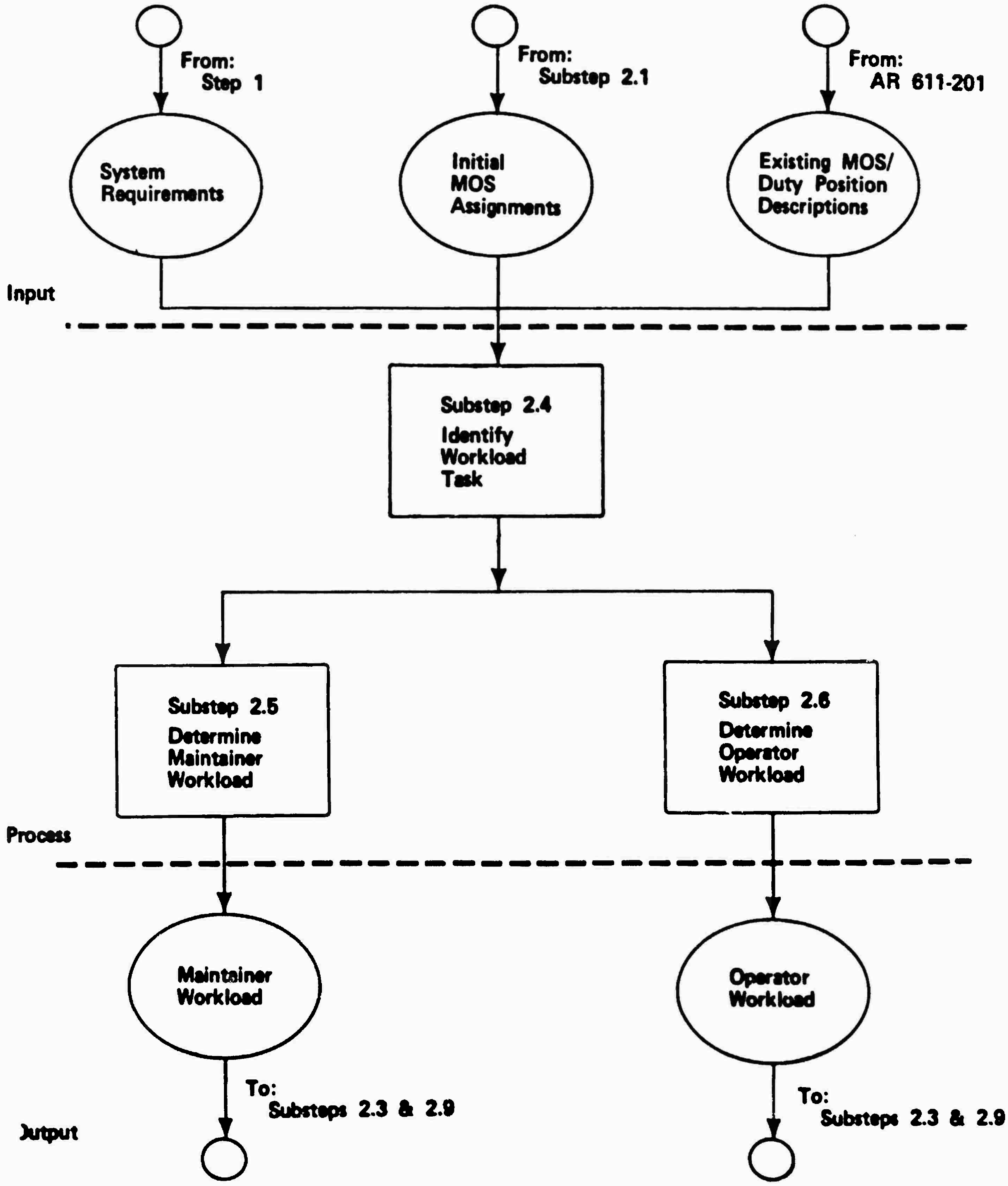

Figure 2B-2. Logic flow for Workload Analysis.

Identify Workload Tasks

Objectives

Workload for each of the BCS and Proposed System alternatives provides the basis for determining manpower requirements. The objectives of this substep are to (1) identify tasks which describe workload at the system level; (2) establish the temporal relationship of these tasks to each other; and (3) develop information on the MOS, skill level, and paygrade requirements of these tasks to provide feedback to Substep Group 2A (MOS/Grade Determination).

Input

Input from other HARDMAN substeps includes function flow/mission event sequence descriptions from Substep Group 1A (Mission Analysis), BCS and Proposed System equipment structures and the Design Difference Index from Substep Group 1C (Equipment Comparability Analysis), and initial and/or refined MOS, skill level, and paygrade determinations for generic tasks and duty positions from Substep Group 2A (MOS/Paygrade Determination).

Input from sources other than HARDMAN includes: (1) system task definitions and/or standards (e.g., results of Army field tests or demonstrations, industrial engineering standards, Logistic Support Analysis Record (LSAR) data, other service tasks, etc.); (2) occupational and task descriptions (e.g., AR 611-201, soldier's manuals, job performance standards, etc.); (3) technical documentation and other system configuration information; and (4) doctrinal documents (e.g., O&O Plan, how-to-fight manuals, etc.).

Products

The three products of this substep are: system-specific task listings, task timeline relationships, and task/position relationships.

Logic

Mission Analysis, Substep Group 1A, established the sequence of actions necessary to complete a single performance of a system function. The logic employed in Mission Analysis is also employed to identify workload tasks.

"Mission events" is the term used in Mission Analysis to describe the actions which comprise a function. Similarly, a single mission event is comprised of collective and individual tasks performed in a particular sequence. Thus, identification of workload tasks extends the process begun in Mission Analysis to a lower level of indenture.

Figure 2.4-1 represents the logic flow for identifying workload tasks. Note that, in practice, much of the analytic work in these three action steps occurs simultaneously. However, to provide a logical frame of presentation, each step will be presented as if accomplished in the sequence shown.

Action Steps

Action Step 1: Specify Operator and Maintainer Tasks

Requirements

The analyst specifies operator and maintainer workload tasks by using detailed mission requirements from Substep 1.2, generic tasks from Substep 1.10, and BCS and Proposed System design information from Substeps 1.5 through 1.8.

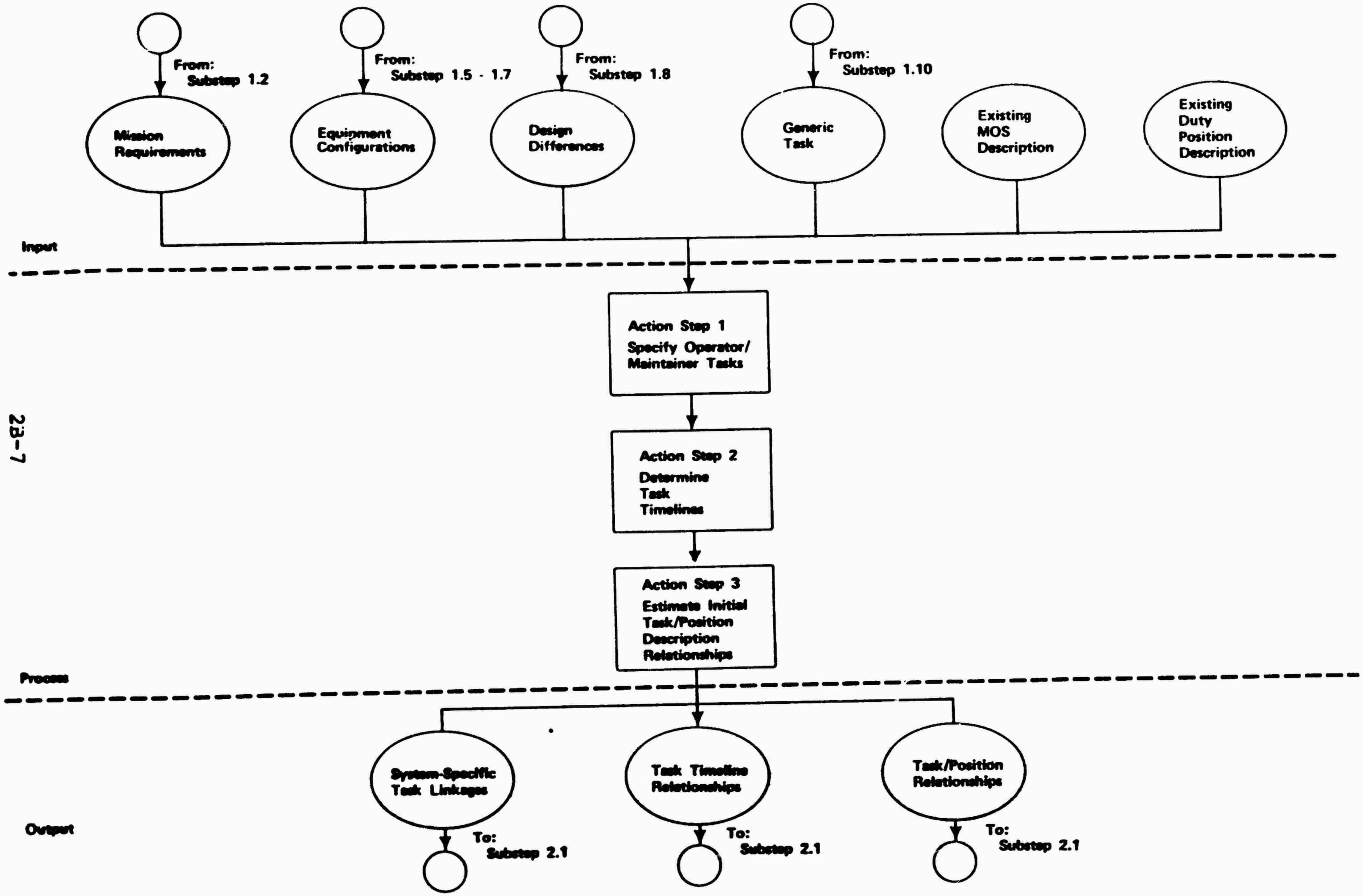

Figure 2.4-1. Logic flow for Identify Workload Tasks.

Objective

The objective of this action step is to identify which tasks will be analyzed in later substeps.

Procedures

Operator Tasks. As noted before, workload tasks are those collective and individual tasks which comprise a mission event. Table 2.4-1 depicts the relationship of functions, mission events, and workload tasks.

Table 2.4-1. Function/Mission Event/Workload Task Relationships

Level	Example
Function	Move
Mission Events	Disemplace, Transit, Emplace
Tasks	Determine Route, Start Engine

Workload analysis procedures in HARDMAN are designed to aggregate workload obtained on a task-by-task basis. However, not all operator work situations require the detailed identification of workload tasks prior to determining workload. The functional/mission event structure of the system under analysis will tend to indicate the level of analysis required.

If the system under analysis is assigned a single function, and/or if any system function is required to be performed continuously, then a detailed listing of operator tasks is usually not required. This holds true because, in these situations, the total operator workload required is typically a function of the system's operational requirement to have an operator continuously present. Workload on a task-by-task basis is subsumed in the total operator workload, which can be easily obtained.

Conversely, if the system under analysis is assigned multiple functions, and/or if these functions are discrete (that is, non-continuous), then a detailed listing of operator workload tasks is required. The detailed listing is a prerequisite for determining the system-specific temporal relationship of these tasks in the next action step. The analyst should determine, in advance, whether the characteristics of the system under analysis warrant a detailed identification of operator workload tasks.

To identify operator workload tasks, the analyst must evaluate information on the physical characteristics and operational employment of the system under analysis. This information might be in the form of technical and field manuals on the Predecessor System, especially doctrinal publications such as how-to-fight manuals. Other sources include training publications, LSAR documentation for the Proposed System alternatives, and output of the preceding HARDMAN substeps.

The analyst compares this information with the list of generic operator tasks from Substep 1.10 and updates the list to reflect the most current and complete information. If the system is particularly complex, additional levels of detail may be required.

After the initial development of operator workload tasks, generic tasks may remain for which existing system tasks cannot be identified with existing documentation. The analyst determines which tasks are appropriate to include, being careful to check his subjective judgment with appropriate subject-matter experts.

Maintainer Tasks. Identification of maintainer workload tasks is a straightforward process of elimination. Substep 1.10 provided a list of generic maintenance action verbs. The analyst reviews this list for each item in both the BCS and Proposed System equipment structures and eliminates those that do not apply.

When completed, the result is a list of maintenance workload tasks in verb-object form, where the object is the specific item from the appropriate equipment structure. The level of detail of maintenance workload tasks is dictated by the level of indenture in the equipment structures.

Workload Categories. The analyst should group the workload tasks into workload categories. Workload categories represent workload at a more aggregated level than do workload tasks. Relevant workload categories are listed below.

Operational Manning (OM). These operator-specific tasks are required in order for the system to accomplish its mission. By definition, OM also includes Common Soldier and system-specific support function tasks that are not specifically related to Preventive or Corrective Maintenance. Examples include: fly mission, plot target, erect netting, drive personnel carrier, and escort convoy.

Scheduled Maintenance (SM). Daily, weekly, monthly, and quarterly checks and adjustments performed on operational equipment.

Preventive Maintenance (PM). Maintenance actions are conducted at scheduled, periodic intervals on operational systems, equipment, or components. These actions contribute to uninterrupted operation within design characteristics. Some examples are: check fluids prior to operating, conduct 75-hour inspection, clean and lubricate daily, and rotate annually.

Corrective Maintenance (CM). This category encompasses maintenance on an unscheduled basis due to malfunction, failure, deterioration, or battle damage. These maintenance actions are required to restore disabled systems, equipment, or components to an operational condition within predetermined tolerances and limitations. Corrective Maintenance includes such activities as: repair broken pipe, replace burned transformer, retube cannon, and patch ripped canvas cover.

Examples

Example 1

The system is a new radar set. Mission analysis has determined that the set must be operated 24 hours a day. In this case, detailed operator workload tasks need not be identified.

Example 2

The system is a new self-propelled howitzer. Mission events under the Move function include Disemplace, Transit, and Emplace. The analyst determines the relevant operation tasks as shown in Table 2.4-2.

Table 2.4-2. Self-Propelled Howitzer (SPH) Operator Workload Tasks

Mission Event	Tasks
Disemplace	Secure Cannon
	Install Travel Lock
	Secure Tools and Equipment
	Secure Ammunition and Charges
	Secure Cab and Hull Doors
	Disemplace and Stow Spades
	Start Engine and Release Brake
	Check Ready to Move Out
Transit	Determine Route to New Position
	Drive SPH
Emplace	Locate New Position
	Inspect New Position
	Prepare New Position
	Move and Adjust SPH in Position
	Emplace Spades
	Set Brake and Cut Engine
	Release Travel Lock
	Check SPH Systems
	Determine Mask
	Communicate System and Mission Status

Example 3

The new howitzer has a radio which is assigned a specific position in the equipment structures. The analyst determines that the following maintenance tasks apply:

—inspect the radio to define symptoms
—troubleshoot the radio to determine failure of lowest replaceable unit (LRU)
—remove the failed LRU
—replace with a new LRU
—test the repaired radio
—adjust as necessary

Since the LRU may be the radio itself, the verbs "inspect," "troubleshoot," "remove," "replace," "test," and "adjust" apply both to the radio itself and to any of the lower level LRUs which comprise it.

Action Step 2: Determine Task Timelines

Requirements

The analyst establishes the temporal relationships which exist between system operator and maintainer tasks and subtasks.

Objectives

In this step, the temporal relationship of workload tasks is established. The objective is to determine, for a particular group of tasks, which tasks may be done sequentially and which may be done simultaneously.

Conversely, to complete some mission events, sequential or simultaneous task performance is required rather than being left to the discretion of operators or maintainers. Establishing temporal relationships, or timelines, identifies these situations for the analyst.

Procedures

Operator and maintainer tasks are examined to establish two categories: sequential and simultaneous. For tasks that may be performed simultaneously with other tasks, the analyst must also determine if the tasks can be accomplished by the same position. Technical manuals, soldier's manuals, and maintenance documentation are principal sources of timeline relationships for tasks at this level.

Principal emphasis is placed on the operator task timelines. The precise determination of the operator task timelines is a key element in calculating the number of operator positions required.

By contrast, maintenance tasks need not be timelined, provided all maintenance tasks are accounted for. Maintenance-task timelines would be important for determining the responsiveness of a maintenance level. That, however, is not a typical objective of a HARDMAN analysis. Maintainer positions may be determined if all maintainer workloads, and hence all tasks, are accounted for.

Example

For the new howitzer's operator workload tasks which were identified previously, the analyst determines that the sequence listed in Table 2.4-2 is appropriate if few operators are available. However, the analyst notes that this sequence could be changed to make some tasks simultaneous if more operators become available. Figure 2.4-2 depicts the results of the analyst's assessment for the tasks under the Disemplace mission event.

Action Step 3: Estimate Initial Task/Position Description Relationships

Requirements

The analyst makes initial estimates of the relationship of workload tasks to duty positions.

Objectives

The purpose of making initial assignment of workload tasks to position descriptions is to start the process of defining (1) exactly what the duty positions will be expected to accomplish and (2) the workload associated with these tasks. Descriptions of duty positions are used in this phase of the analysis because actual numbers of system positions based on workload requirements have not yet been determined. System tasks that must be performed at more than one duty position with the same position description are identified.

Procedures

Assigning workload tasks to the duty positions of the BCS is a straightforward matter. This simplicity results from the fact that the duty positions associated with the BCS equipment/components already exist and tend to be well defined. However, the BCS may have some tasks which are not in an existing position.

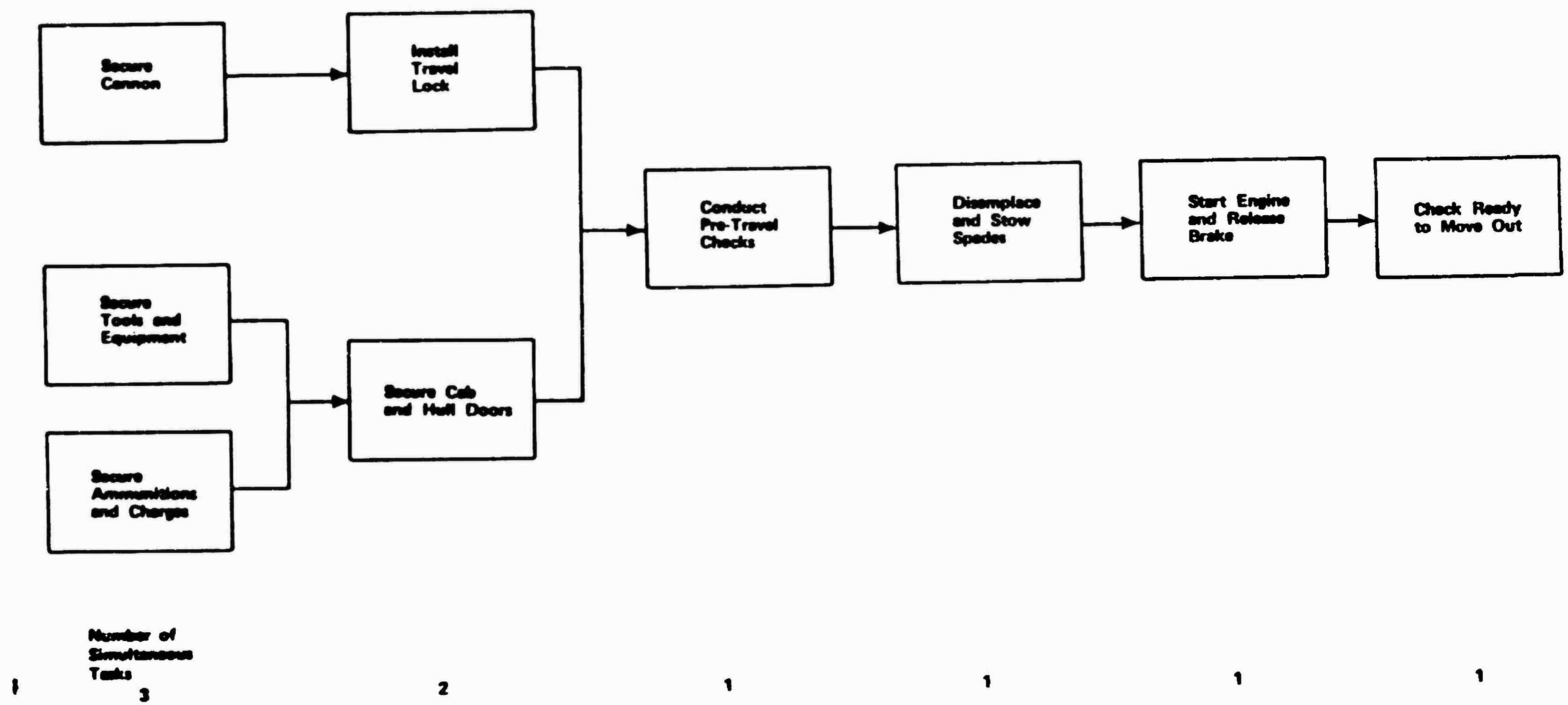

Figure 2.4-2. Operator workload task sequence.

This problem is addressed by comparing the relation between the task in question and position description with those associated with the specific equipment/components in the BCS. Technical manuals, training and operations/doctrine documents, and the design differences from Substep 1.9 are used by the analyst to resolve any ambiguities.

The same process is used for the Proposed System(s). In the case of a system without clear-cut task/position relationships, the analyst bases the association on sequential and simultaneous task timelines established in the previous action step.

In any emerging system, some tasks are not system-position specific (e.g., drive 5/4-ton truck, lay field telephone wire, clean rifle, etc.). Such tasks are identified at this point in the analysis for later use in Substep 2.9 (Compute Manpower Requirements). There they will serve to level system positions and to determine optimum manpower requirements.

Finally, as part of this action step, the analyst must identify system tasks which require more than one person to accomplish. Position description(s) associated with it, if any, must also be identified. The task must be duplicated for each person needed to perform it.

Examples

Example 1

A new remote ground reconnaissance vehicle has three mission events that appear to be mutually exclusive: vehicle operations, sensor operations, and mission command operations. Review of the system design differences and operational requirements from Step 1 indicates that vehicle operations will probably require a full-time operator during the mission. However, the sensor and mission command operations overlap to such an extent that one position could, if supported by console design, accomplish both functions.

Example 2

The task is to hand-carry a 250-pound air vehicle 100 yards. Analysis of the task indicates that four people will be needed to accomplish the carry. The task is duplicated and annotated to reflect "Carriers 1, 2, 3, and 4."

Determine Maintainer Workload

Objectives

Workload for each maintenance task for each item in the BCS and Proposed System equipment structures is used to establish maintenance manpower requirements for those systems. Substep 2.5 combines usage, task, task time, and maintenance task frequency data to determine qualitative and quantitative maintenance workload for each equipment structure item and for the system as a whole.

Input

Maintainer tasks from Substep 2.4 are the basis for this determination. Data needed to determine task time to accomplish and maintenance task frequency are provided by Substeps 1.2 and 1.9. To convert from wrench-turning time to workload, Army guidance is needed in accounting for indirect maintenance labor requirements associated with a task.

Products

The workload by maintainer task for a single system is the basis for determining numbers of maintainer positions required by the system and the position skill level/grade in Substep 2.9 (Compute Manpower Requirements).

Logic

The basic logic for determining maintainer workload is the same as described in the Overview for Substep Group 2B, Workload Analysis. However, the basic logic may now be modified to represent the specific situation of maintainer workload. Figure 2.5-1 displays this modified logic.

INTENSITY	x	RELIABILITY	x	MAINTAINABILITY	=	WORKLOAD
$\frac{\text{Use}}{\text{Period}}$	x	$\frac{\text{Actions}}{\text{Use}}$	x	$\frac{\text{Labor}}{\text{Action}}$	=	$\frac{\text{Labor}}{\text{Period}}$

Figure 2.5-1. Maintainer workload logic.

"Intensity," "Reliability," and "Maintainability" have been substituted for the more general terms. Intensity is a measure of the system's usage, in miles, rounds, hours, or other suitable units, for the period required under the conditions prescribed by the combat scenario.

Reliability can be defined in many ways, but, in determining maintainer workload, reliability equals the number of maintenance actions required per unit of usage. Thus, it may be viewed as the system's demand for maintenance.

Maintainability is the amount of labor, in man-hours, required to perform each maintenance action. The product of these factors yields direct maintainer workload, for the item and action specified, under the usage required by the system's scenario.

The equation in Figure 2.5-1 is sufficient to determine quantitive maintainer workload. However, the determination of qualitative maintainer workload depends upon the analyst's ability to describe the Reliability and Maintainability parameters with terms which express more than just the dimensions required to produce quantitative workload.

For example, "Labor per Action" would be expressed as "man-hours per action." Among the other descriptions which can be applied to this concept are:

—the maintenance level where the action occurred (e.g., Organizational or Direct Support)
—the particular type of maintenance action (e.g., remove, replace)
—the MOS and paygrade of the personnel performing the action
—the elapsed time, rather than man-hours, which the action requires
—any tools or test equipment required to complete the action

The analyst may have all, some, or none of these additional descriptive data available. However, the degree to which qualitative workload and, later, qualitative manpower, may be determined is directly related to the availability of this supporting information.

The analyst must also account for indirect maintainer workload. Indirect maintainer workload is defined as necessary but not specifically related to a particular item or maintenance action. Examples include the time required to prepare the maintenance site, storing/retrieving maintenance tools and equipment, and clean-up. Indirect workload is accounted for by using a standard factor which is applied to the direct maintenance workload.

Figure 2.5-2 depicts the logic flow for determining maintainer workload. This substep consists of four action steps.

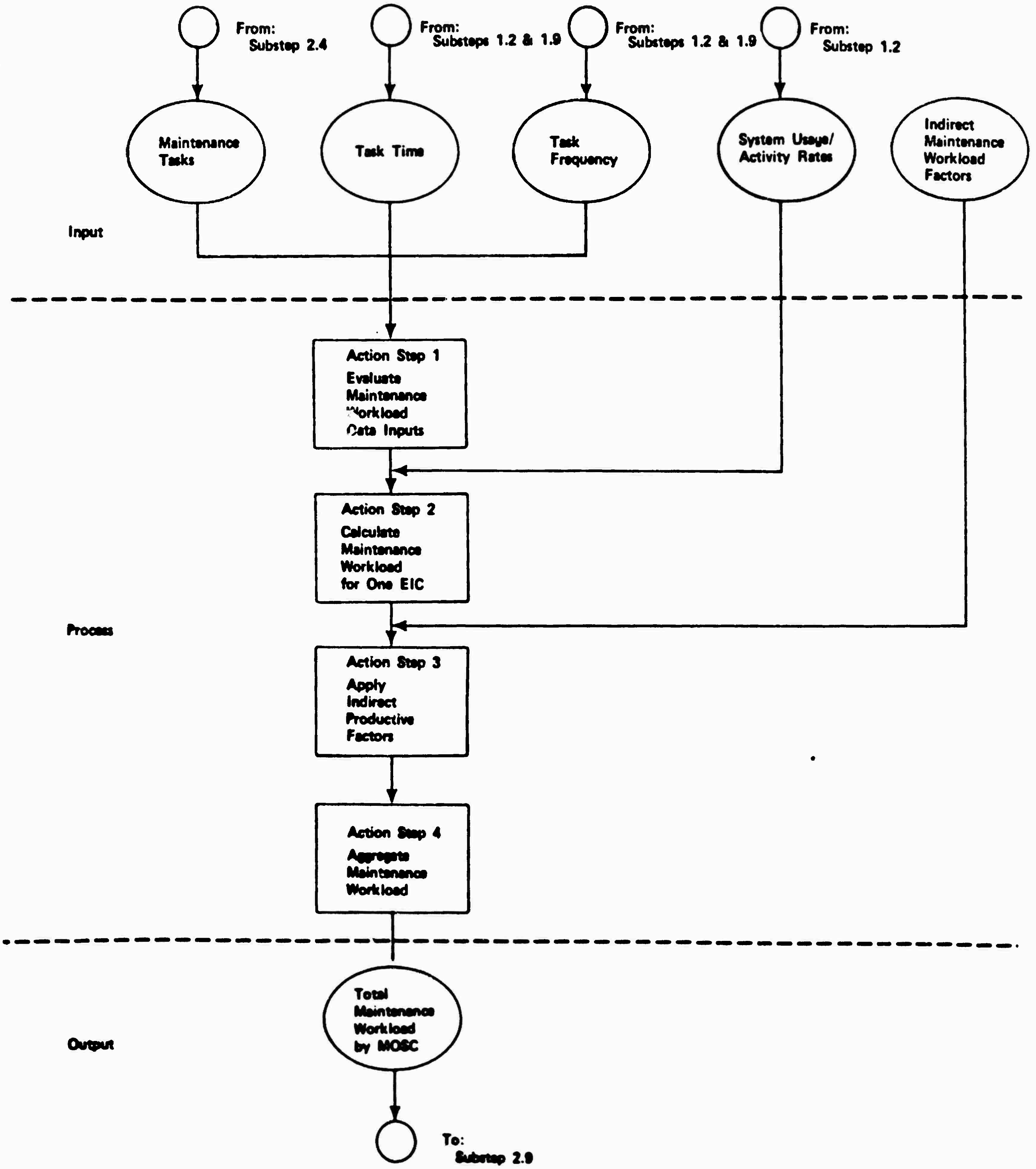

Figure 2.5-2. Logic flow for Determine Maintainer Workload.

Action Steps

Action Step 1: Evaluate Maintainer Workload Data Input

Requirements

For each EIC in the equipment structures under analysis, the analyst selects usage, action/task, as well as reliability and maintainability (R&M) data. The availability of other descriptive information necessary to determine qualitative workload is also ascertained.

Objective

The purpose of this action step is to identify, evaluate, and organize the data and information necessary to calculate maintainer workload associated with each EIC in the equipment structures under analysis.

Procedures

For each EIC, the analyst should check the availability of the items of data listed in Table 2.5-1. These data elements are used in the maintenance workload equation.

The analyst should insure that the values provided for task times, whether in maintenance man-hours or mean time to repair (MTTR), reflect direct productive time. If not, the analyst should consult with the R&M analyst to obtain values where indirect productive time has been removed. These data are necessary because indirect productive time factors are applied in Action Step 3.

For Army systems, maintenance data sometimes exists only in the form of a Maintenance Ratio. Maintenance ratio is defined as the ratio of total maintenance man-hours to a unit of system usage (e.g., 14 maintenance man-hours per flying hour, 2.5 maintenance man-hours per mile).

Maintenance ratios may be broken down by level (e.g., 8 organizational maintenance man-hours and 6 direct-support maintenance man-hours per flying hour). The maintenance ratio is the product of the Reliability and Maintainability terms of the maintenance workload equation for all actions associated with an EIC. This ratio simplifies the analyst's computational effort in the next action step but reduces the ability to associate workload with each action or task.

Table 2.5-1. Maintenance Workload Data Elements

Workload Equation Data Elements	
Use	Quantitative requirements for operational system activity/ usage under scenario conditions; expressed in all relevant metrics (miles driven, rounds fired, hours operated, etc.)
Period	Duration of the scenario requirement (day, week, month, year)
Actions	Number of maintenance actions for each action type (remove, replace, repair, troubleshoot)
Labor	Maintenance man-hours (MMH) for one action of each type

Table 2.5-1. Maintenance Workload Data Elements [con't]

Other Descriptive Information	
For Actions	
Cause	Primary cause for the action (hardware, software, operator error, maintenance error, accident)
Effect	The effect of the action on the system's mission
For Labor	
MOSC, Paygrade, Duty Position	For the maintainer who is assigned responsibility and/or is performing the action
Maintenance Level	Where the maintenance action occurs
Mean Time to Repair (MTTR)	Average elapsed time required perform the maintenance action
Number of Maintainers	If the action requires more than one maintainer in order to be performed successfully

Action Step 2: Calculate Maintenance Workload for One EIC

Requirements

For each EIC, the analyst calculates maintenance workload for each task, then aggregates workload for each task performed at a particular maintenance echelon.

Objective

Determine maintainer workload for EIC by task and maintenance echelon.

Procedures

1. If available data do not support the determination of workload by task, the analyst may start with the next procedure. The analyst selects one EIC. For one action/task associated with the EIC, the analyst substitutes values into the Reliability and Maintainability terms of the workload equation. The result is a calculation of man-hours per unit of system usage or metric. This calculation is also termed the "maintenance ratio."

$$\text{RELIABILITY} \times \text{MAINTAINABILITY} = \text{MAINTENANCE RATIO}$$

$$\frac{\text{\# of Type Actions}}{\text{One Metric}} \times \frac{\text{Man-hours}}{\text{One Type Action}} = \frac{\text{Man-hours}}{\text{One Metric}}$$

This general equation may take different specific forms, depending on the form of the available data elements. One form that may be appropriate wholly or in part is as follows:

$$\text{RELIABILITY} \times \text{MAINTAINABILITY} = \text{MAINTENANCE RATIO}$$

$$\frac{1}{M[M]BMA} \times MTTR \times K = \frac{\text{Man-hours}}{\text{One Metric}}$$

Where: M[M]BMA = Mean [Metric] Between the Maintenance Action being analyzed, metric expressed in time (MTBMA), rounds (MRBMA), etc.

MTTR = Mean Time To Repair, or the average elapsed or clock time required to complete the action

K = Number of people required for the action, which is a factor to convert clock time to man-hours

The analyst repeats this procedure for each action/task required for the EIC at each maintenance echelon. The results are then aggregated to derive the man-hours per unit of system usage for all tasks by the EIC at each maintenance echelon.

2. If a maintenance ratio exists for the EIC, the analyst determines whether it is subdivided by maintenance echelon. If only a total maintenance ratio exists, the analyst consults with the R&M analyst to apportion the total maintenance ratio to the maintenance echelons being analyzed.

In completing the first procedure, the equivalent maintenance ratios for each echelon is derived. Direct maintainer workload associated with EIC at one maintenance echelon can be derived by the following equation:

$$\frac{\text{Use}}{\text{Period}} \times \begin{matrix}\text{Maintenance} \\ \text{Ratio} \\ \text{(One Echelon)}\end{matrix} = \begin{matrix}\text{Workload} \\ \text{(for that echelon)}\end{matrix}$$

The analyst repeats the procedure for each echelon and aggregates the results. These results equal the total direct productive workload for that EIC.

Examples

Example 1

Situation. A new self-propelled howitzer (SPH) has several EICs, one of which is a radio receiver. At the organizational level, the receiver requires two maintenance actions/tasks: troubleshoot and remove. Their respective frequencies are .10 and .05 actions per operating hour. The MTTRs are .2 hours and .3 hours, respectively, for the tasks. Both tasks can be accomplished by one maintainer with MOS 31V (Tactical Communications System Operator/ Maintainer).

Results. Results are provided by multiplying frequency by MTTR by a K factor. This product is stated in maintenance man-hours per operating hour (MMH/OH).

Task:

Troubleshoot .1 x .2 x 1 = .02 MMH/OH

Remove .05 x .3 x 1 = .015 MMH/OH

Example 2

Situation. The situation in Example 1 is continued here. Instead of task detail, the analyst is only able to obtain a maintenance ratio of .05 MMH/OH for the radio receiver at the direct support level. These man-hours are assigned to a maintainer with MOS 31E (Field Radio Repairer). In a combat scenario, the receiver is projected to operate 140 hours/week.

Results. The maintenance ratio for the organizational level is .035 MMH/OH (.02 + .015). Total direct maintainer workload for a week of combat is the product of each maintenance ratio and the scenario requirement:

Organizational (MOS 31V)	.035 MMH/OH	x	140 OH/Week	=	4.9 MMH/Week
Direct Support (MOS 31E)	.05 MMH/OH	x	140 OH/Week	=	7.0 MMH/Week
Total, Radio Receiver EIC				=	11.9 MMH/Week

Action Step 3: Apply Indirect Productive Factors

Requirements

The analyst applies indirect productive factors to direct maintainer workload.

Objective

The objective for Action Step 3 is to determine the total workload for one EIC.

Procedures

Indirect Productive Time (IPT) is the time required to support maintenance but is not specifically related to particular EICs or maintenance actions. Examples include the time required to prepare the maintenance site, store/retrieve maintenance tools and equipment, and clean up.

IPT is determined by applying percentage factors to direct maintainer workload. The factors are allowed to vary according to specific circumstances dictated by the unit type and scenario of the system. However, AR 570-2 (Manpower Requirements Criteria) specifies that these factors will not exceed a ratio of 1 to .40 (direct to indirect) for organizational/AVUM and Direct Support/AVIM maintenance. For General Support maintenance, indirect productive time will not exceed a ratio of 1 to .22 (direct to indirect).

Example

Situation. The situation from the previous examples is continued.

Results. The analyst derives total workload (direct + indirect) for the radio receiver as follows:

	DIRECT	+	INDIRECT	=	ECHELON TOTAL
Organizational (MOS 31V)	4.9	+	(4.9 x .4)	=	
	4.9	+	1.96	=	6.86 MMH/Week
Direct Support (MOS 31E)	7.0	+	(7.0 x .4)	=	
	7.0	+	2.8	=	9.8 MMH/Week
Total, Radio Receiver EIC					16.66 MMH/Week

Action Step 4: Aggregate Maintenance Workload

Requirements

The analyst repeats Action Steps 2 and 3 for each EIC, then aggregates the resulting system workload by MOSC.

Objective

For each equipment structure under analysis, the objective is to determine the total maintainer workload by Military Occupational Specialty Code (MOSC).

Procedures

1. The analyst repeats Action Steps 3 and 4 for each EIC in a particular equipment structure. When all EICs have been completed, the analyst aggregates the results. The result is direct maintainer workload for one equipment structure, i.e., that particular system alternative.

2. As Action Steps 3 and 4 are repeated, the analyst records the total workload associated with each EIC by MOSC. A convenient method of doing this is to assign each MOS to a maintenance echelon and keep separate records for each maintenance echelon. When finished, total system workload can be divided three ways:

- by EIC
- by Maintenance Echelon
- by MOSC

The analyst should arrive at the same total regardless of the method of aggregation.

Example

Situation. In addition to being used in the howitzer, the radio receiver of the previous examples is a component of another radio system, one which also contains a transmitter and an antenna group. All workload values for the receiver remain the same. Workload values for the new EICs are as follows:

	Organizational		Direct Support	
	MMH/ Week	MOS	MMH/ Week	MOS
Transmitter	4.6	31V	2.9	31E
Antenna Group	1.0	31V	.5	31E

Results. The analyst obtains the following results:

EIC	Organizational 31V	Direct Support 31E	Total, EIC
Receiver	6.86	9.8	16.66 MMH/Week
Transmitter	4.6	2.9	7.3 MMH/Week
Antenna	1.0	.5	1.5 MMH/Week
Total, MOS	12.46	13.2	
Total System Workload (checks)			25.46 MMH/Week

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Determine Operator Workload

Objectives

Workload for each operator task required by the BCS and Proposed System alternatives is used to establish operator manning requirements. Substep 2.6 combines usage, task, task time, and task frequency data to determine qualitative and quantitative operator workload requirements for each system alternative.

Input

Operator tasks from Substep 2.4 are the basis for this determination. Data needed to determine task time to accomplish and task frequency are provided by Substeps 1.2 and 1.9.

Products

The total operator workload for one system alternative is used to determine the numbers of operator positions required by the system and the position skill level/grade in Substep 2.9 (Compute Manpower Requirements).

Logic

The basic logic for determining operator workload on a task-by-task basis is the same as that described in the Overview for Substep Group 2B (Workload Analysis). The formula below (Figure 2.6-1) displays this basic logic.

$$\underset{\text{ACTIVITY}}{\frac{\text{Use}}{\text{Period}}} \times \underset{\text{FREQUENCY}}{\frac{\text{Actions}}{\text{Use}}} \times \underset{\text{QUANTITY}}{\frac{\text{Labor}}{\text{Action}}} = \underset{\text{WORKLOAD}}{\frac{\text{Labor}}{\text{Period}}}$$

Figure 2.6-1. Obtaining workload.

However, as noted in the Overview and in Substep 2.4, the degree of detail required to apply the basic logic varies according to the specific characteristics of the system under analysis.

As is the case for maintainer workload analysis, HARDMAN operator workload analysis procedures are designed to aggregate workload that is initially obtained on a task-by-task basis. (Workload tasks are the collective and individual tasks which comprise a mission event.)

Not all operator work situations require the analyst to determine workload at the task level. The functional/mission event structure of the system under analysis will tend to indicate the level of analysis required.

If the system under analysis is assigned a single function, and/or any system function is to be performed continuously, then the total workload required is a function of the scenario requirement. Workload on a task-by-task basis is subsumed in the requirement to have an operator continuously present.

Conversely a system assigned multiple functions does require more detailed analysis when the functions are subdivided into discrete (i.e., non-continuous) and interrelated mission events. This substep provides procedures for both situations.

Figure 2.6-2 represents the logic flow for obtaining operator workload. This substep consists of three action steps.

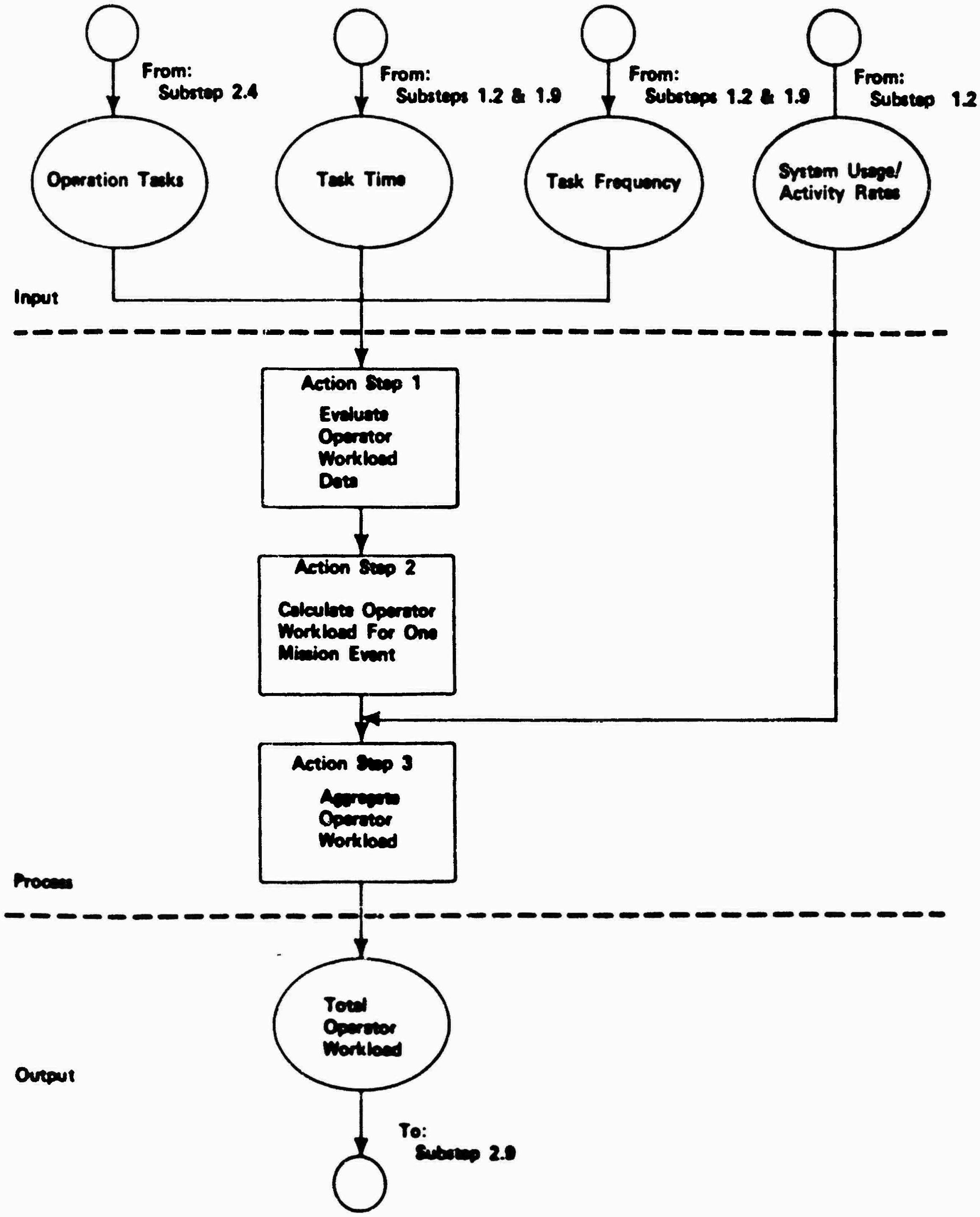

Figure 2.6-2. Logic flow for Determine Operator Workload.

Action Steps

Action Step 1: Evaluate Operator Workload Data Input

Requirements

For each function, mission event, and/or task in the system alternative being analyzed, the analyst selects usage, frequency, and task/event times. The analyst also ascertains the availability of other descriptive information necessary to determine qualitative aspects of operator workload.

Objective

The purpose of this action step is to identify, evaluate, and organize the data and information needed to calculate the operator workload associated with each function, mission event, or task for the system under analysis.

Procedures

The analyst should confirm whether the system under analysis requires the determination of operator workload on a task-by-task basis. In a single system, especially one assigned multiple functions, detailed analysis may be required for some functions, while simpler methods will suffice for others.

Operator tasks, aggregated by mission events and formatted in timelines, are obtained from Substep 2.4. The analyst should be sure that only tasks prescribed for Operational Manning (OM) are selected. For each task, the analyst checks the availability of data elements listed in Table 2.6-1. These data elements are applied in the operator workload equation.

Table 2.6-1. Operator Workload Data Items

Workload Equation Data Elements	
Use	Quantitative requirements for operational system activity/ usage under scenario conditions; expressed in all relevant metrics (miles driven, rounds fired, hours operated, etc.)
Period	Duration of the scenario requirement (day, week, month, year)
Labor	Task/mission event performance time: average elapsed time for each task/mission event
Other Descriptive Information	
For Labor	
MOSC, Paygrade, Duty Position	For the operator assigned responsibility and/or is performing the task/ mission event
	Number of operators: the minimum number of operators required for each discrete task/mission event

The analyst should identify the time performance standards associated with each workload task. Standards indicate whether completion of the task is required in a specified period of time. The standard may be expressed as the minimum, mean, or maximum time to perform. Examples include: operate radar console for a four-hour shift (miminum), average a transit time of 0.4 hours (mean), respond to a call for fire within one minute (maximum)).

The analyst must determine if (1) these types of standards are stated for each workload task and (2) the actual data, if available, indicate whether the standards are being met in practice.

Occasionally, performance data exist only at the mission event level rather than at the task level. For a specific system, the analyst may have a combination of mission event and task performance times.

As with the maintenance ratio in Substep 2.5, having mission event instead of task performance times simplifies the analyst's computational effort in the next action step. However, it reduces the ability to associate workload with each task.

Action Step 2: Calculate Operator Workload For One Mission Event

Requirements

For each mission event, the analyst determines operator workload by task and then aggregates workload for each task performed in a particular mission event.

Objective

The objective of Action Step 2 is to determine operator workload for each mission event by task.

Procedures

To achieve that objective, the analyst carries out the following procedures.

1. If available data do not support the determination of workload by task, the analyst may start with the fourth procedure. The analyst selects one mission event. A task timeline for this mission event was developed in Substep 2.4. For each task in the timeline, the analyst determines values for two data elements:

- Minimum number of people required to perform the task
- Task performance time

The analyst should pay close attention to whether the task performance time is a minimum, average, or maximum value. He should also note whether the nature of the task indicates that performance time may be reduced if more operators are assigned to the task.

In contrast to maintenance workload, the dimensions of the task performance times in operator workload are stated in elapsed or clock hours rather than in man-hours.

2. From the task timeline, the analyst identifies which tasks are simultaneous and which are sequential. To obtain values for calculating operator workload for the mission event, the analyst employs the following criteria:

Criterion 1. The minimum number of operators required to perform the mission event is the largest number required simultaneously during the course of the mission event.

Criterion 2. Time required to complete the mission event is the sum of the sequential task performance times.

Criterion 3. For purposes of the second criterion, a set of simultaneous tasks equates to one sequential task if the largest value for task performance time is used.

3. To obtain workload for the mission event, the analyst substitutes the values obtained in Procedure 2 into the following equation:

Total Task Times	x	Number of Men	=	Operator Workload

Note that this approach assumes that during the course of a particular mission event, operators are dedicated to the system under analysis, i.e., they are unavailable for other work.

4. For mission events where available data do not support the determination of workload by task, the analyst treats the mission event as a task, obtaining performance times and the minimum number of men required to complete the mission event. This situation occurs where a mission event contains only one or two tasks. The data the analyst needs may often be obtained from the detailed results of Substep 1.2 (Identify Detailed Mission Requirements).

Examples

Example 1

Situation. In Substep 2.4, a workload task sequence was produced for the Disemplace mission event of the new self-propelled howitzer. That task sequence is reproduced here as Figure 2.6-3. Elapsed time in minutes and the minimum number of operators required are shown for each task.

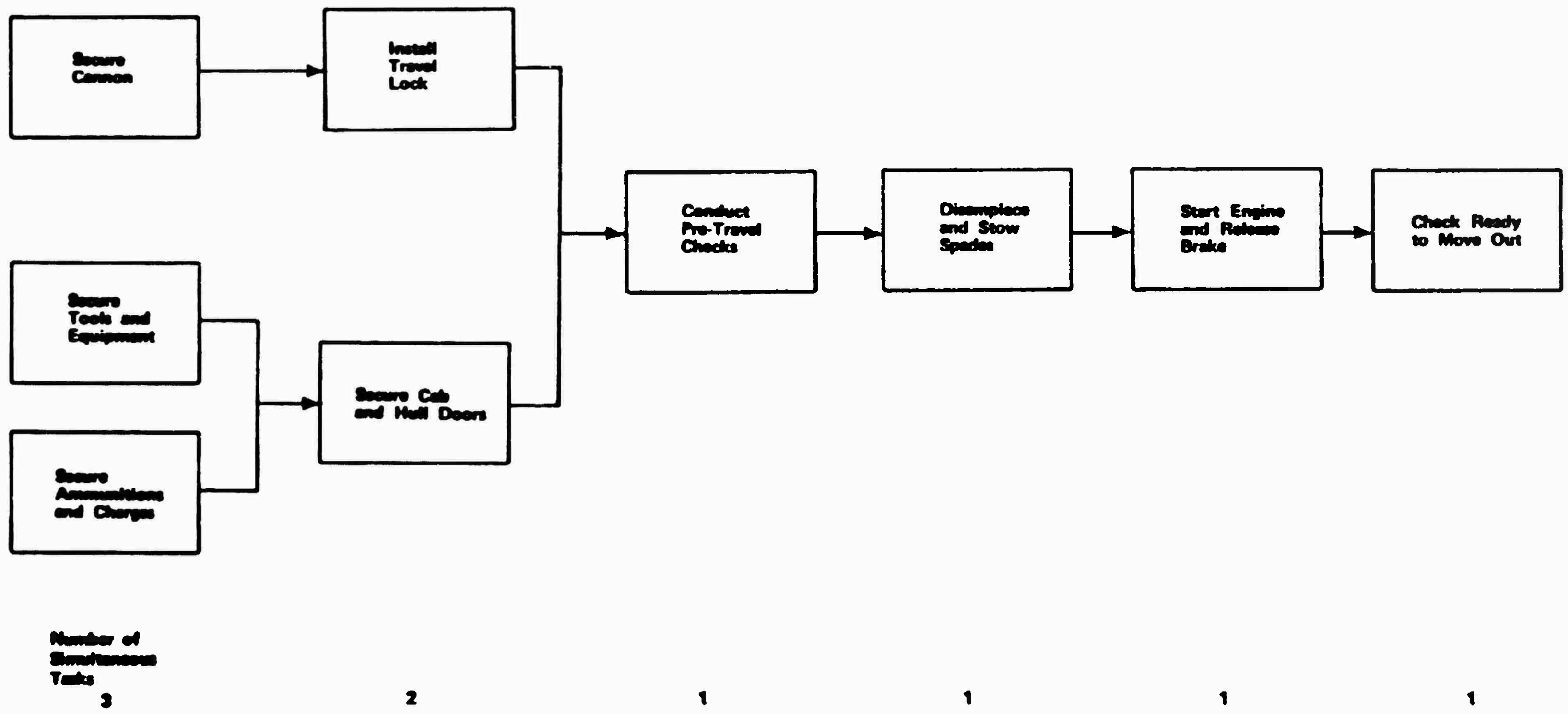

Figure 2.6-3. Operator workload task sequence.

Results. The analyst determines the results as shown on the bottom of Figure 2.6-4. Total elapsed time for the mission event is 18 minutes. Minimum number of operators required is 4 (largest simultaneous value). Total workload for the mission event is 72 man-minutes (4 x 18).

Example 2

Situation. The mission event of transit has two tasks: Determine Route and Drive SPH to New Location. Individual task times are not known. Two operators are required. Mission Analysis results indicate that an average move of this type will be 6 miles. The SPH speed for the indicated road surface is 15 miles/hour.

Results. The analyst determines that the elapsed time for one transit is 0.4 hours (6 miles divided by 15 miles/hour) or 24 minutes. The analyst accepts this value as the elapsed time for the mission event, assuming that the Determine Route task can be accomplished once underway. Workload for the mission event is 48 man-minutes (24 x 2).

The analyst notes that if operators are considered dedicated to the system across mission events, then this workload estimate will double to account for the total operators determined in the previous example.

Action Step 3: Aggregate Operator Workload

Requirements

The analyst repeats Action Step 2 for each mission event, analyzes the sequence of mission events to determine the minimum operators and elapsed time

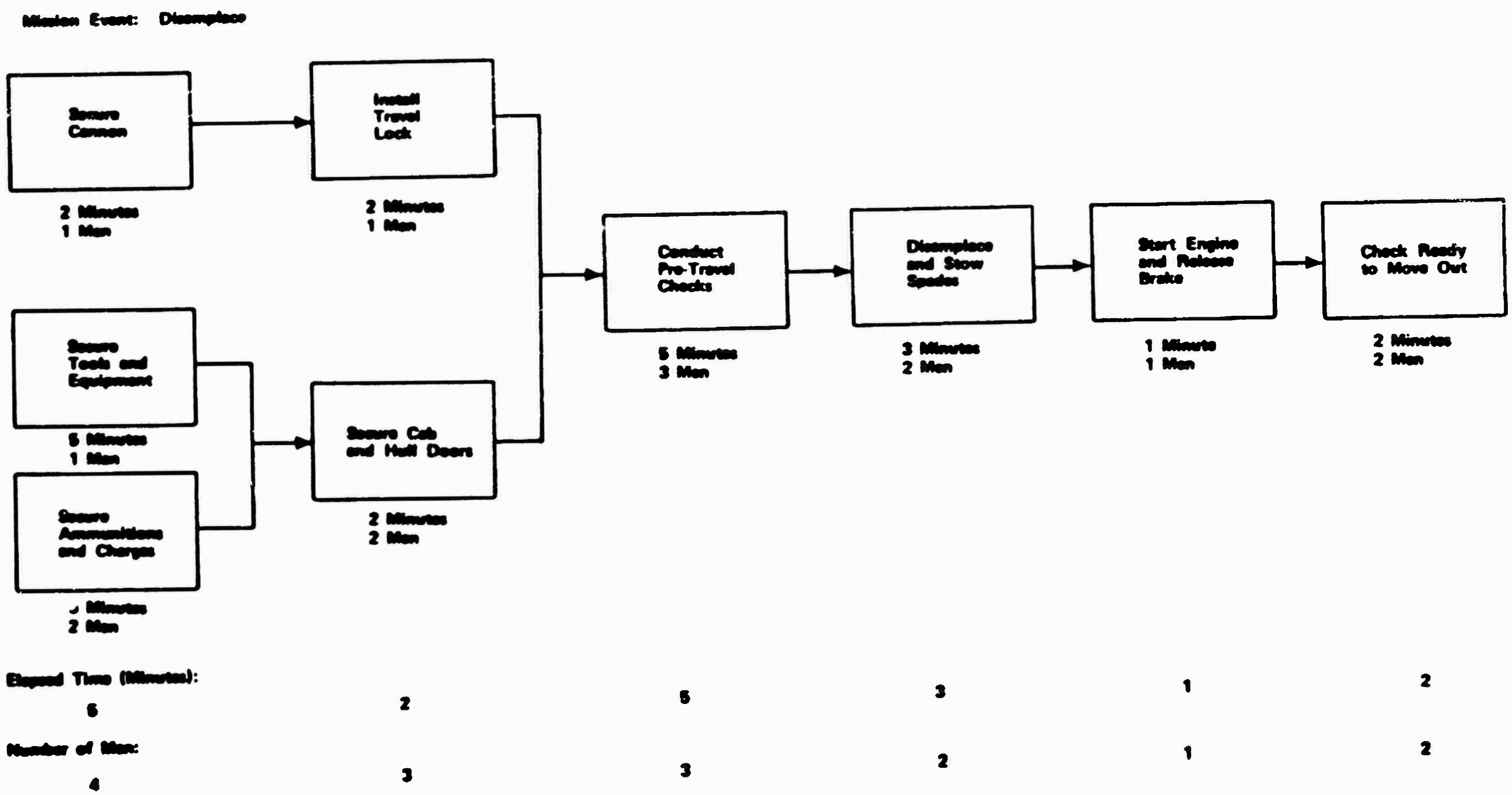

Figure 2.6-4. Operator workload example.

for one sequence, and obtains system operator workload required to satisfy scenario and mission requirements.

Objective

The objective of Action Step 3 is to determine (1) the operator workload required by the system for one sequence of mission events and (2) the total workload required to satisfy system mission requirements.

Procedures

1. The analyst repeats Action Step 2 for each mission event assigned to the system. Mission events may be arranged in timelines similar to tasks. These timelines are produced by Substep 1.2 (Identify Detailed Mission Requirements). The analyst repeats the logic of Action Step 2, considering the mission events as tasks. The result is operator workload required for one sequence of mission events.

2. In consultation with the mission analyst, the analyst determines how much of the quantitative scenario requirement (miles driven, rounds fired, hours operated) is satisfied by one sequence of mission events. The sequence of mission events is repeated until either the scenario requirement is satisfied or the time available for its completion expires. The analyst aggregates the operator workload, which results when either of the ending conditions is satisfied.

Examples

Example 1

Situation. The situation of the previous examples is continued. Figure 2.6-5 depicts the mission event sequence

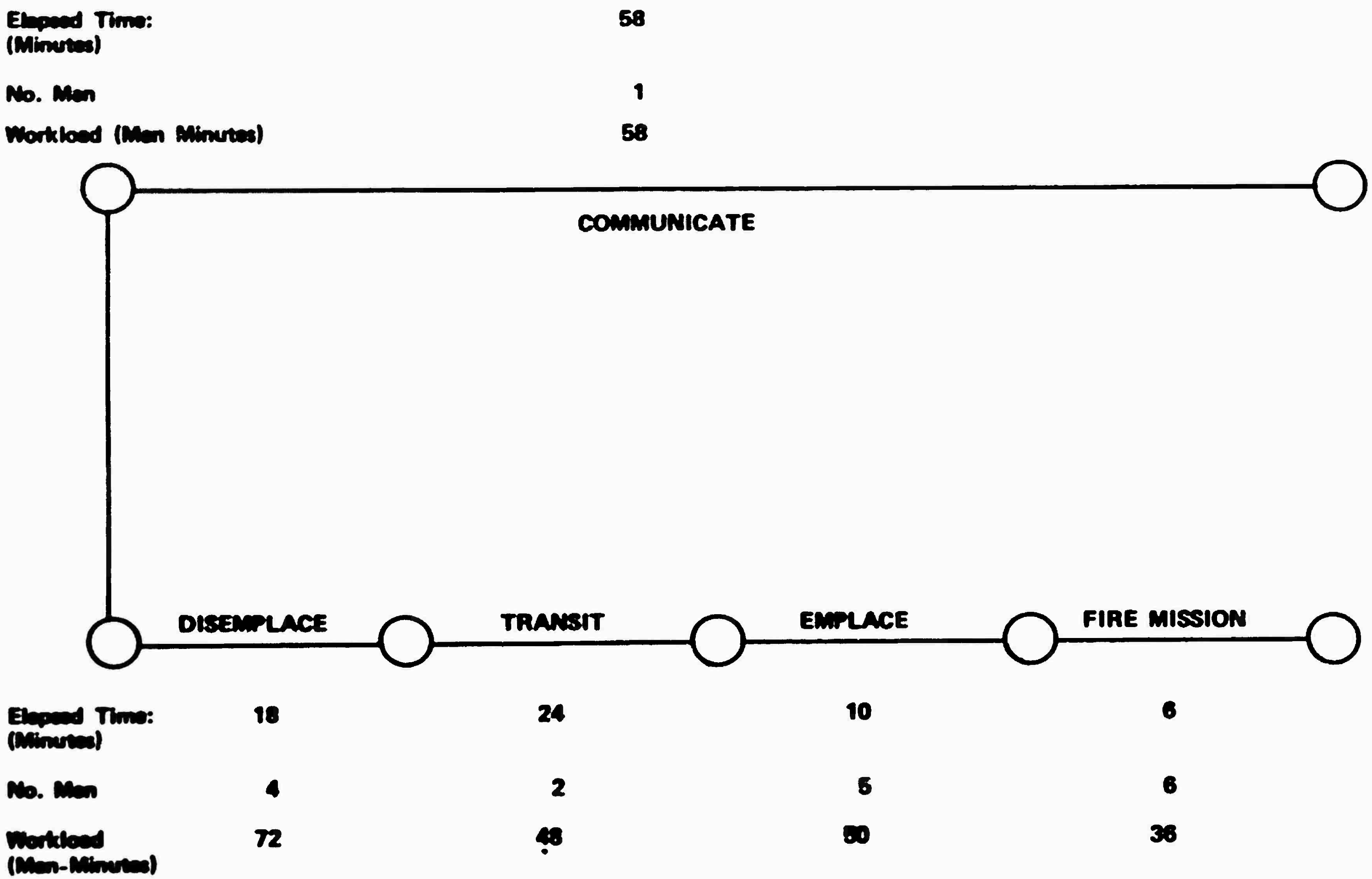

Figure 2.6-5. Mission event workload example.

for the self-propelled howitzer with the values obtained by the analyst from repeating Action Step 2.

Results. For all mission events except communications, the analyst determines the following results:

Elapsed Time = 18 + 24 + 10 + 6

= 58 minutes

Number of Men = 6

This number of men is the largest required by any mission event, hence it equals the minimum number required for one sequence.

Workload = 6 men x 58 minutes

= 348 man-minutes

Example 2

Situation. Communications is a mission event that must be performed continuously, as it is essential to the performance of the other mission events. The communications mission event requires one operator over the time span of the other mission events (58 minutes). The analyst must determine whether this workload is within the capabilities of the number of operators already determined.

Results. The total workload required is 348 man-minutes. However, the sum of the workloads for each of the mission events yields only 206 man-minutes. The difference of 142 man-minutes is due to the requirement to have a minimum of 6 operators continuously present for the most demanding mission event, Fire Mission. Since 142 is greater than 58, the additional communications workload is within the capabilities of 6 operators already determined. No additional operators are necessary.

Example 3

Situation. In consultation with the mission analyst, the analyst determines that the most critical mission requirement for the SPH is to fire 600 rounds per week. During one mission event sequence, the SPH fires 12 rounds.

Results. The analyst obtains the following results:

$$\frac{\text{600 rounds/week}}{\text{12 rounds/mission event}} = \text{50 mission events/week}$$

348 minutes x 50 mission events/week

= 17,400 man-minutes/week

= Operator Workload

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Substep Group 2C

Manpower Requirements Determination

Overview

Determining the manpower requirements for an emerging system defines a basis for comparing the system's demand on Army personnel and training resources to the available supply of those resources. A system's manpower requirement consists of the qualitative and quantitative demands to be met in order to accomplish all the functions which have been assigned to or are required to support the system.

Input to this substep group includes MOS/skill level/grade results from Substep Group 2A; operator and maintainer workload results from Substep Group 2B; and information on the Army's anticipated distribution, or basis of issue, of systems to various force structure elements.

This input is combined with the work capacity of each operator and maintainer position. The results of this process are the qualitative (MOS/Skill Level/Grade) and quantitative (Numbers of Positions) manpower requirements for each system alternative — Predecessor, BCS, and Proposed.

Unless noted otherwise, all analyses in this substep group are performed on one MOS. When manpower requirements have been determined for each MOS in one system alternative, the total manpower for the system alternative may be obtained through simple aggregation. The entire substep group is then repeated, if necessary, to obtain results for all the system alternatives under analysis.

Logic

Army Regulation 570-2 (Manpower and Equipment Control: Organization and Equipment Requirements Tables) prescribes the manpower requirements criteria (MARC) for Army units. MARC defines two types of manpower requirements, or positions:

- Standard Positions, which are not directly related to measurable workload but are controlled by tactical, logistical and organizational doctrine; and
- Variable Positions, which are required for essential functions and are directly related to measurable workload. The number of positions required to perform the essential functions varies with the workload, hence the name.

In HARDMAN, a system may have both types of positions associated with it. Maintenance manpower requirements directly related to the system under analysis are variable positons, since their workload can be measured by Substep 2.5 (Determine Maintainer Workload). The operator requirement may be a combination of both standard and variable positions, depending on whether the operator work situation permits the quantification of operator workload.

The logic for determining the requirements for standard positions is determined by the analyst in the course of each application. Judgment; previous experience; and the tactical, logistical, and organizational doctrine of the system under analysis are used to make this determination.

In contrast, the basic logic of obtaining variable position requirements may be reduced to a simple equation (see Figure 2C-1). This logic is used to obtain quantitative manpower requirements, i.e., the number of positions required.

GENERAL:

$$\frac{\text{WORKLOAD} \times \text{FORCE STRUCTURE}}{\text{WORK CAPACITY}} = \text{MANPOWER}$$

Specific:

$$\frac{\dfrac{\text{Man-hours (Direct + Indirect)}}{\text{One System}} \times \text{Number of Systems}}{\dfrac{\text{Man-hours Available}}{\text{One Position}}} = \text{Number of Positions}$$

Figure 2C-1. Determining manpower.

As the figure shows, manpower is determined by combining three factors: (1) the workload for one system; (2) the number of systems, or system density, to be deployed in various elements in the force structure; and (3) the number of productive man-hours available in one manpower position. The result obtained equals the number of positions required to support the given system density, or the quantitative manpower requirement.

The determination of qualitative manpower requirements depends upon the success the analyst has achieved in previous Substep groups, especially MOS/Grade Determination and Workload Analysis. The more descriptive information available from these two analyses, the more detailed the description of qualitative manpower requirements.

Figure 2C-2 depicts the logic flow used to determine manpower requirements. This figure shows the major input, processes, and output required for this substep group. Input includes: (1) data elements generated from other HARDMAN substep groups and (2) Army Manpower Directives/Regulations. On the basis of this input, three substeps analyze and determine manpower results:

2.7 Determine Force Structure

2.8 Determine Workload Capacity

2.9 Compute Manpower Requirements

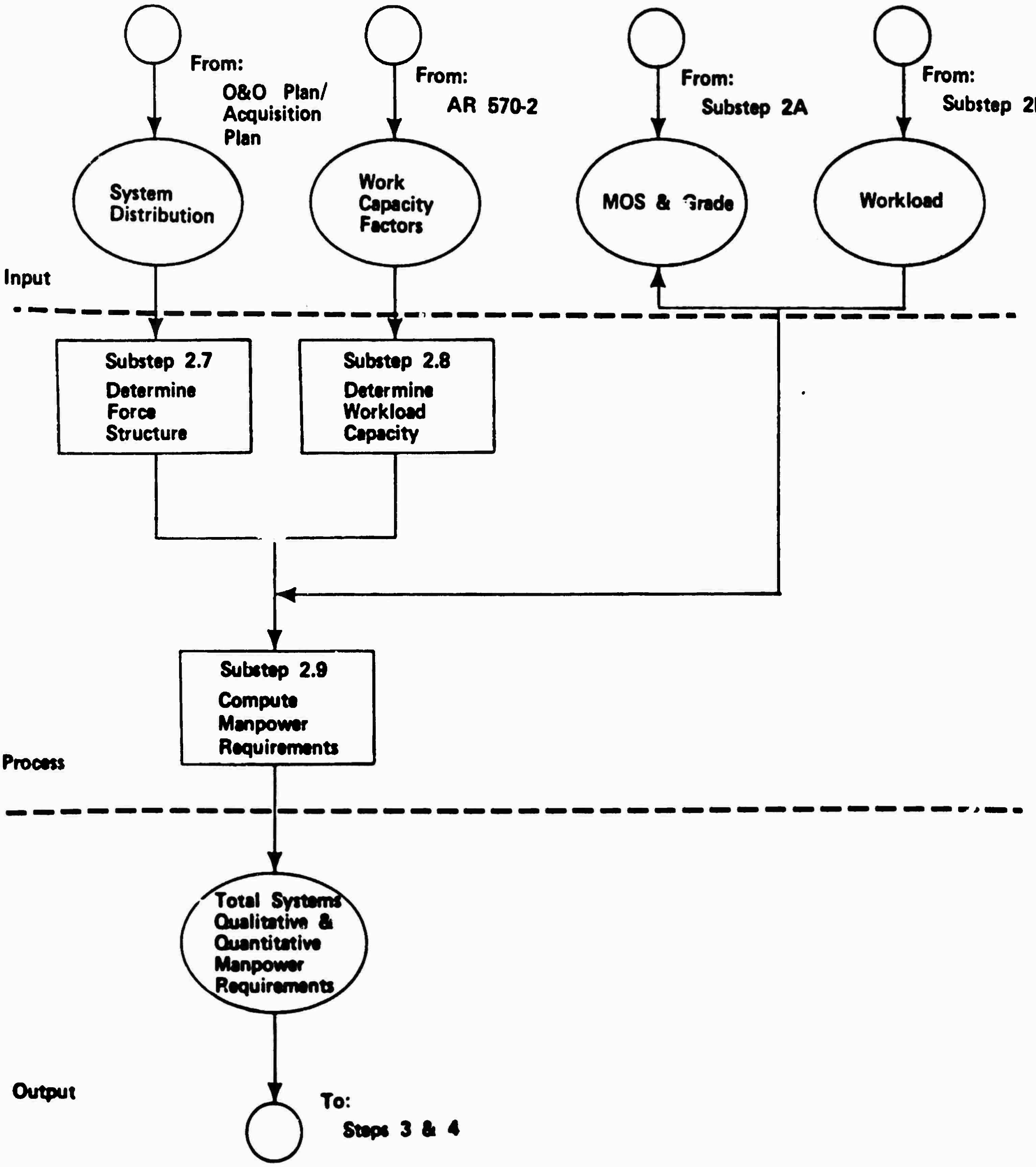

Figure 2C-2. Logic flow for Manpower Requirements Determination.

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Determine Force Structure

Objectives

Previous substeps produce operator and maintainer workload calculated on the basis of one system. This substep identifies (1) the total number of systems the Army is planning to field and (2) the anticipated distribution of the systems to various elements of the Army's force structure.

Input

Input includes system-specific density and/or distribution information found in the system Operational and Organizational (O&O) Plan, Materiel Fielding Plan, Basis of Issue Plan, or developmental Tables of Organization and Equipment (TO&E). General density and/or distribution information is obtained from existing TO&E and doctrinal field manuals.

Products

Results of this substep are the system densities and distributions for each system alternative. Distribution results include the system densities assigned to relevant elements of the Army's force structure and the maintenance distribution by maintenance level.

Logic

The Army's existing and proposed distribution of the system(s) to its assigned units is extracted from Army program documents, actual inventories, and TO&Es. The applicable maintenance distribution philosophy is also derived from these sources.

Figure 2.7-1 depicts the logic flow for determining force structure. As shown in the figure, the identification process entails one action step.

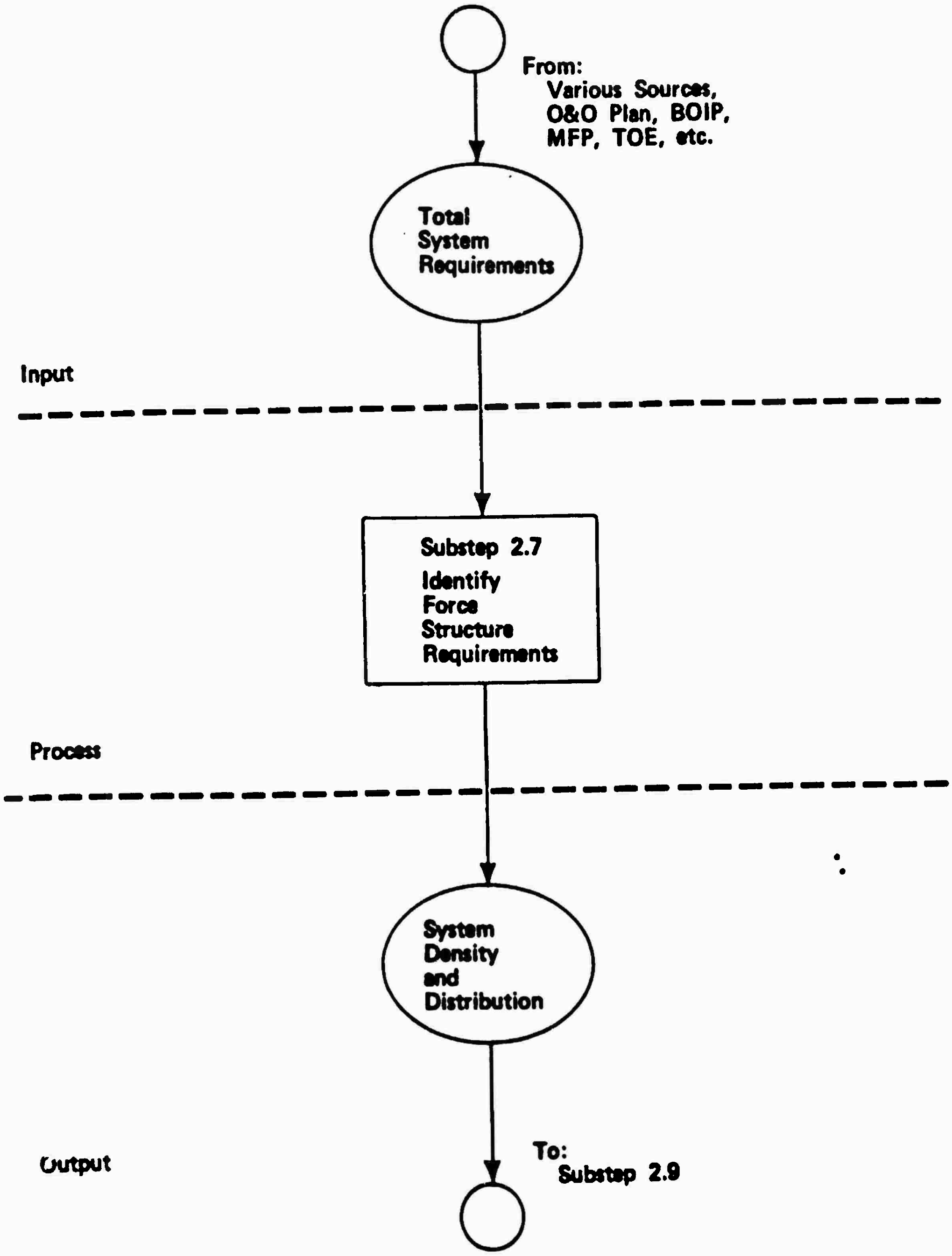

Figure 2.7-1. Force structure determination logic.

Action Step

Requirements

The analyst synthesizes information and data from all relevant input, then determines three factors: (1) the total number of systems the Army is planning to field, (2) their anticipated distribution to units, and (3) the maintenance echelons which will be assigned maintenance reponsibility for the system.

Objectives

The objectives of this action step are to determine the system's numerical distribution throughout the Army's structure and the maintenance echelons which will be assigned maintenance responsibility for the system.

Procedures

1. The analyst determines the total number of systems the Army is planning to field. The analyst insures that this number reflects only the systems to be deployed in active Army units because manpower requirements need to be determined only for this portion of the total procurement quantity. Reserve requirements are typically outside the scope of a HARDMAN application, and other portions of the total procurement quantity do not require manpower. Prepositioned Materiel Configured to Unit Sets (POMCUS) and operational floats are examples of such requirements.

The analyst can usually obtain the total number of systems to be fielded from existing program documentation on the system (e.g., O&O Plan, Materiel Fielding Plan, Basis of Issue Plan). Often the analyst obtains different results from different documents.

Experience has shown that the Army's best estimate of anticipated system density may change frequently. This happens because the total acquisition cost of the new system is directly related to the number of systems procured. The analyst should be sure to review any inconsistencies in the documents with appropriate program personnel.

2. Figure 2.7-2 depicts the three phases of a system's fielding: deployment, steady state, and retirement. The total number of fielded systems represents peak, or steady state, deployment. HARDMAN manpower requirements are typically based on the steady state situation rather than the deployment or retirement phases.

However, this does not prevent the analyst from calculating manpower requirements for any one year, a figure which may be warranted by the nature of the application. If system fielding information is available on a year-by-year basis, it can usually be obtained from the materiel fielding plan.

3. Distribution of the system to elements of the Army's force structure must also be determined. The analyst obtains the following information from appropriate documentation:

Number of:
- —systems per section/platoon
- —sections per company
- —companies per battalion
- —battalions per division
- —divisions per corps

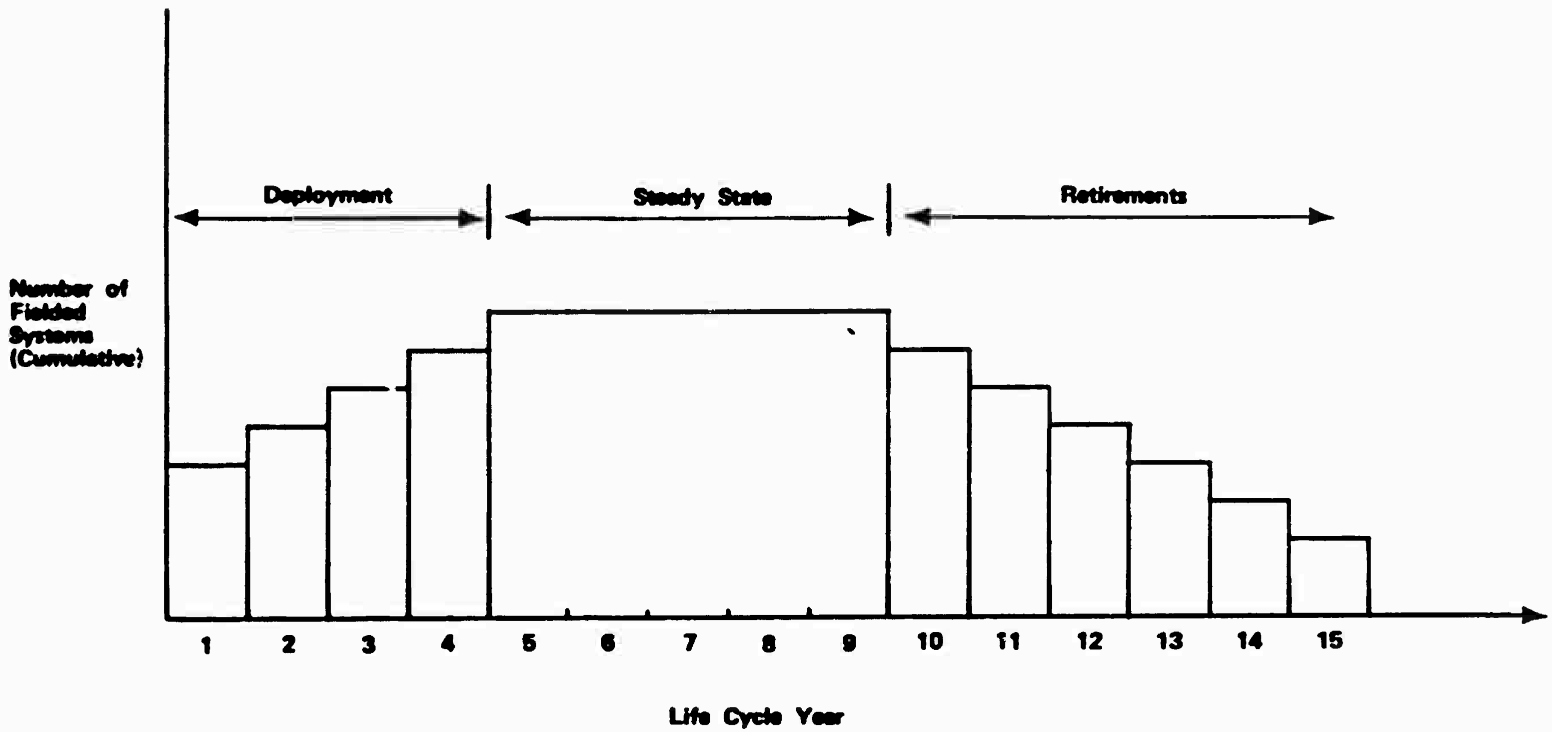

Figure 2.7-2. System fielding phases.

If available documentation does not contain specific information on the system density supported by a particular maintenance echelon, the analyst can calculate the density from the above information.

To obtain the density supported by a particular maintenance echelon or for any level of force structure, the analyst calculates the product of the above parameters up to that level. For example, to obtain the density of a system in a division, which is also the density supported by the division's Direct Support maintenance unit (DSU), the analyst uses the following equation:

$$\frac{\text{Systems}}{\text{Section}} \times \frac{\text{Sections}}{\text{Company}} \times \frac{\text{Companies}}{\text{Battalion}} \times \text{Battalions} = \text{System Density}$$

Examples

Example 1

Situation. A field artillery battery contains six firing sections, with each possessing one self-propelled howitzer. Doctrine dictates that a field artillery battalion contains three batteries, while division artillery consists of three batallions.

Results. The analyst obtains the following results for system densities at each level.

Battery:

$$1 \frac{\text{SPH}}{\text{Section}} \times 6 \frac{\text{Sections}}{\text{Battery}} = 6 \frac{\text{SPH}}{\text{Battery}}$$

Battalion:
(Organizational Maintenance)

$$6 \frac{\text{SPH}}{\text{Battery}} \times 3 \frac{\text{Batteries}}{\text{Battalion}} = 18 \frac{\text{SPH}}{\text{Battalion}}$$

Division:
(Direct Support Maintenance)

$$18 \frac{\text{SPH}}{\text{Battalion}} \times 3 \frac{\text{Battalions}}{\text{Division}} = 54 \frac{\text{SPH}}{\text{Division}}$$

Example 2

Situation. A division command and control system consists of seven components. These components are distributed to eight different types of division elements/sections. All sections do not have every component, and multiple numbers of some section types exist.

Table 2.7-1 summarizes the available information. Because the maintenance concept for each component depends on where the component is located in the division structure, the analyst must determine the density of each component in each section.

Results. By employing the basic equation, the analyst obtains the results contained in Table 2.7-2.

Table 2.7-1. System Density Example

1\. Component Density for One Section

Component Name	Section Number: 1	2	3	4	5	6	7	8
Large Screen Display	2	1						1
Input/Output Display	2	1	1	1				1
Keyboard	2	1	1	1				1
Printer	1	1		1				1
Microprocessor			1					
CPU	2	1		1			2	1
Hand-held Interactive Display					4	3		

2\. Number of Sections Per Division

Section Number: 1	2	3	4	5	6	7	8
1	1	3	3	6	32	2	1

Table 2.7-2. System Density Results

Component Name	Component Density by Section Section Number: 1	2	3	4	5	6	7	8	Division Component Density
Large Screen Display	2	1						1	4
Input/Output Display	2	1	3	3				1	10
Keyboard	2	1	3	3				1	10
Printer	1	1		3				1	6
Microprocessor			3						3
CPU	2	1		3			4	1	10
Hand-held Interactive Display					24	96			120

Determine Work Capacity

Objective

The objective of this substep is to establish the productive work capacity for system operator and maintainer positions. Work capacity may be defined as the amount of workload a position can be assigned. Work capacity is used as the basis for determining the number of positions needed to accomplish system workload.

Input

Army Regulation 570-2 (Manpower and Equipment Control: Organization and Equipment Requirements Tables) provides estimates of annual productive work capacity for positions assigned to different unit categories. These estimates are input along with the location of the units to which the system will be assigned and those units responsible for its maintenance.

(The analyst should be aware that AR 570-2 DRAFT is currently being staffed throughout the Army. If the draft is approved, it will delete Categories I, II, and II — rolling all nonavailable man-hours into new productive factors according to division, corps, and echelons above corps. The analyst should be sensitive to this action and make the appropriate adjustments in calculating work capacity. The proponent agency for this action is the US Army Manpower Requirements and Documentation Agency (USAMARDA) attention: PEMS-RO, Fort Belvoir, Virginia, 22060-5587.)

Products

Results of this substep are the work capacity for system operator and maintainer positions at the identified level within the force structure.

Logic

Organizational level information from Substep 2.7 (Determine Force Structure) and annual productive work capacities from AR 570-2 are used to determine work capacities for system operator and maintainer positions. AR 570-2 provides annual capacities. However, system usage/activity requirements under scenario requirements usually drive workload expressed in smaller units of time (i.e., day, week, or month).

In this substep, the analyst normalizes the annual capacities to the smaller units. Additionally, if a non-standard method for determining work capacity is applied, then appropriate capacity factors must be researched and documented. Figure 2.8-1 depicts the logic flow for determining work capacity. As shown in the figure, Substep 2.8 entails only one action step.

Action Step

Requirements

The analyst determines positional work capacity using AR 570-2 or original research as appropriate.

Objective

In this step, the positional work capacities are determined. These will be used in Substep 2.9 to determine numbers of positions required by the system.

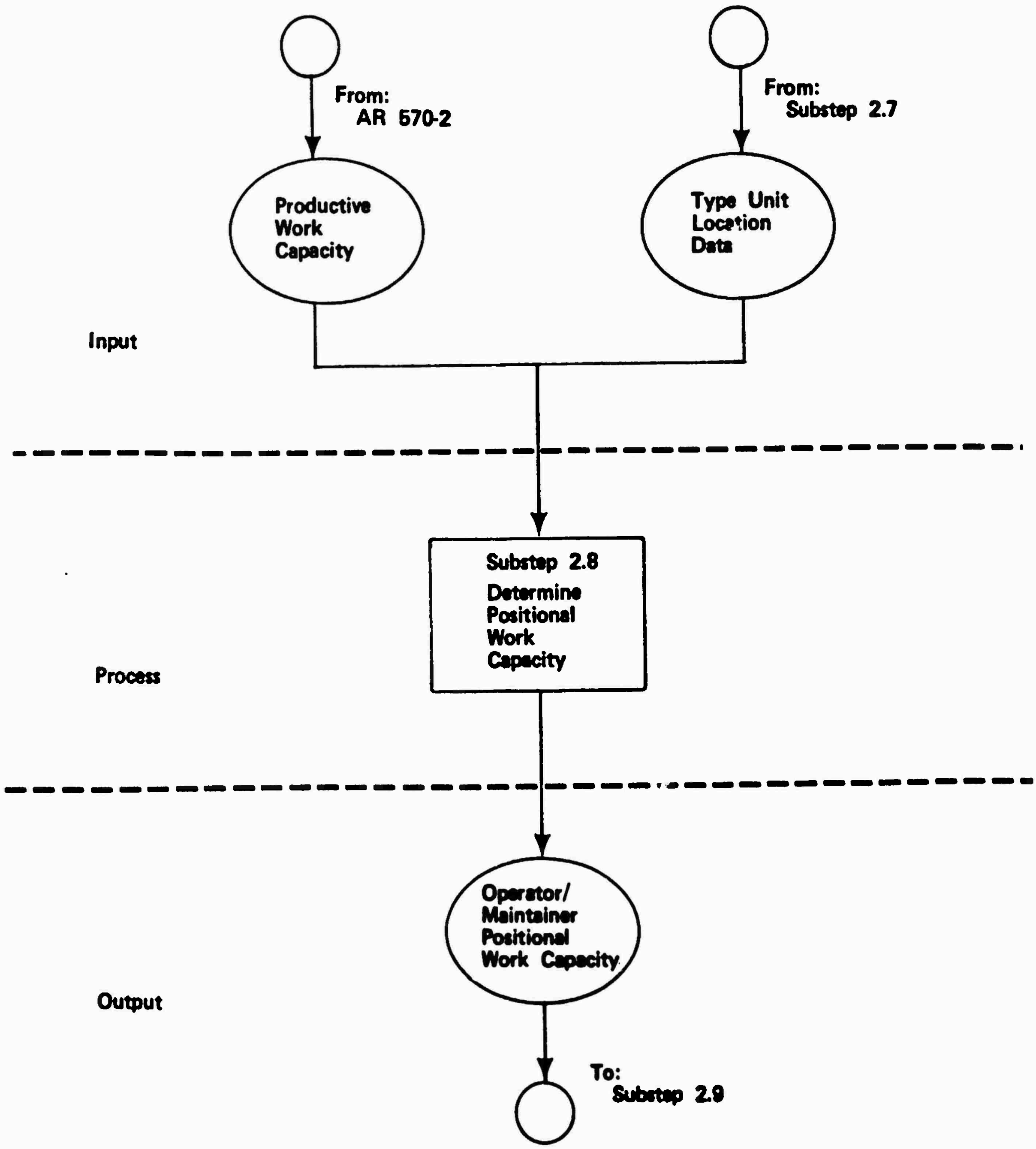

Figure 2.8-1. Logic flow for Determine Work Capacity.

Procedures

.1 AR 570-2 provides estimates of annual productive work capacity for positions assigned to different unit categories. Unit catergories are defined as follows:

Category I. A unit, organized under a TOE, whose primary mission includes engaging the enemy and inflicting casualties and/or equipment damage by use of its organic weapons. Included in Category I are headquarters and service companies of the first units and command and control headquarters operating forward of the brigade's rear boundary.

Category II. A unit, organized under a TOE, whose mission is primarily to provide command and control, combat support, and combat service support to Category I units.

Category III. A unit, organized under a TOE, whose mission is primarily service and assistance to the units operating in the combat area. The unit is located in the communications zone or along the lines of communication which lead to the communications zone.

The analyst determines the category for each force structure element or unit which is assigned or has maintenance responsibility for the system. The following assignments generally apply:

Category	Unit Type
I	Operational Unit Organizational Maintenance
II	Direct Support Maintenance
III	General Support Maintenance

2. Work capacity is not the same for all unit categories. While it does not provide them directly, the logic of AR 570-2 indicates that for operators, the annual work capacity is 4,380 man-hours (12 hours/day x 365 days). The regulation does provide the following annual values for maintenance and support units.

Category	Annual Work Capacity (Man-hours)
I	2500
II	2700
III	3100
III (fixed)	3330

The last value is applicable when the unit is located in fixed facilities and has essentially lost the capability for organic movement.

Values for work capacity and for workload must be derived on the same period basis. Because workload for combat situations is typically calculated for periods shorter than a year, the annual values must be normalized to those periods. The analyst uses the following equation:

$$\frac{[\text{AR 570-2 value}]\ \dfrac{\text{Man-hours}}{\text{Year}}}{365\ \dfrac{\text{Days}}{\text{Year}}} = \frac{\text{Man-hours}}{\text{Day}}$$

To obtain the weekly values for work capacity, the analyst multiplies the above result by 7. Monthly values are derived by multiplying the above result by 30.

Of course, under combat conditions, many more man-hours may be worked. The above factors are for planning purposes only. They serve to establish the number of positions necessary to provide work on a sustained basis rather than to forecast the workload the positions will receive.

3. In consultation with subject matter experts on the system's operational environment, the analyst may decide to use non-standard factors for determining work capacity. This decision is acceptable, provided the methods and information are sufficiently documented to support deviation from AR 570-2.

Example

Situation. A new self-propelled howitzer will be assigned to an artillery battery for combat operations. The analyst must determine the weekly and monthly work capacities for the crew as well as organizational and direct support maintenance.

Results. The analyst determines the following results:

Level	Annual Values (AR 570-2)	Work Capacities (Man-hours) Daily (Annual/365)	Weekly (Daily x 7)	Monthly (Daily x 30)
Crew	4380	12.00	84.00	360.00
Organizational Maintenance	2500	6.85	47.95	205.50
Direct Support Maintenance	2700	7.40	51.80	222.00

Compute Manpower Requirements

Objectives

Computing manpower requirements for an emerging system defines a basis for comparing the system's demand on Army personnel and training resources to the available supply of those resources. A system's manpower requirement consists of the qualitative and quantitative demands to be met in order to accomplish all the functions which have been assigned to or are required to support the system.

Input

Input to Substep 2.9 includes MOS, skill level, and paygrade results from Substep Group 2A; operator workload results and the minimum number of operators from Substep 2.6 (Determine Operator Workload); maintainer workload results from Substep 2.5 (Determine Maintainer Workload); the number of systems to be fielded and their basis of issue from Substep 2.7 (Determine Force Structure); and the work capacity of each operator and maintainer position from Substep 2.8 (Determine Work Capacity).

Products

The results of this substep are the qualitative (MOS/Skill Level/Grade) and quantitative (Numbers of Positions) manpower requirements for each system alternative — Predecessor, BCS, and Proposed.

These results are aggregated and displayed in five types of manpower requirements reports:

- Manpower: Operator/Crew Requirements
- Manpower: Organizational Maintenance Requirements
- Manpower: Direct Support Maintenance Requirements

- Manpower: Force Structure Summary

- Manpower: Total Requirement

Examples of these reports are provided in Tables 2.9-1 through 2.9-5.

Logic

Army Regulation 570-2 (Manpower and Equipment Control: Organization and Equipment Requirements Tables) prescribes the manpower requirements criteria (MARC) for Army units. MARC defines two types of manpower requirements, or positions:

- Standard Positions, which are not directly related to measurable workload but are controlled by tactical, logistical and organizational doctrine; and

- Variable Positions, which are required for essential functions and are directly related to measurable workload. The number of positions required to perform the essential functions varies with the workload, hence the name.

In HARDMAN, a system may have both types of positions associated with it. Maintenance manpower requirements directly related to the system under analysis are variable positons, since their workload can be measured by Substep 2.5 (Determine Maintainer Workload). The operator requirement may be a combination of both standard and variable positions, depending on whether the operator work situation permits quantification of operator workload.

Table 2.9-1. *Manpower: Operator/Crew Requirements (System Density = 1)*

MOS		Predecessor	BCS	ALT 1	ALT 2	ALT 3
				Proposed System Alternatives		
13X		14	8	7	10	4
19V		10	8	5	4	6
	Total	24	16	12	14	10

Table 2.9-2. *Manpower Unit Maintenance Requirements (System Density = 24)*

MOS		Predecessor	BCS	ALT 1	ALT 2	ALT 3
				Proposed System Alternatives		
31V		0	8	0	2	8
35E		0	16	0	1	1
45D		6	13	16	14	5
63D		6	2	2	4	3
63J		0	1	0	1	1
	Total	12	40	18	22	18

Table 2.9-3. Manpower: Intermediate Maintenance (Forward) Requirements

(System Density = 72)

			Proposed System Alternatives		
MOS	Predecessor	BCS	ALT 1	ALT 2	ALT 3
31E	9	10	23	10	23
31S	0	0	6	0	6
34Y	6	0	1	1	1
35E	9	0	27	1	1
35H	0	0	1	0	1
41C	6	5	1	1	1
44B	0	1	1	1	1
45B	3	0	2	2	2
45L	15	65	65	65	10
63G	9	1	1	1	1
63H	42	1	1	8	5
63J	3	0	3	1	3
Total	102	83	132	91	55

Table 2.9-4. Manpower: Force Structure Summary

				Proposed System Alternatives		
Level	**Basis**	**Predecessor**	**BCS**	**ALT 1**	**ALT 2**	**ALT 3**
Company	8 Crews	72	56	120	96	56
Battalion	24 Crews	216	168	360	288	168
	1 Unit Maintenance	12	40	18	22	18
	Total Battalion	228	208	378	310	186
Division	72 Crews	648	504	1080	864	504
	3 Unit Maintenance	36	120	54	66	54
	1 IMA - Forward	102	132	83	91	55
	Total , Division	786	756	1217	1021	613

Table 2.9-5. Manpower: Total Requirement
(System Density = 848)

MOS	Predecessor	BCS	ALT 1	ALT 2	ALT 3
			Proposed System Alternatives		
13B	8,820	5,936	12,720	10,176	5,936
31E	2	456	120	120	456
31S	0	72	0	0	72
31V	0	282	0	70	282
32G	0	96	0	0	96
34Y	0	24	0	24	24
35C	0	192	0	12	12
35E	0	324	0	12	12
35H	0	12	0	0	12
41C	15	120	432	36	36
44B	0	24	24	24	24
45B	7	24	0	24	24
45D	343	459	565	494	176
45L	244	1,548	1,548	1,548	216
63D	518	70	70	141	105
63G	0	24	24	24	24
63H	357	72	72	156	120
63J	0	71	0	47	71
Total	10,306	9,806	15,575	12,908	7,698

Logic for determining the requirements for standard positions is determined by the analyst in the course of each application. Judgment; previous experience; and the tactical, logistical, and organizational doctrine of the system under analysis form the basis for this determination.

In contrast, the basic logic of obtaining variable position requirements may be reduced to a simple equation (see Figure 2.9-1). This logic is used to obtain quantitative manpower requirements, i.e., the number of positions required.

GENERAL:

$$\frac{\text{WORKLOAD} \times \text{FORCE STRUCTURE}}{\text{WORK CAPACITY}} = \text{MANPOWER}$$

Specific:

$$\frac{\dfrac{\text{Man-hours (Direct + Indirect)}}{\text{One System}} \times \text{Number of Systems}}{\dfrac{\text{Man-hours Available}}{\text{One Position}}} = \text{Number of Positions}$$

Figure 2.9-1. Determining manpower.

As the figure shows, manpower is determined by combining three factors: (1) the workload for one system; (2) the number of systems, or system density, to be deployed in various elements in the force structure; and (3) the number of productive man-hours available in one manpower position. The result is the number of positions required to support the given system density, or the quantitative manpower requirement.

Determination of qualitative manpower requirements depends on the success the analyst has achieved in previous substep groups, especially MOS/Grade Determination and Workload Analysis. The more descriptive information that is available from these two analyses, the more detailed the description of qualitative manpower requirements can be.

Figure 2.9-2 depicts the logic flow for determining manpower requirements. This figure shows the major input, processes, and output required for the final detailed analysis required to establish a system's qualitative and quantitative manpower requirements. As the figure shows, this substep consists of two action steps.

Action Steps

Action Step 1: Determine Maintainer Manpower Requirements

Requirements

The analyst must combine input from previous substeps with the basic manpower equation to determine qualitative and quantitative maintenance manpower requirements.

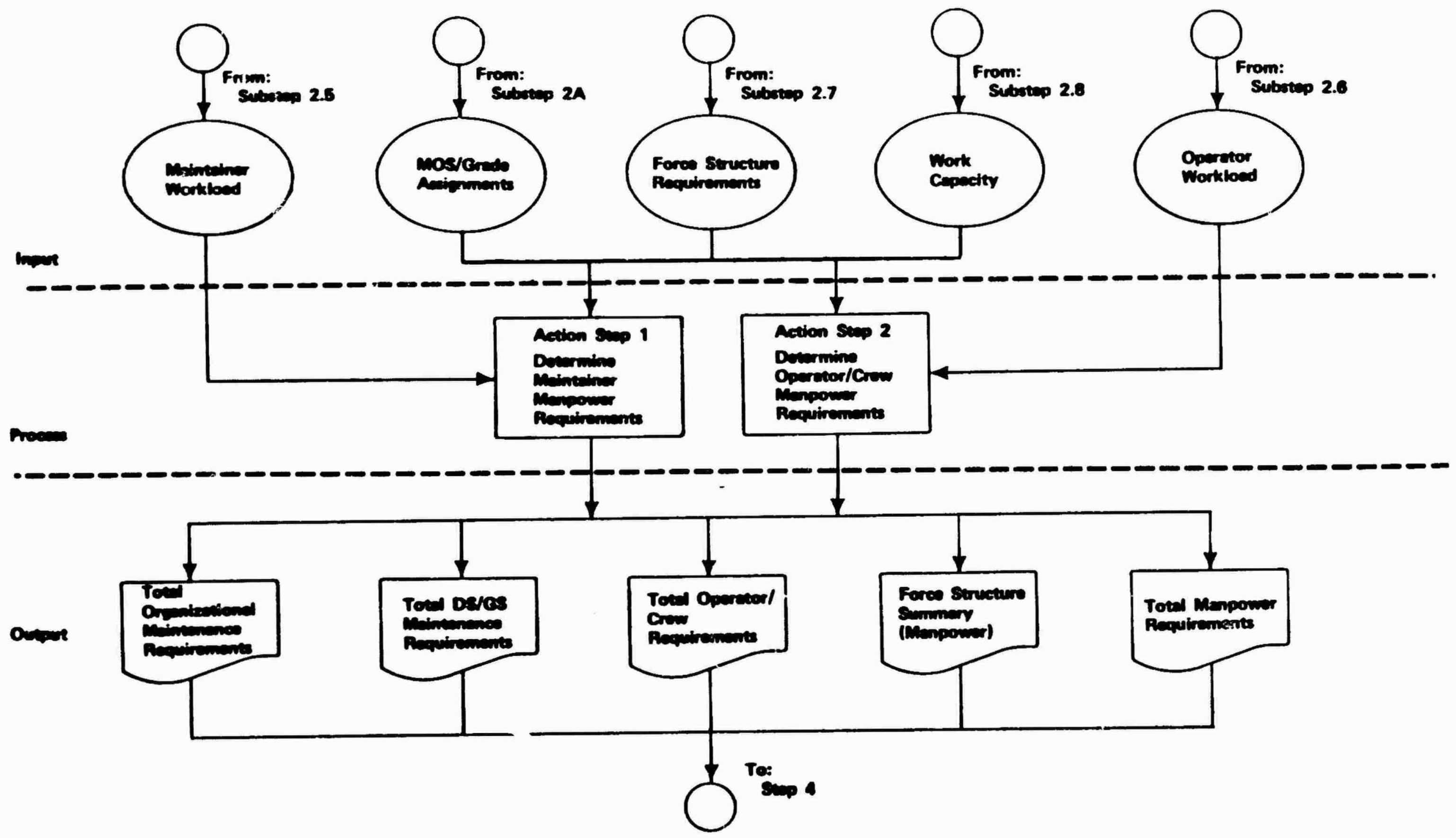

Figure 2.9-2. Logic flow for Compute Manpower Requirements.

Objective

The objective of this action step is to determine qualitative and quantitative manpower requirements at each maintenance echelon supporting the system.

Procedures

1. The analyst selects one maintainer MOS and obtains the workload, work capacity, and system density values for that MOS from previous substeps. To obtain the number of positions required for the MOS, the analyst substitutes the values into the specific manpower equation:

<u>GENERAL:</u>

$$\frac{\text{WORKLOAD} \times \text{FORCE STRUCTURE}}{\text{WORK CAPACITY}} = \text{MANPOWER}$$

<u>Specific:</u>

$$\frac{\dfrac{\text{Man-hours (Direct + Indirect)}}{\text{One System}} \times \text{Number of Systems}}{\dfrac{\text{Man-hours Available}}{\text{One Position}}} = \text{Number of Positions}$$

2. The analyst repeats Procedure 1 for each maintenance level, using specific values for workload, system density, and work capacity for each.

3. If the MOS is likely be "shared" by different systems at a particular maintenance level, then the number of positions may be expressed with one or two decimal places. If the MOS is

system-specific or at the total Army level, then the number of positions should be rounded.

AR 570-2 prescribes rounding off the number of maintainer positions to the nearest whole number. However, the analyst must use caution and judgment in applying the rounding rule, especially if the number of positions calculated is small and rounding down is indicated.

The following example underscores the need for caution. For instance, if the equation yields a requirement for 1.45 positions, AR 570-2 rules would round to 1 position. However, this position would then be overloaded by 45 percent.

Navy and Air Force standards call for rounding up when the remainder is greater than 7.6 percent of the whole number of positions calculated. This rule applies up to twelve positions. Above that number, the analyst always rounds down. The analyst may employ this rule as an alternative to those prescribed in AR 570-2, provided subject matter experts are consulted and concur with that decision.

4. Once positions are defined, both in numbers and by MOS, skill level, and paygrade, maintainer manpower requirements by maintenance echelon are provided to Substep 2.3 (Determine Final MOS/Grade) to ensure that position descriptions based on assigned workload are appropriate. At the same time, workload-determined positions are compared to the Standards of Grade Authorization in AR 611-201 MOS by MOS. The final skill level and paygrade assigned to the subject positions is the senior of the two. (This procedure is accomplished in Substep 2.3 but presented again here for reference.)

5. Note that the maintenance manpower requirements for the Predecessor System may also be derived using all of the analyses in this substep group. Typically, the existing total maintenance manpower associated with the Predecessor System is unknown, especially at the Direct Support maintenance level and above.

However, the Manpower Requirements Criteria (MARC) portion of AR 570-2 does provide workload information, in the form of Annual Maintenance Man-hours, by maintenance level for each MOS associated with standard equipment Line Item Numbers (LINs). The analyst may use MARC workload data or workload data developed from Predecessor system R&M information to determine Predecessor System maintenance manpower requirements.

Workload estimates from MARC do not always agree with those obtained from field R&M information. Therefore, the analyst should be careful to resolve any inconsistencies with subject-matter experts.

Examples

Example 1

Situation. The system is a radio set. Results from previous susbsteps provide the following information:

	Organizational	Direct Support
Maintainer MOS	31V	31E
Workload	12.46 MMH/Week	13.20 MMH/Week
Work Capacity	47.95 MMH/Week	51.80 MMH/Week
System Density	24	336

Results. The analyst determines the following results:

MOS 31V:

$$\frac{12.46 \times 24}{47.95} = 6.24 \text{ positions}$$

MOS 31E:

$$\frac{13.20 \times 336}{51.80} = 85.62 \text{ positions}$$

The analyst leaves the number of positions as a decimal because both MOS work on other systems at both maintenance levels.

Example 2

Situation. The situation of the previous example is continued. The analyst must obtain the total Army manpower requirement for both MOSs given a total system density of 1,680.

Results. Work capacity for the total Army is unknown. The analyst must obtain total Army results based on the proportion of the system density at one echelon to the total system density.

MOS 31V:

$$\frac{6.24 \frac{\text{positions}}{\text{echelon}} \times 1680 \frac{\text{systems}}{\text{Army}}}{24 \frac{\text{systems}}{\text{echelon}}} = 436.8$$

$$= 437 \frac{\text{positions}}{\text{Army}}$$

MOS 31E:

$$\frac{85.62 \frac{\text{positions}}{\text{echelon}} \times 1680 \frac{\text{systems}}{\text{Army}}}{336 \frac{\text{systems}}{\text{echelon}}} = 428.1$$

$$= 428 \frac{\text{positions}}{\text{Army}}$$

In this case, the rounding rule is applied.

Action Step 2: Determine Operator/Crew Manpower Requirements

Requirements

The analyst combines input from previous substeps with the basic manpower equation to determine the qualitative and quantitative operator requirements for the system.

Objective

The objective of this action step is to determine qualitative and quantitative manpower requirements for system operators, including all system crew positions.

Procedures

The general procedures to be followed are the same as in Action Step 1. For clarity, they will be repeated here, with particular attention given to operator manpower.

1. The analyst selects one operator MOS and obtains the workload, work capacity, and system density values for that MOS from previous substeps. To obtain the number of positions required for the MOS, the analyst substitutes the values into the specific manpower equation:

<u>GENERAL:</u>

$$\frac{\text{WORKLOAD} \times \text{FORCE STRUCTURE}}{\text{WORK CAPACITY}} = \text{MANPOWER}$$

<u>Specific:</u>

$$\frac{\dfrac{\text{Man-hours (Direct)}}{\text{One System}} \times \text{Number of Systems}}{\dfrac{\text{Man-hours Available}}{\text{One Position}}} = \text{Number of Positions}$$

The analyst should note that operator workload is always direct, i.e., factors for indirect productive time are not applied.

2. Two sets of workload may result from Substep 2.6 (Determine Operator Workload). The first set is the actual, direct workload necessary to accomplish all required mission events. The second set results from a requirement to have a minimum number of operators continuously present during all system functions. Moreover, Substep 2.6 may have determined this minimum number of operators directly.

However, this minimum number is not necessarily based on workload. To determine the required number of operator positions, the analyst selects the greater of the two workload values and applies the manpower equation. The resulting number of positions should be compared to the minimum number of operators required. The analyst selects the greater of the two values as the system's operator manpower requirement.

To the extent that the minimum number of operators is greater than required by actual workload, the analyst is advised to consider reexamining/restructuring the assignment of operator workload to particular positions. Such a reexamination may result in reducing the number of minimum positions required.

Alternatively, the analyst may be required by the scope of the study to determine unit, rather than system-specific, manpower requirements. The workload associated with non-system-specific unit requirements may be assigned to system operators if it does not interfere with system operations. In this way, the minimum unit manpower requirements may be obtained.

3. The analyst repeats Procedures 1 and 2 for each operator MOS, using specific values for workload, system density, and work capacity.

4. If fractional positions result, the analyst determines if the workload associated with the remainder can be restructured (see Procedure 2 above). If not, or if in doubt, the analyst should always round up to the next whole position.

5. Once positions are defined, both in numbers and by MOS, skill level, and paygrade, operator manpower requirements are provided to Substep 2.3 (Determine Final MOS/Grade) to ensure that position descriptions based on assigned workload are appropriate. At the same time, workload-determined positions are compared to the Standards of Grade Authorization in AR 611-201 MOS by MOS. The final skill level and grade assigned to the subject positions is the senior of the two. (This procedure is accomplished in Substep 2.3 but reiterated here for reference.)

6. Predecessor System operator manpower requirements may be determined by using all of the analyses in this substep group. However, the requirements may be ascertained more easily either by inspecting the Required column of appropriate TOE containing the Predecessor System or examining the Basis of Issue Plan for the Predecessor System.

In examining TOEs, care must be taken to distinguish direct system operator positions from positions which, although requiring the same MOS, are based on non-system-specific workload. Only the direct system operator positions are necessary to support subsequent analyses.

Example

Situation. The system is a new self-propelled howitzer. From previous substeps, the analyst determines the following information:

Workload:

Direct Required: 171.67 MH/Week

Minimum: 290.00 MH/Week

Work Capacity: 84.00 MH/Week

Minimum Operators: 6

System Density:

Battery:	6
Battalion:	18
Division:	54
Total Army:	852

The analyst must obtain the crew size and the total Army manpower requirement.

Results. The analyst selects the greater of the two workload values. Crew size is defined when the system density is one. The analyst obtains the following results:

Crew Size:

$$\frac{290 \times 1}{84} = 3.45 \text{ positions}$$

The analyst concludes that crew size equals six because the minimum number of operators required is greater than the number of positions based on workload.

Total Army:

$$6 \frac{\text{positions}}{\text{system}} \times 852 \frac{\text{systems}}{\text{Army}}$$

$$= 5112 \frac{\text{positions}}{\text{Army}}$$

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STEP 3

Training Resource Requirements Analysis

Purpose

The Training Resource Requirements Analysis (TRRA) enables analysts to estimate systematically the training requirements for Army weapon systems during the earliest phases of their development. These training requirement estimates include specification of the system's task, course, and resource requirements.

Early estimates of training serve two important purposes. First, by estimating training requirements for each design alternative under consideration, the TRRA provides information needed to identify and correct training-intensive alternatives. If appropriate corrective action is taken, the analysis helps insure that a system will not be unreasonably difficult to train for, operate, and maintain.

Second, by developing earlier and more accurate estimates of training requirements, the training planning process can begin sooner. As a result, the training products associated with a system, many of which may require long lead times, are more likely to be available when the system is fielded.

Objectives

The five major objectives of the TRRA are:

- To provide decision-makers with estimates of training resource requirements and costs so this information can be used in making early design tradeoff decisions

- To provide training resource planners with early estimates of the resource requirements and costs of training courses

- To provide program and training managers with input to new weapon system training documents and processes such as the Individual and Collective Training Plan (ICTP), the Qualitative and Quantitative Personnel Requirements Information (QQPRI), and the Cost and Training Effectiveness Analysis (CTEA)

- To provide training developers with a list of suitable existing training and estimates of modified/new tasks, media, and programs of instruction so this data can support the design and development of the new system's training program

- To provide personnel and force structure analysts with task/skill data and student characteristics for assessing job difficulty and aptitude requirements

Interrelationships

Figure 3-1 presents an overview of the relationships between the TRRA and the other HARDMAN methodology steps. TRRA output depends on input generated by Systems Analysis (Step 1), Manpower Requirements Analysis (Step 2), and Personnel Requirements Analysis (Step 4). Information is exchanged among these steps in an interactive manner. For example, the system manning requirements (produced by the Manpower Analysis) and the number of personnel who must be trained (produced by the Personnel Analysis) are both needed to conduct the TRRA.

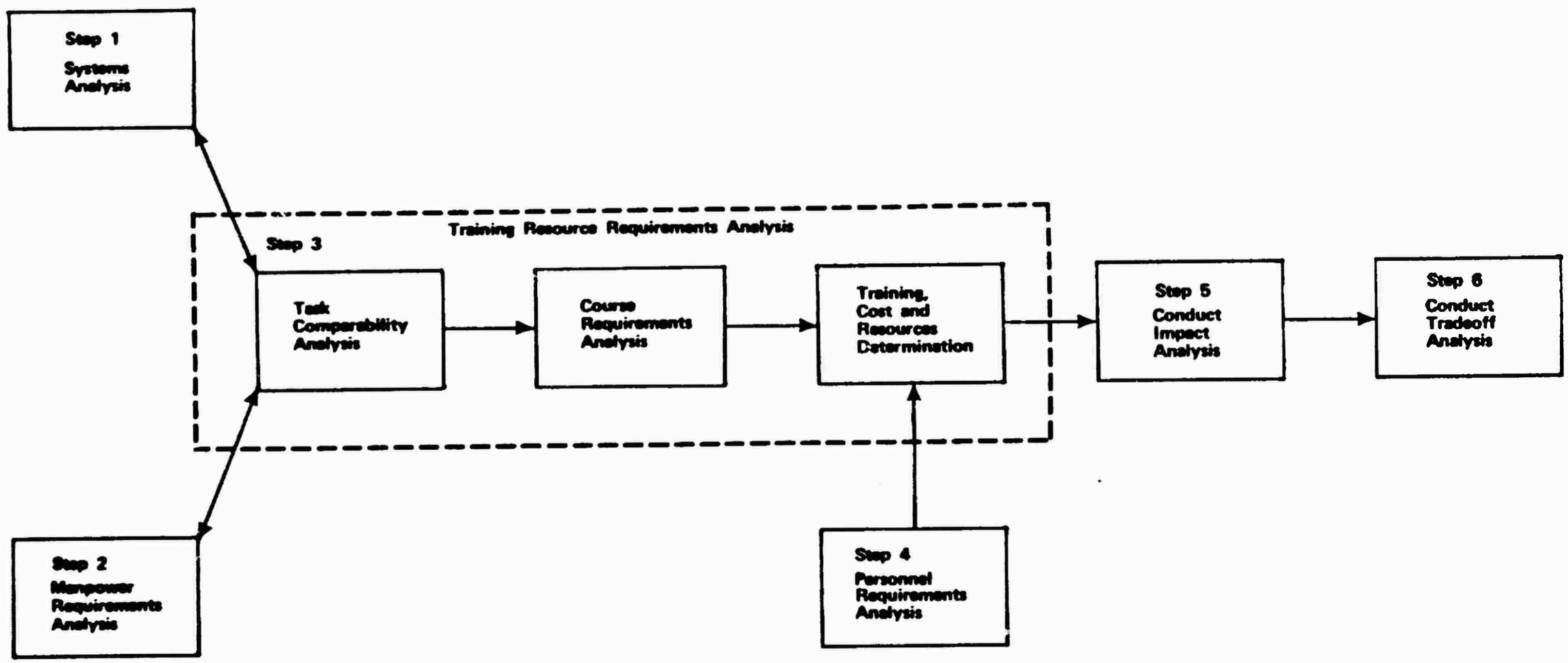

Figure 3-1. Relationships of TRRA to Other HARDMAN Steps.

In turn, the TRRA provides input to the Manpower Requirements Analysis regarding the appropriate MOS/SSI and skill level for each operator and maintainer. The TRRA also provides training-path information to the Personnel Requirements Analysis as well as summary training data to Step 5 (Impact Analysis) and Step 6 (Tradeoff Analysis).

Assumptions/ Constraints

The following assumptions and constraints should be kept in mind when applying a TRRA:

- All estimates in the TRRA are based on the best available data. Projections are made from the existing tasks, subsystems, courses, etc., which most closely meet the technological and functional requirements of the new system.

- Unlike Instructional Systems Development, the TRRA is NOT designed to generate detailed training products such as courses or media. Instead, the TRRA estimates the requirements for these products.

- Only those resources and costs associated with courses of instruction conducted at formal schools and training centers are estimated in the TRRA. Training resources and costs regarding unit and collective training are not estimated.

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

- Training associated with the proposed system's operational test and evaluation, transition, and initial fielding is not estimated.

- Development and acquisition costs of training devices, equipment, media, and other products are not estimated.

- In the initial application of the TRRA, existing courses included in the analysis are assumed to meet stated performance standards. The training task, methods/media selection, and other analyses associated with the development of these courses are also assumed to be valid.

- Detailed estimates of training resources and costs are provided only for (1) operators and maintainers who will be assigned to the subsystems under analysis and (2) noncommissioned, warrant, and commissioned officers directly responsible for their supervision. The level of supervision and technical capability incorporated for noncommissioned officers typically extends through Skill Level 3.

Comparability Analysis

The TRRA is conducted in three basic phases. During the first phase, the training data required to support the Predecessor System are obtained and formatted.

During the second phase, a Baseline Comparison System (BCS) training program is established. This program is consistent with the BCS equipment and manning requirements developed in

HARDMAN Steps 1 and 2, respectively. Since the BCS is composed of existing subsystems, the BCS training program is essentially a compilation of elements from those subsystems' course and task requirements.

Exceptions to the above occur when (1) a BCS equipment is so new that its courses and tasks have not yet been fully developed, or (2) a BCS equipment is selected from outside the Army inventory (e.g., a Navy aircraft engine). Since the selected BCS equipment lacks Army training documentation, a further analytical step must be taken.

A comparability analysis is applied to identify existing Army equipment which most closely resembles the BCS equipment. These comparable tasks and courses are then modified to reflect differences between the selected BCS equipment and the comparable existing equipment.

During the third phase, the Proposed System's training program is established. BCS course and task data are modified, where necessary, or other existing course and task data are obtained to reflect differences between Proposed System and BCS equipment.

If the Proposed System has documentation on a planned training program, the modifications made in this procedure are intended to reflect this plan. Otherwise, using the best available data and descriptions of the Proposed System, BCS courses and tasks are modified to reflect the impacts of design differences.

Substep Groups

Three substep groups make up the TRRA: Task Comparability Analysis, Course Requirements Analysis, and Training Cost and Resources Determination. These substep groups represent distinct components of a training system and are easily identified within the Army training system. Each group requires a different set of training data for input, uses different analytical procedures, and results in the development of distinct products.

Table 3-1 compares the TRRA procedural approach with the major substep groups of the TRRA. The analysis progresses from left to right and top to bottom. Two concepts underlie this flow. First, whenever possible, tasks are the foundation on which courses are built. Courses, in turn, are the basis for generating cost and resource requirements.

Second, the Predecessor System and its existing training provide the initial data for establishing the BCS training program. In turn, the BCS training program usually forms the basis for determining the Proposed System training program.

Analyses within substep groups can be performed on the respective system configurations in whole or in part. For example, the substeps in all three groups could be completed for the Predecessor System before applying the substeps to the BCS. On the other hand, all substeps in the Task Comparability Analysis group could be applied across all system configurations before determining course requirements. The choice of either approach or a combination of both depends mainly on the availability of data needed to conduct the substep analyses and on the preference of the training analyst(s).

Table 3-1. TRRA Procedural Approach

Substep Groups	Phase 1 Identify Predecessor System Training Program	Phase 2 Establish BCS Training Program	Phase 3 Establish Proposed System Training Program
Task Comparability Analysis (Detailed TRRA Only)	Identify Predecessor System Tasks	Select Existing and Predecessor System Tasks	Select Existing and BCS Tasks
	Predecessor System Outcomes: • Soldiers Manual Tasks • Trainers Guide Tasks • AR 611-201 Task Descriptions • Other Existing Tasks	BCS Outcomes: • Task List • △ Task	Proposed System Outcomes: • Task List • △ Task
Course Requirements Analysis	Identify Predecessor System Courses	Select Existing and Predecessor System Courses	Select Existing and BCS Courses
	Predecessor System Outcomes: • Programs of Instruction	BCS Outcomes: • Quasi-POIs • △ Courses	Proposed System Outcomes: • Quasi-POIs • △ Courses
Training Cost and Resources Determination	Identify Predecessor System Cost and Resources	Compute Impacts of Design Differences	Compute Impacts of Design Differences
	Predecessor System Outcomes: • Detailed Course Cost Data (ATRM-159) • Detailed Instructor Determination Data (TRAMEA)	BCS Outcomes: • △ Resources • △ Costs	Proposed System Outcomes: • △ Resources • △ Costs

Levels of Application

The TRRA can be applied at two distinct levels — general and detailed. The general TRRA is designed to provide initial estimates of training resources and costs early in the system acquisition process. Because only high-level task and skill information is collected and analyzed, the general TRRA produces results more quickly.

However, the broad scope of the general TRRA makes it less appropriate for conducting detailed tradeoffs of instructional methods and media. Also, the generic task data used in the general TRRA are insufficient for the application of many of the procedures developed for front-end analysis and Instructional Systems Development (ISD).

In contrast with the general TRRA, the detailed TRRA is designed to be applied later in the acquisition process. At that point, detailed tradeoffs of tasks, training settings, and instructional methods/media are required, but more time and resources are available for conducting those analyses. The main difference between general and detailed TRRA applications concerns inclusion of these substeps. This difference is summarized in Table 3-2.

Table 3-2. General vs. Detailed TRRA Components

Level of Application	TRRA Components
General	Course Requirements Analysis Substeps 3.9, 3.10
	Training Cost and Resources Determination Substeps 3.11—3.16
Detailed	Task Comparability Analysis Substeps 3.1—3.8
	Course Requirements Analysis Substeps 3.9, 3.10
	Training Cost and Resources Determination Substeps 3.11—3.16

Task Comparability Analysis

Overview

Task comparability analysis leads to identification of a system's training tasks. Traditional job and task analysis is not employed to generate these tasks. Rather, the comparability analysis embedded in the HARDMAN methodology is used to identify existing tasks for comparative purposes. Having applied comparability analysis, the existing comparable tasks provide a substantial amount of data that can be used to estimate skill levels, training products, training settings, resource requirements, etc.

The analysis conducted within this subgroup comprises the bulk of the additional work that differentiates a general TRRA from a detailed TRRA. However, Substep 3.1 (Identify Existing Training) is as crucial for organizing and focusing the general TRRA as it is for the detailed TRRA.

Training source indexes developed in this first substep provide a mission- and equipment-based direction to the overall analysis. This insures that all training materials incorporated in the analysis results are actually needed to fulfill the system's operator and maintainer requirements.

In a series of task worksheets, Predecessor System, BCS, and Proposed System tasks are identified, evaluated, and fully described. Once the Proposed System tasks have been developed, the assignment of tasks to training and training settings can be further studied.

Logic

Figure 3A-1 depicts the logic flow for conducting the task comparability analysis phase of the TRRA. A wide array of data specific to the system and/or alternative is required to conduct the analysis. Much of this data is generated by other HARDMAN substeps. The mission events, functions, and equipment configurations are critical HARDMAN output that become the focus of the analysis conducted within this substep group.

Upcoming sections describe these substeps in detail:

3.1 Identify Existing Training

3.2 Evaluate Predecessor System Tasks

3.3 Determine New Tasks

3.4 Establish BCS Tasks

3.5 Evaluate BCS Tasks

3.6 Establish Proposed System Tasks

3.7 Assign Tasks to Training

3.8 Assign Tasks to Training Settings

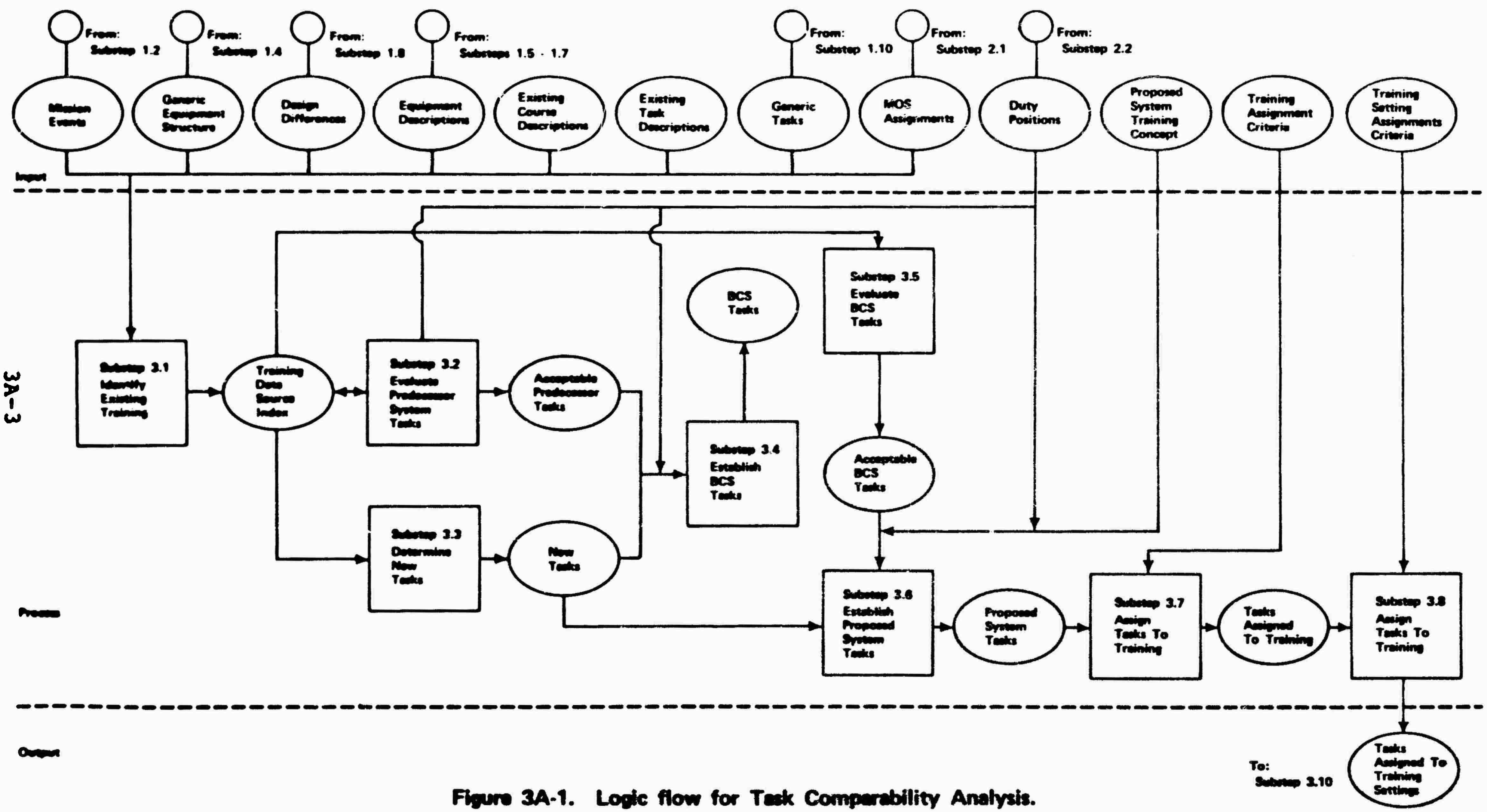

Figure 3A-1. Logic flow for Task Comparability Analysis.

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Identify Existing Training

Objective

This initial Training Resource Requirements Analysis (TRRA) substep organizes and focuses the entire training resource requirements analysis. It insures, for each system alternative, that training is identified for every system mission event and every equipment component.

Identified within this substep are all courses of instruction, course modules, and tasks that are to be used to estimate the system designs' training requirements. References are made to these training sources in order to facilitate access to training data in later steps of the training analysis.

Additionally, the training data source indexes developed in this substep coordinate the early identification of required training information. This promotes timely data gathering from the proponents of the training information.

Several HARDMAN steps provide input to this substep. They include the mission events from Substep 1.2; the generic equipment structure from Substep 1.4; the Predecessor System, BCS, and Proposed System equipment descriptions from Substeps 1.5, 1.6, and 1.7, respectively; the design difference indexes from Substep 1.8; the generic tasks from Substep 1.10; and the MOS assignments from Substep 2.1. Input from sources other than HARDMAN include descriptions of existing courses and existing tasks.

Product

Two major products result from this substep: (1) the operator training data source index, and (2) the maintainer training data source index. See Tables 3.1-1 and 3.1-2 for an example of each.

Logic

Although two major indexes are produced in this substep, the procedure for deriving both requires only one action step. Figure 3.1-1 shows an overview of this substep.

Both training data source indexes developed in this substep are initially organized around other HARDMAN output. The operator training data source index requires initial input of the system's mission events and high-level function plus the equipment for each system alternative. The maintainer training data source index focuses on each system alternative's equipment configuration which is keyed by the generic equipment structure.

Once the indexes are filled, each requires the same data. The sole exception is that maintenance levels are required for the maintainer index. Representative equipment for training estimation is identified when the system alternative's equipment does not have sufficient training data available. For each maintenance level and each skill level, all relevant task and course information is then added to the indexes.

Table 3.1.-1. Operator Training Source Index Worksheet: Example

System: SINCGARS Configuration: BCS

Function No.	Function Name	Generic Equipment No.	Equipment Name	Configuration Equipment Name
6.0	Maintain Voice Communications	GA680901	Radio, FM	AN/VRC-47

System: SINCGARS Configuration: BCS

Representative Equipment for Training Estimation Radio Set AN/VRC-47						
Skill Level 1	MOS/ASI 13E	Source of Task Information FM 6-13E/CM				
Task Number	Training Responsibility Institution			Unit	Source of Course Information	
					POI Number	Annex/File Number
113-587-3004	BCT AIT/OSUT Q PLDC	PIC/PNCOC BIC/BNCOC ANCOC	SNCOC SGMA SVC School	SOJT A Self Study A SCHOLD TNG A	250-13E10	CEIOOC

Table 3.1-2. Maintainer Training Source Index Worksheet: Example

System: SINCGARS **Configuration:** BCS

Generic Equipment No.	Generic Equipment Name	Configuration Equipment Name
GA680901	Radio, FM	AN/VRC-47

System: SINCGARS **Configuration:** BCS

Representative Equipment for Training Estimation Radio Set AN/VRC-47						
Maintenance Level DS	Skill Level 1	MOS/ASI 31E	Source of Task Information FM 11-31E/TG			
Task Number	Training Responsibility — Institution			Unit	Source of Course Information	
					POI Number	Annex/File Number
	BCT AIT/OSUT PLDC	PIC/PNCOC BIC/BNCOC ANCOC	SNCOC SGMA SVC School	SOJT Self Study SCHOLD TNG		

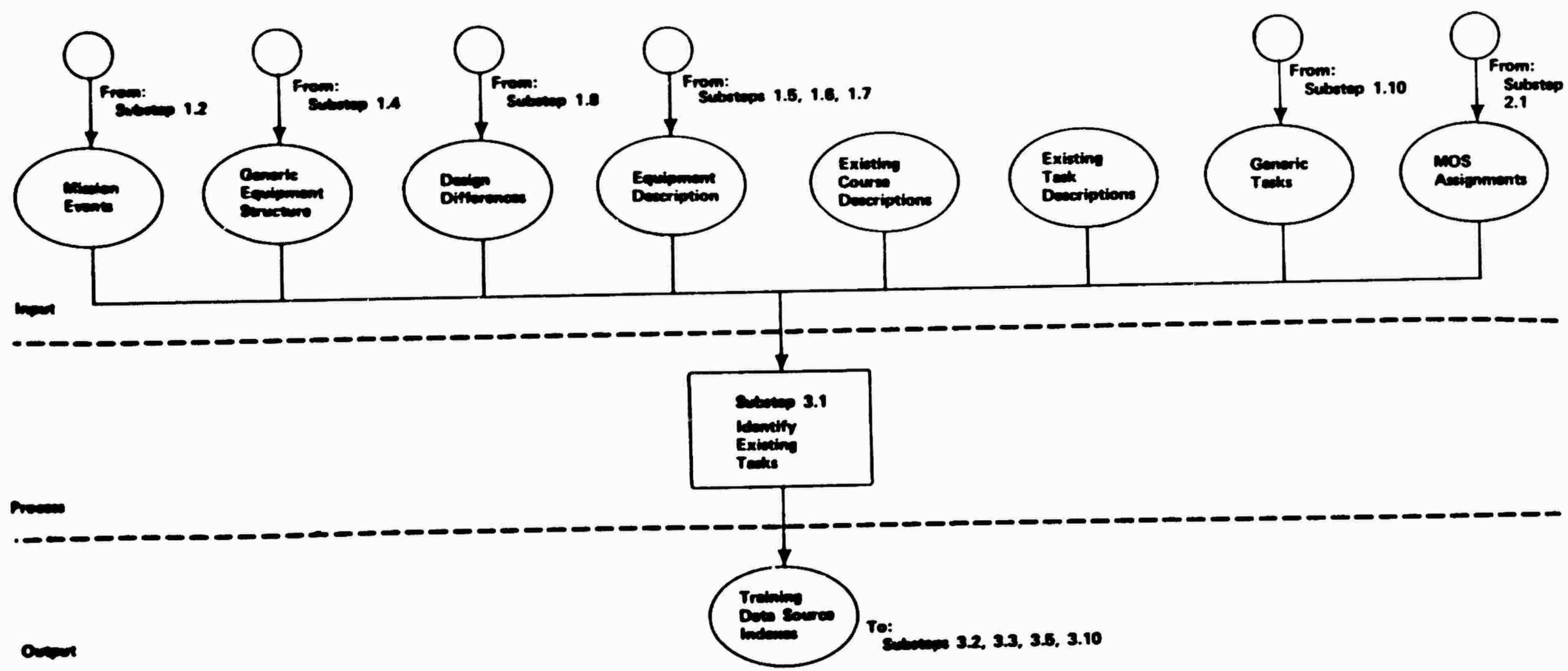

Figure 3.1-1. Logic flow for Identify Existing Training.

Action Step

Requirements

During this substep, the analyst conducts a substantial amount of the training analysis. Equipment comparability analysis is employed to choose additional equipment for training estimation. Extensive searches for task and course module information are conducted, and time-consuming documentation of identified training data is made.

Objectives

This substep has two objectives. The first is to provide a complete audit trail of all training data used. The second, more important objective is to focus the TRRA on the missions, functions, and equipment of the system and its alternatives.

Procedures

To achieve this objective, the analyst carries out the following procedures:

1. For the operator training data source index, use Table 3.1-3 as an example of how to organize the data. Obtain the sequenced mission events developed in Substep 1.2. For each event, identify the generic equipment that performs the event and assign its equipment identification code to the event. Add each system alternative's equipment number and name as required.

2. Evaluate each system alternative's equipment. First, determine the availability of the operator's manual. Next, identify the Army MOS, Air Force

Table 3.1-3. Operator Training Source Index Worksheet: Blank

System: SINCGARS **Configuration:** BCS

Function No.	Function Name	Generic Equipment No.	Equipment Name	Configuration Equipment Name
6.0	Maintain Voice Communications	GA680901	Radio, FM	AN/VRC-47

System: **Configuration:**

Representative Equipment for Training Estimation						
Skill Level	MOS/ASI	Source of Task Information				
Task Number	Training Responsibility: Institution			Unit	Source of Course Information	
					POI Number	Annex/File Number
	BCT AIT/OSUT PLDC	PIC/PNCOC BIC/BNCOC ANCOC	SNCOC SGMA SVC School	SOJT Self Study SCHOLD TNG		

AFSC, Navy Rating, or Marine Corps MOS that operates the equipment. Determine the availability of:

- Task data (soldier's manual, trainer's guide, etc.)

- Course materials (programs of instruction, lesson plans, etc.)

If much of this data does not exist or is unavailable, a different equipment should be selected for training estimation purposes. Employ the equipment comparability criteria described in Substep 1.6. Sometimes this selection process has already been performed. An appropriate equipment for training estimation purposes may have already been evaluated in this substep but was rejected because of a lack of reliability and maintainability data. In making this selection, try wherever possible to identify Army equipment.

Once the equipment is chosen, order the needed training sources as soon as possible.

3. As materials are identified or as they arrive, document them on the index. Use the index to track the identification process and the arrival of materials. In this way, it is clear what analysis remains to be accomplished and what materials are still required.

4. For the maintainer training data source index, use Table 3.1-4 as an example. Obtain the generic task structure and the equipment list for each system alternative and add them to the table. Complete the remainder of this index in the same way as for the operator index. The only additional element to account for in this index is the maintenance level.

Table 3.1-4. Maintainer Training Source Index Worksheet: Blank

System: SINCGARS **Configuration:** BCS

Generic Equipment No.	Generic Equipment Name	Configuration Equipment Name
GA660901	Radio, FM	AN/VRC-47

System: Configuration:

Representative Equipment for Training Estimation						
Skill Level	MOS/ASI	Source of Task Information				
Task Number	Training Responsibility ——— Institution ———			——— Unit ———	Source of Course Information	
	BCT AIT/OSUT PLDC	PIC/PNCOC BIC/BNCOC ANCOC	SNCOC SGMA SVC School	SOJT Self Study SCHOLD TNG	POI Number	Annex/File Number

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Evaluate Predecessor System Tasks

Objectives

The purpose of this substep is to identify all of the Predecessor System tasks and to evaluate them for inclusion in the BCS task list. If the system under study does not have a Predecessor System, this substep is not performed.

Typically, the largest portion of BCS training data is obtained from the Predecessor System's operator and maintainer MOSs. Beginning the training analysis with the Predecessor System tasks provides an easy means of identifying large numbers of tasks. It also provides, through analysis of their tasks, insight into the operation and maintenance requirements of the new system. Additionally, through the analysis of soldier training publications (STPs), the analyst gains greater understanding of existing MOS training plans and the overall training concept employed by the proponent school.

The Predecessor System task evaluation is conducted interactively between this substep and Substep 3.1. The Training Data Source Indexes in Substep 3.1 provide the BCS's equipment configuration, mission events, and generic tasks which serve as the focus of the evaluation process. The Predecessor System tasks appropriate to the BCS are then fed back to these indexes for inclusion.

Another goal of this substep is to estimate the impact that the introduction of the new weapon system will have upon the Predecessor System's training products. Estimates of resource requirements for training product development can be made by identifying what portions of existing trainer's guides and soldier's manuals can be retained, and, in later substeps, how many new tasks will have to be developed.

Input

Input from other HARDMAN substeps includes the Training Data Source Indexes from Substep 3.1, Predecessor System equipment descriptions from Substep 1.5, BCS equipment description from Substep 1.6, and the MOSs/ASIs identified for the Predecessor System in Substep 2.1. The only other sources required are descriptive information about the Predecessor System tasks. These are found mostly in soldier's manuals and trainer's guides, but, at times, more detailed task information is required from technical manuals, field manuals, and programs of instruction.

Product

Results of this substep include (1) detailed descriptions of all Predecessor System tasks and (2) the Predecessor System tasks acceptable for inclusion in the BCS task list.

Logic

As shown in Figure 3.2-1, only one step is required to evaluate the Predecessor System tasks. All Predecessor System tasks are initially identified. Each task and the Predecesor System equipment associated with it is evaluated against the equipment and task requirements of the BCS.

A set of modification/deletion codes indicates the impact of this evaluation on the Predecessor System tasks. Acceptable tasks are added to the Training Data Source Indexes in Substep 3.1 and are included in the BCS task list in Substep 3.4.

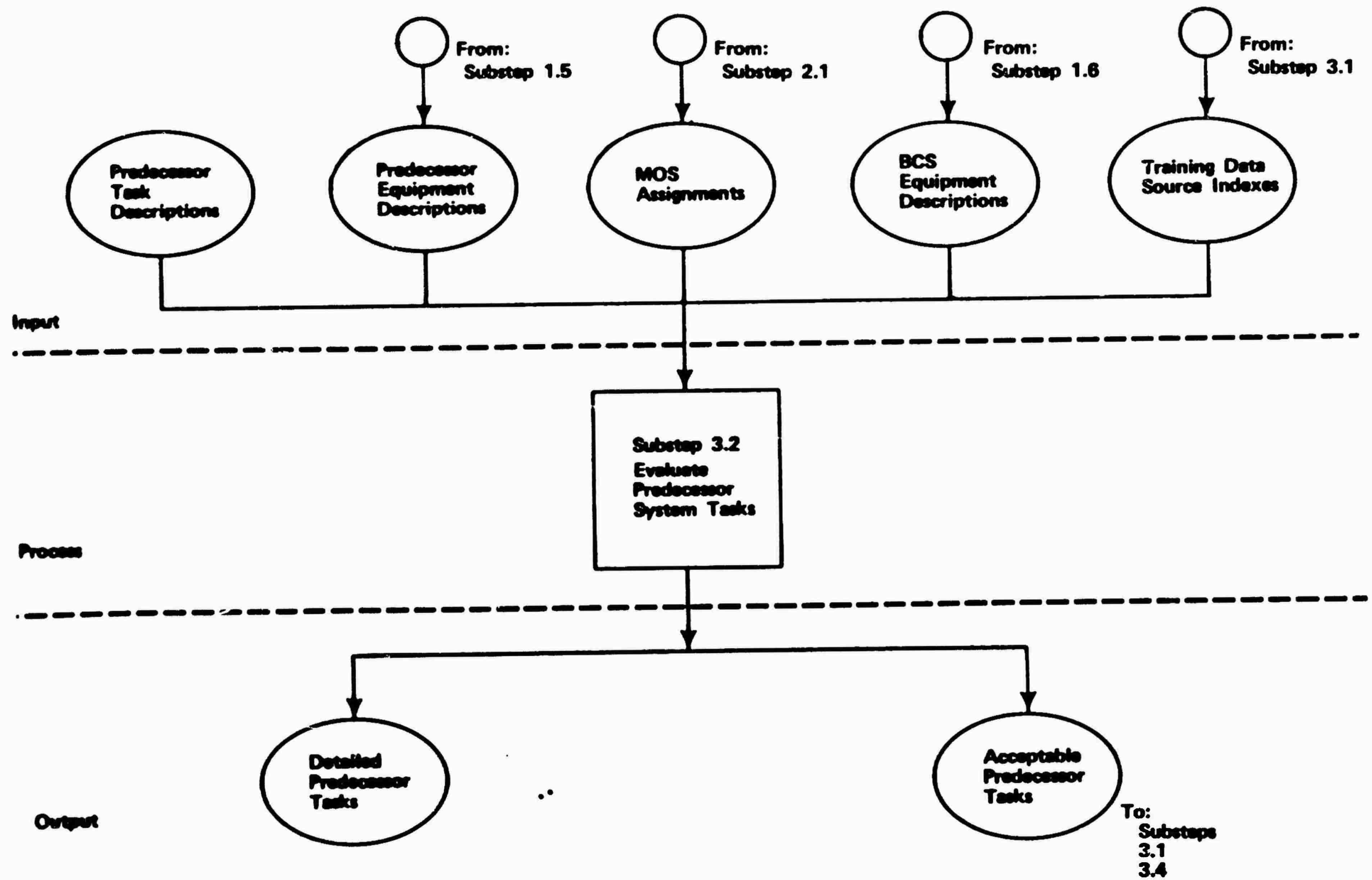

Figure 3.2-1. Logic flow for Evaluate Predecessor Tasks.

Action Step

Requirements

The analyst identifies the Predecessor System tasks by studying the appropriate trainer's guide, soldier's manual, technical manuals, and programs of instruction. The BCS equipment, mission events, and generic tasks located on the Training Data Source Indexes in Substep 3.1 are used to conduct an evaluation of these tasks. Appropriate Predecessor System tasks are added to the BCS task list.

Objective

The objective of this action step is to identify all Predecessor System tasks and to evaluate these tasks for inclusion on the BCS task list.

Procedures

To achieve this objective, the analyst carries out the following procedures:

1. For the Predecessor System, obtain the Summary of MOS/ASI Assignments by Equipment from Table 2.1-1 in Substep 2.1. For each of the Predecessor System's MOSs/ASIs, obtain the trainer's guide and the soldier's manual for the appropriate skill levels.

2. Determine which of the tasks listed in the trainer's guide pertain to the Predecessor System. Most of the tasks will be easy to identify because the name or nomenclature of the Predecessor System or its equipment will be included in part of the task description.

However, for some tasks, the Predecessor System will not be readily identified, requiring additional analysis. Consult the following additional sources to determine whether the task is performed on the Predecessor System:

- The detailed description of the task in the soldier's manual
- The program of instruction in which the task is taught
- Technical manuals and other documents referenced by the task
- Training development personnel at the MOS/ASI's proponent school

3. Use Table 3.2-1, Predecessor Task Evaluation Worksheet, to record each task. Enter the following information from the trainer's guide and the soldier's manual:

- Task Number
- Military Occupational Specialty/ Additional Skill Identifier
- Trainer's Guide — the field manual or soldier training publication number for the trainer's guide to the MOS
- Skill Level
- Task Description
- Duty Position — the duty position assigned responsibility for the performance of the task on the Predecessor System

Table 3.2-1. Predecessor Task Evaluation Worksheet: Blank

<table>
<tr><td colspan="3">MOS/ASI:</td><td colspan="3"></td><td>Trainer's Guide:</td></tr>
<tr><td colspan="6">Predecessor System</td><td>Equipment Number</td></tr>
<tr><td>Task Number</td><td colspan="2"></td><td>Skill Level</td><td colspan="2"></td><td rowspan="3"></td></tr>
<tr><td colspan="6">Task Description:</td></tr>
<tr><td colspan="6">Duty Position:</td></tr>
<tr><td rowspan="4">Training</td><td rowspan="2">Responsibility</td><td colspan="3">Institution</td><td>Unit</td><td>Task Modification Code</td></tr>
<tr><td>BCT
AIT/OSUT
PLDC</td><td>PIC/PNCOC
BIC/BNCOC
ANCOC</td><td>SNCOC
SGMA
SVC School</td><td>SOJT
Self Study
SCHOLD TNG</td><td></td></tr>
<tr><td colspan="5">Primary Materials:</td><td>Task Deletion Code</td></tr>
<tr><td>Devices</td><td colspan="4">None</td><td></td></tr>
</table>

- Training Responsibility — location of qualification and additional training responsibilities for the task; enter "Q" for qualification and "A" for additional training

- Primary Training Materials — training materials for the task identified in the trainer's guide as being normally available to or used by soldiers in the MOS, e.g., technical manuals, Army correspondence courses, training extension courses, etc.

- Training Devices — training devices used to support the training of the task

4. Obtain the Predecessor System equipment list and identify the equipment on which each task is performed. Enter these equipment numbers on the table.

5. Once the preceding descriptive information has been recorded for all tasks, evaluate each task for inclusion in the BCS task list. This evaluation is relatively straightforward.

Obtain the BCS equipment list developed in Substep 1.6 and determine which Predecessor System equipment is included. If the Predecessor System equipment is part of the BCS equipment configuration, add its associated Predecessor System task to the BCS task list. Use the following task evaluation codes to make this assessment. Use of task modification codes signifies inclusion of the task in the BCS task list.

Table 3.2-2. Task Modification Code

Code	Type of Modification
NC	No change in task.
MIN	Minor task modification — Task essentially the same. Only minor change in equipment/procedure required.
SKI	Skill level change — Task essentially the same but assigned to different skill level.
FRE	Frequency change — Same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ	Major task modification — Significant change in skills and knowledge and/or other task characteristics.

The reason for the frequency change in tasks designated with the FRE task modification code can be qualified further by using an additional code:

Table 3.2-3. Frequency Modification Codes

Code	Type of Modification
R	Change in Reliability
M	Change in Maintenance Concept/Doctrine
O	Change in Operational Concept/Doctrine
D	Degraded Operational Mode

The additional code is added to the FRE code but is separated by a dash. For example, a frequency change due to change in reliability is represented by FRE-R.

Tasks designated with the MAJ task modification code can also be further qualified by an additional code, as listed in Table 3.2-4.

Table 3.2-4. Major Modification Codes

Code	Type of Modification
D	Change in design
A	Automation
O	Change in Operational Concept/Doctrine
M	Change in Maintenance Concept/Doctrine

Table 3.2-5 lists codes for indicating task-deletion reasons.

Table 3.2-5. Task Deletion Code

Code	Reason for Deletion
ELI	Elimination of subsystem
AUT	Task automation - Task now performed by equipment
RTF	Reduced task frequency
MC	Change in maintenance concept/doctrine
OC	Change in operational concept/doctrine
SUB	Substitution of subsystem

This set of task codes is used throughout Substep Group 3A (Task Comparability Analysis) to evaluate tasks. Some of these codes are applied more often in later task evaluations.

Tasks evaluated with a modification code are entered on the BCS task list in Substep 3.4 and on the appropriate Training Data Source Index in Substep 3.1.

Example

The AN/VRC-47 radio is the Predecessor System for a new radio. Table 2.1-1, Summary of MOS/ASI Assignments by Equipment, is obtained from Substep 2.1. MOS 31E is designated in this table as the direct support maintainer.

The 31E trainer's guide is obtained and its tasks are reviewed. Many different receiver-transmitters, amplifiers, control groups, etc., are identified in the task titles, but no references are made to the VRC-47 radio. References at the end of the trainer's guide indicate that receiver-transmitters RT-524 and RT-246, receiver R-442/VRC, and RT-524/RT-246/VRC are components of the VRC-12 series of radios. The VRC-47 radio is one configuration of those components.

In the operator's technical manual for the AN/VRC-47, RT-524/VRC is listed as the receiver-transmitter. Based on this additional identification, all of the tasks for the radio's receiver-transmitter are identified and entered in Table 3.2-1.

The BCS equipment list is checked on the Maintainer Training Data Source Index in Substep 3.1. The RT-524 receiver-transmitter is included on the list. Since the subsystems match exactly, each of the Predecessor System tasks is evaluated with the modification code of NC (no change). Table 3.2-6 shows an example of one task which has been entered on the Predecessor Task Evaluation Worksheet.

Table 3.2-6. Predecessor Task Evaluation Worksheet: Example

MOS/ASI: 31E

Trainer's Guide:

Predecessor System						Equipment Number
Task Number 1	113-587-0008		Skill Level		1	GA680901
Task Description: Troubleshoot Receiver-Transmitter RT-524/VRC						
Duty Position: Field Radio Repairer						
		Institution			Unit	Task Modification Code
Training	Responsibility	BCT AIT/OSUT Q PLDC	PIC/PNCOC BIC/BNCOC ANCOC	SNCOC SGMA SVC School	SOJT Self Study A SCHOLD TNG A	MAJ-D
	Primary Materials: TM 11-5820-401-34-2					Task Deletion Code
	Devices	None				

Determine New Tasks

Objective

In this substep, new tasks are developed. These tasks, which are not part of the Predecesor System, are drawn from other weapon systems because that system's equipment or functions are able to best meet the technological and functional requirements of the system being studied. New tasks are generated in this substep for both the BCS and the Proposed System.

Input

Input from other HARDMAN steps includes the BCS and Proposed System equipment descriptions from Substeps 1.6 and 1.7, respectively, the design difference between these two systems from Substep 1.8, and the equipment lists and mission events entered on the training data source indexes in Substep 3.1. Input from other sources includes descriptions of the comparable tasks that are used to develop new tasks from.

Product

This substep produces new tasks that become part of either the BCS task list or the Proposed System task list. A sample new task is shown in Table 3.3-1.

Logic

As shown in Figure 3.3-1, only one step is required to develop new tasks. The training data source indexes established in Substep 3.1 identify the need and provide the basis for developing the new tasks in this substep. From the analysis conducted in that substep, the analyst determines whether the Predecesor System is capable of meeting the functional and technological requirements of the BCS and, in turn, the Proposed System.

Table 3.3-1. Task Generation Worksheet: Example

System: SINCGARS

	Comparable Task				New Task			
	Task Number 113-609-2008	Skill Level 1	MOS/ASI 13E		Task Number 113-13E-1002	Skill Level 1	MOS/ASI 13E	
Task Des	Prepare for Operation & Operate Speech Security Equip. TSEC/KY-38				Prepare for Operation & Operate SINCGARS ECCM Unit			
Duty Pos	Fire Direction Specialist Radio Telephone Operator				Fire Direction Specialist Radio Telephone Operator			
Training	Responsibility	BCT AIT/ OSUT Q PLDC	Institution PIC/PNCOC SNCOC BIC/BNCOC SGMA ANCOC SVC School	Unit SOJT A Self-Study A SCHDLD TNG A	Responsibility	BCT AIT/ OSUT Q PLDC	Institution PIC/PNCOC SNCOC BIC/BNCOC SGMA ANCOC SVC School	Unit SOJT A Self-Study A SCHDLD TNG A
	Prim. Mater	TM 11-5810-300-12, TEC 201-113-4562-J			Prim. Mater	Technical Manual, TEC Lesson		
	Devices	None			Devices	None		

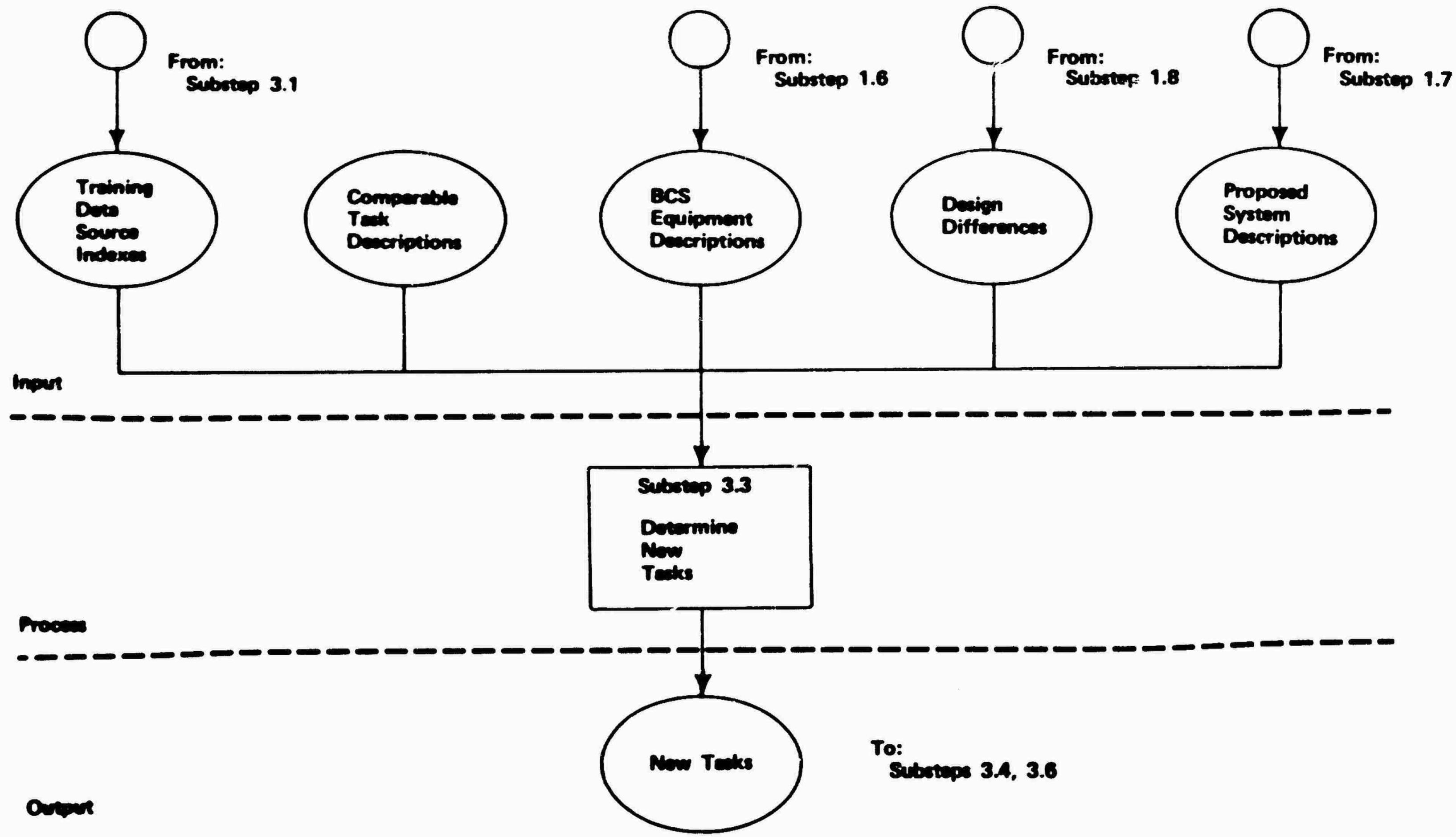

Figure 3.3-1. Logic flow for Determine New Tasks.

Based on the availability of training data to support the analysis, BCS equipment is evaluated as to its ability to satisfy this requirement and, if necessary, additional BCS equipment is identified. The various BCS equipment and the mission events required of the new system provide their associated tasks to this substep for evaluation. From these tasks, new tasks are projected for the BCS and, to a lesser degree, for the Proposed System.

Action Step

Requirements

The analyst obtains the training data source indexes from Substep 3.1 and identifies all of the tasks which are not part of the Predecessor System. Each of these tasks is then input to Substep 3.3 for evaluation.

Objective

The objective of this step is to develop a new task for each of the tasks identified on the training data source index as not being part of the Predecessor System.

Procedures

To accomplish this objective, the analyst carries out the following procedures:

1. From Substep 3.1, obtain the training data source indexes and identify all BCS tasks that are not part of the Predecessor System. Add each task to the "comparable task" side of Table 3.3-2. Using the source indicated on the index for each task, complete as much of the comparable task description as possible.

Table 3.3-2. Task Generation Worksheet: Blank

System:

<table>
<tr><td rowspan="2"></td><td colspan="5">Comparable Task</td><td colspan="5">New Task</td></tr>
<tr><td colspan="2">Task Number</td><td colspan="2">Skill Level</td><td>MOS/ASI</td><td colspan="2">Task Number</td><td colspan="2">Skill Level</td><td>MOS/ASI</td></tr>
<tr><td>Task Des</td><td colspan="10"></td></tr>
<tr><td>Duty Pos</td><td colspan="5"></td><td colspan="5"></td></tr>
<tr><td rowspan="3">Training</td><td>Responsi-
bility</td><td>BCT
AIT/
OSUT
PLDC</td><td>Institution
PIC/PNCOC
BIC/BNCOC
ANCOC</td><td>SNCOC
SGMA
SVC
School</td><td>Unit
SOJT
Self-Study
SCHDLD
TNG</td><td>Responsi-
bility</td><td>BCT
AIT/
OSUT
PLDC</td><td>Institution
PIC/PNCOC
BIC/BNCOC
ANCOC</td><td>SNCOC
SGMA
SVC
School</td><td>Unit
SOJT
Self-Study
SCHDLD
TNG</td></tr>
<tr><td>Prim. Motor</td><td colspan="4"></td><td>Prim. Motor</td><td colspan="4"></td></tr>
<tr><td>Devices</td><td colspan="4"></td><td>Devices</td><td colspan="4"></td></tr>
</table>

2. Create a new task by projecting from the comparable task description to the new task. Complete each element of the task description as follows:

- Task Number - Ten-character code in the form XXX-XXX-XXXX

  New task numbers are created in the following manner:

  (1) The first three numbers identify the proponent school for the task as found in TRADOC Reg 351-11.

  (2) The next three characters indicate the MOS that will be assigned the task, e.g., 31E.

  (3) The last four-digit numeric code contains the skill level in the first position and the remaining three positions allow a maximum of 999 tasks per skill level.

- Skill Level - Typically not changed from the comparable task

- MOS/ASI - The MOS/ASI going to perform the task

- Task Description - Change the description to reflect the new system and its equipment

- Duty Position - May be added now or later when all of the BCS tasks are completed

- Training Responsibility - Location of qualification and additional training responsibilities for the task. Enter "Q" for qualification and "A" for additional training. Each letter may be entered more than once.

- Primary Training Materials - Typically not changed from the comparable task
- Training Devices - Typically not changed from the comparable task

3. Repeat the preceding steps for any Proposed System tasks which are not added to the BCS.

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Establish BCS Tasks

Objectives

In this substep, applicable Predecessor System tasks and new tasks developed from existing equipment found in the Baseline Comparison System are combined into a BCS task list. The descriptions of each of the BCS tasks are completed and the BCS duty positions and equipment are added.

Input

Input from other HARDMAN steps includes the applicable Predecessor System tasks evaluated in Substep 3.2, the new BCS tasks developed in Substep 3.3, the BCS equipment descriptions and numbers from Substep 1.6, and duty positions identified in Substep 2.2. No other sources developed outside of HARDMAN are used.

Product

Completed BCS tasks are produced by this substep. An example of a completed BCS task is shown in Table 3.4-3.

Logic

As shown in Figure 3.4-1, only one step is required to complete the BCS tasks. Acceptable Predecessor System tasks and other new tasks are combined to create a comprehensive set of BCS tasks. The descriptions of each task is updated as needed and BCS duty positions and equipment are added.

Action Step Requirements

The analyst gathers the Predecessor System tasks which were designated in Substep 3.2 for the BCS and the new tasks developed in Substep 3.3. A a comprehensive set of BCS tasks is then compiled. The task descriptions are completed and updated with BCS-specific

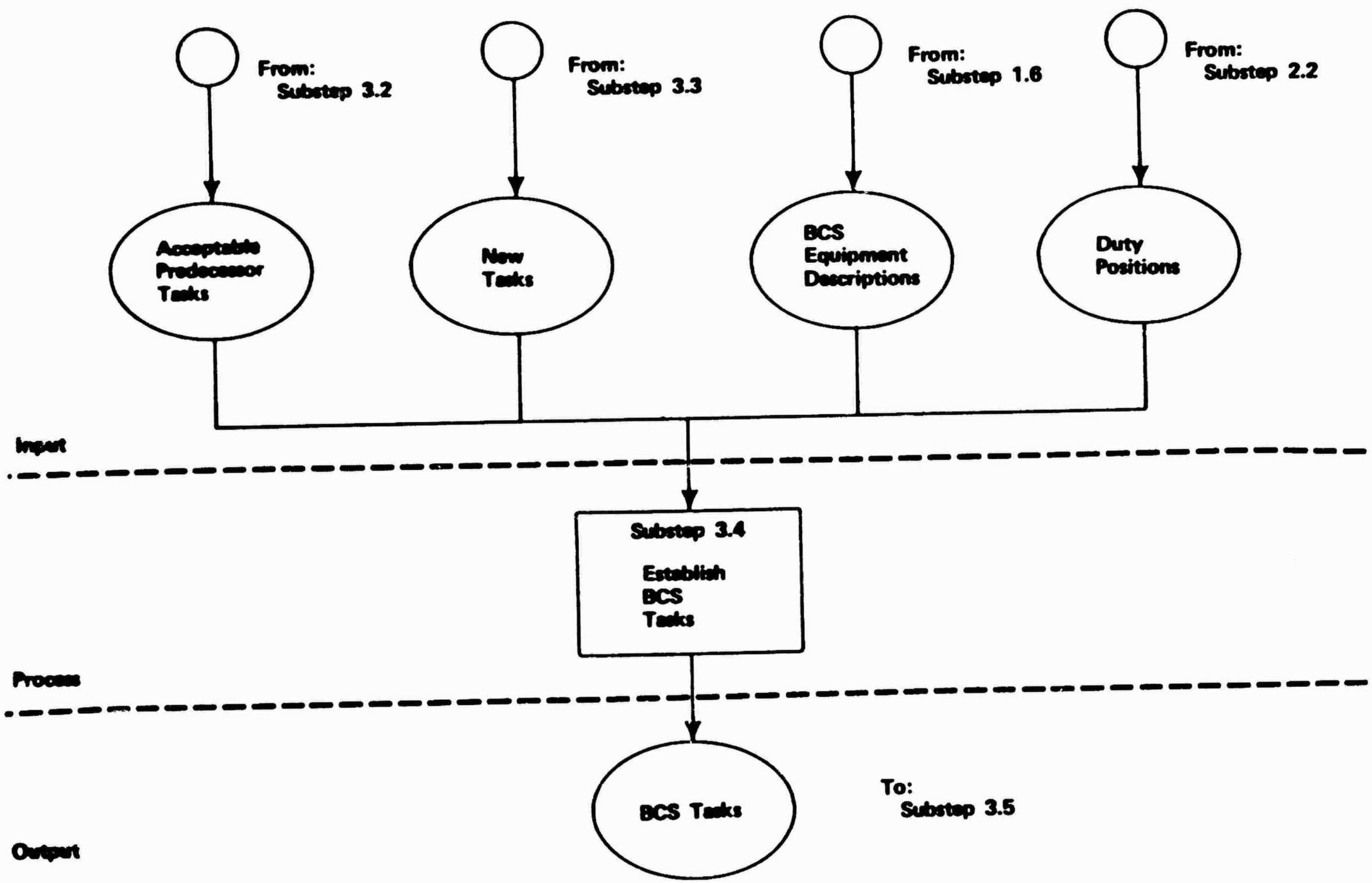

Figure 3.4-1. Logic flow for Establish BCS Tasks.

equipment descriptions, task numbers, equipment numbers, and duty positions.

Objective

The objective of this action step is to develop a complete set of BCS tasks.

Procedures

To achieve this objective, the analyst carries out the following procedures:

1. Complete the BCS task list by entering all of the acceptable Predecessor System tasks from Substep 3.2 and all of the new BCS tasks developed in Substep 3.3 to Table 3.4-1, BCS Task List. Using the existing task information, complete all of the elements in this table except for the duty position and the equipment numbers. Leave these two elements blank.

Tasks generated from Substep 3.3 can be entered in the table without alteration. However, Predecessor System tasks evaluated in Substep 3.2 may need to have elements changed if certain modification codes were indicated. Use the codes in Table 3.4-2 to identify the task elements that may require changes.

Table 3.4-2. BCS Task Element Changes by Modification Code

Modification Code	Task Element
MIN	Task Description
MAJ	Task Number* Task Description

*see Substep 3.3 for a description of how to create new task numbers

Table 3.4-1. BCS Task List: Blank

MOS/ASI:

Task Number				**Skill Level**	
Task Des					
Duty Pos					
Equip. No.					
Training	**Responsibility** **AIT/CSUT**	**BCT** **AIT/OSUT** **PLDC**	**Institution** **PIC:PNCOC** **BIC/BNCOC** **ANCOC**	**SNCOC** **SGMA** **SVC School**	**Unit** **SOJT** **Self Study** **SCHDLD TNG**
	Prim. Mater				
	Devices				

Make no changes as a result of using the remaining modification codes.

2. Obtain the BCS equipment lists and identify which BCS equipment is associated with the tasks. Add one or more of the BCS equipment identification codes to the equipment number part of Table 3.4-1.

3. Using this task list, reconcile the identification and assignment of duty positions to the BCS. The reconciliation process includes, as a minimum, the manpower analyst and involves a comparison of workload tasks to training tasks. This process occurs as a part of the refinement of MOS/Grade assignments and is described in Substep 2.2.

Based on the results of this reconciliation, identify one or more duty positions for each task and enter it in Table 3.4-1. If the skill level of the duty position does not coincide with the skill level of a task, do not change the task's skill level. This information can be used later to study the complexity and span of control of the duty positions.

Example

The BCS new tasks are obtained from Substep 3.3. All the elements of Table 3.4-1, BCS Task List, are completed except for the duty position and the equipment number. The BCS equipment list is obtained from Substep 1.6 and the appropriate equipment number(s) is added.

Collectively, the BCS tasks are compared to the workload tasks developed by the Manpower analyst. Differences are reconciled and duty positions are identified. The duty positions are added to each task on BCS Task List. An example of a completed BCS task is shown in Table 3.4-3.

Table 3.4-3. BCS Task List: Example

MOS/ASI: 13E

Task Number	113-13E-1002		Skill Level	1
Task Des	Prepare for Operation & Operate SINCGARS ECCM Unit			
Duty Pos	Fire Direction Specialist Radio Telephone Operator			
Equip. No.	GA880904			
Training	Responsibility AIT/OSUT Q	Institution BCT AIT/OSUT Q PLDC	PIC:PNCOC BIC/BNCOC ANCOC	SNCOC SGMA SVC School
				Unit SOJT A Self Study A SCHDLD TNG A
	Prim. Mater	Technical Manual, TEC Lesson		
	Devices	None		

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Evaluate BCS Tasks

Objective

The purpose of this substep is to evaluate each of the BCS tasks relative to the design of the new system. This evaluation is accomplished using a systematic set of modification codes that results in the inclusion, further evaluation, or deletion of the BCS tasks.

Input

Input from other HARDMAN steps includes the training data source indexes from Substep 3.1, the BCS tasks developed in Substep 3.4, the BCS and Proposed System equipment descriptions from Substep 1.6 and 1.7, and the design differences from Substep 1.8.

Other required sources include descriptive information about the BCS tasks. Most of this information is found in trainer's guides and soldier's manuals, but, at times, more detailed task information is required from technical manuals, field manuals, and programs of instruction.

Products

The results of this substep include BCS tasks that are acceptable for inclusion in the Proposed System(s) task list. Table 3.5-1 shows an example of the BCS task description and evaluations for these different Proposed Systems.

Logic

As shown in Figure 3.5-1, one step is required to evaluate the BCS tasks. Each of the BCS tasks developed in Substep 3.4 is evaluated in this substep. This evaluation documents what impact each Proposed System design has on the BCS tasks. A comprehensive set of modification/deletion codes is used

Table 3.5-1. BCS Task Evaluation Worksheet: Example

MOS/ASI: 13E

Baseline Comparison System					
Task Number	113-13E-1002	Skill Level	1		
Task Des	Prepare for Operation & Operate SINCGARS ECCM Unit				
Duty Pos	Fire Direction Specialist Radio Telephone Operator				
Training	Responsibility	Institution: BCT AIT/OSUT Q PLDC	PIC/PNCOC BIC/BNCOC ANCOC	SNCOC SGMA SVC School	Unit: SOJT A Self-Study A SCHDLD TNG A
	Prim. Mater	Technical Manual, TEC Lesson			
	Devices	None			

Equipment Number		
GA680904		
Proposed System	Task Modification Code	Task Deletion Code
1	NC	
2		
3		

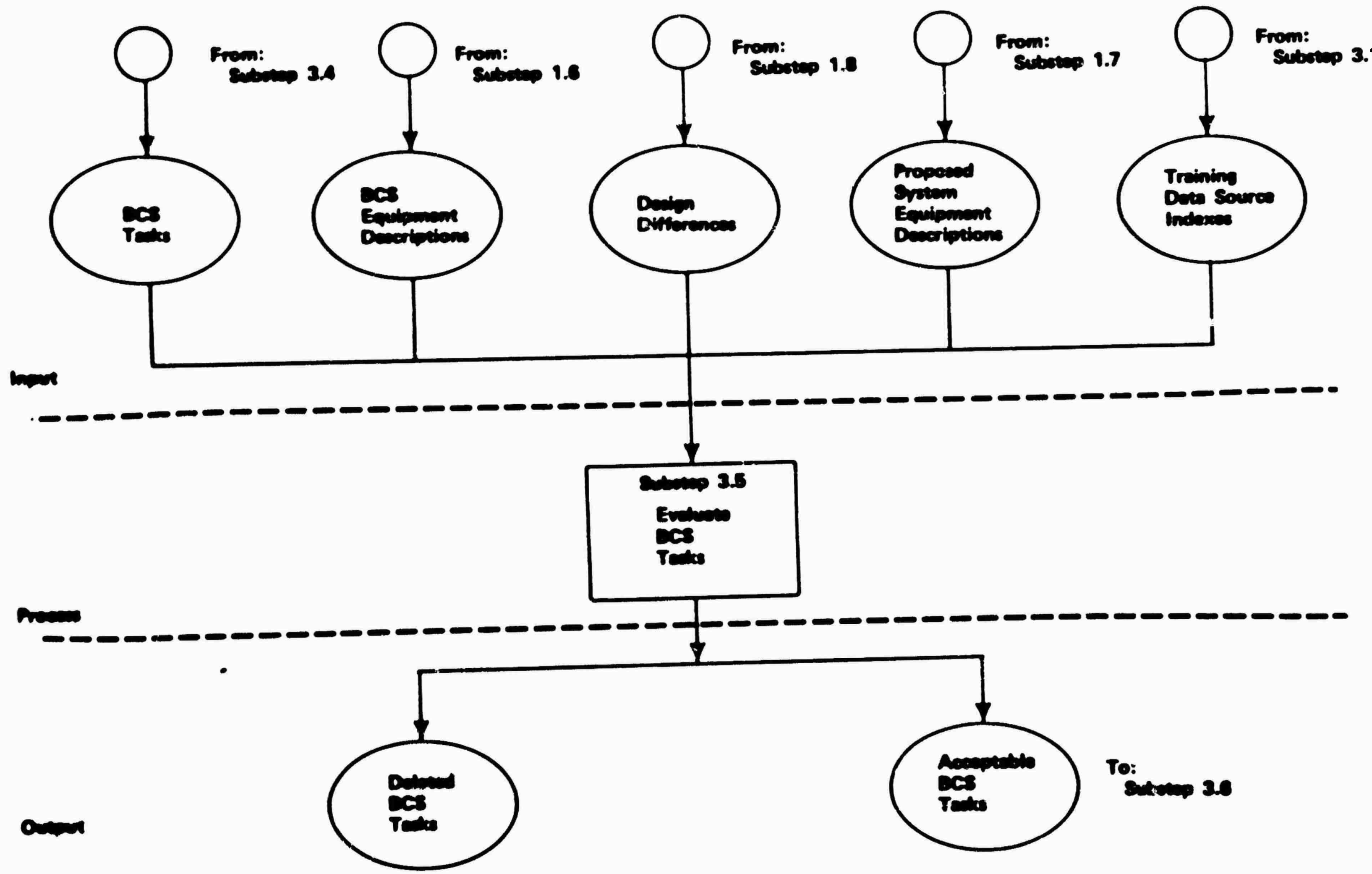

Figure 3.5-1. Logic flow for Evaluate BCS Tasks.

to indicate these impacts. Acceptable tasks are added to the Proposed System task list in Substep 3.6.

Action Step

Requirements

The analyst studies the operator and maintainer requirements of each Proposed System and evaluates the impact of these requirements on each of the BCS tasks. In making this evaluation, the analyst uses whatever sources are available that describe the performance requirements of both the BCS task and the Proposed System task.

These sources include the mission events and generic tasks found on the training data source indexes, and appropriate Trainer's Guides, Soldier's Manuals, technical manuals, field manuals, programs of instruction and subject matter experts at the proponent school.

Objective

The objective of this step is to evaluate the design impacts of the Proposed System(s) on each BCS task and determine if it is appropriate for inclusion in the Proposed System task list.

Procedure

The analyst obtains the BCS tasks developed in Substep 3.4. Each task is evaluated relative to the design impacts of the Proposed System(s). The task evaluation codes in Table 3.5-2 designate this assessment. Use of any task modification code indicates that the task is to be added to the Proposed System's task list.

Table 3.5-2. Task Modification Code

Code	Type of Modification
NC	No change in task.
MIN	Minor task modification — Task essentially the same. Only minor change in equipment/procedure required.
SKI	Skill level change — Task essentially the same but assigned to different skill level.
FRE	Frequency change — Same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ	Major task modification — Significant change in skills and knowledge and/or other task characteristics.

Tasks designated with the FRE task modification code can be qualified further as to the reason for the frequency change by using an additional code. These codes are listed in Table 3.5-3.

Table 3.5-3. Frequency Modification Codes

Code	Type of Modification
R	Change in Reliability
M —	Change in Maintenance Concept/Doctrine
O —	Change in Operational Concept/Doctrine
D —	Degraded Operational Mode

The additional code is added to the FRE code and is separated by a dash. For example, a frequency change due to change in reliability is indicated by the code FRE-R.

Tasks designated with the MAJ task modification code can be further qualified by an additional code. These codes are listed in Table 3.5-4.

Table 3.5-4. Major Modification Codes

Code	Type of Modification
D	Change in Design
A	Automation
O	Change in Operational Concept/Doctrine
M	Change in Maintenance Concept/Doctrine

The deletions listed in Table 3.5-5 can be indicated by entering the appropriate code.

Table 3.5-5. Task Deletion Codes

Code	Reason for Deletion
ELI	Elimination of subsystem
AUT	Task automation - task now performed by equipment
RTF	Reduced task frequency
MC	Change in maintenance concept/doctrine
OC	Change in operational concept/doctrine
SUB	Substitution of subsystem

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Establish Proposed System Tasks

Objective

In this substep, applicable BCS tasks and additional new tasks are combined into a Proposed System task list. A description of each Proposed System tasks is completed, and Proposed System duty positions, equipment, training materials, and training devices are added.

Input

Input from other HARDMAN steps includes the applicable BCS tasks evaluated in Substep 3.5, the new Proposed System tasks developed in Substep 3.3, the Proposed System equipment descriptions and numbers from Substep 1.7, and the duty positions identified in Substep 2.2. Input from other sources includes those portions of the Proposed System training concept that describe the training products and training devices to be developed.

Product

This substep produces a comprehensive set of Proposed System tasks. An example of a completed Proposed System task is shown in Table 3.6-1.

Logic

As shown in Figure 3.6-1, only one step is required to complete the Proposed System tasks. Acceptable BCS tasks and other new tasks are combined to create a complete set of Proposed System tasks. The description of each task is updated as needed, and Proposed System duty positions, equipment, and training materials are added.

Action Step Requirements

The analyst gathers the BCS tasks evaluated in Substep 3.5 as appropriate for the Proposed System and the new

Table 3.6-1. *Proposed System Task List: Example*

MOS/ASI: 13E

Task Number		113-13E-1002		Skill Level	1
Task Des	Prepare for Operation & Operate SINCGARS ECCM Unit				
Duty Pos	Fire Direction Specialist Radio Telephone Operator				
Equip. No.	GA680904				
Training	Responsibility AIT/OSUT Q	BCT AIT/OSUT Q PLDC	Institution PIC:PNCOC BIC/BNCOC ANCOC	SNCOC SGMA SVC School	Unit SOJT A Self Study A SCHDLD TNG A
	Prim. Mater	Technical Manual, TEC Lesson			
	Devices	None			

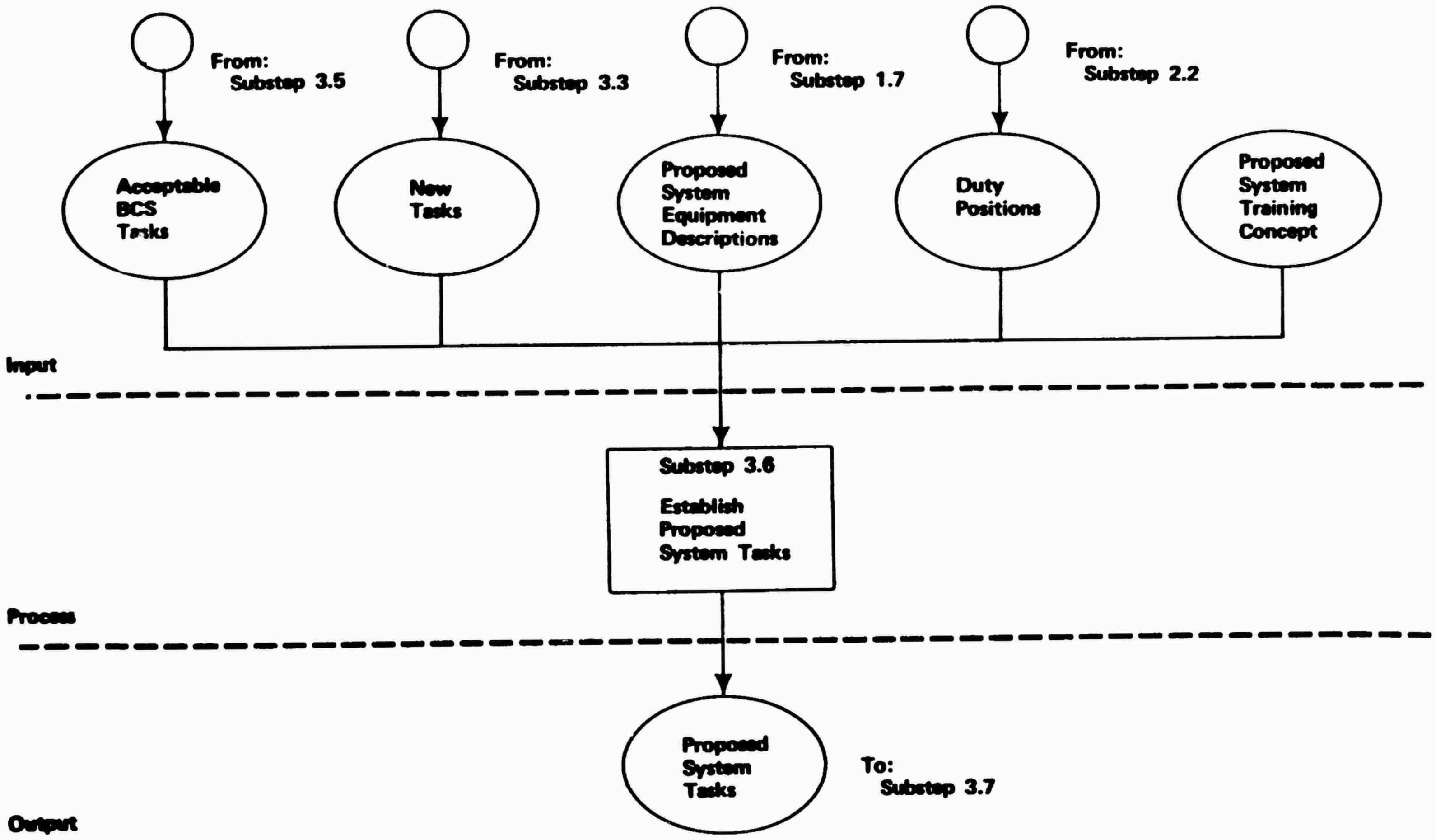

Figure 3.6-1. Logic flow for Establish Proposed Tasks.

tasks developed for the Proposed System in Substep 3.3. An integrated set of Proposed System tasks is then compiled. The task descriptions are completed and updated with Proposed System equipment descriptions, task numbers, equipment numbers, duty positions, training products and training devices.

Objective

The objective of this step is to compile a comprehensive set of Proposed System tasks based on tasks generated in other substeps.

Procedures

To achieve this objective, the analyst carries out the following procedures:

1. Compile the Proposed System task list by entering all of the acceptable BCS tasks from Substep 3.5 and all of the new BCS tasks developed in Substep 3.3 to Table 3.6-2, Proposed System Task List. Using these tasks, fill in all of the elements on this table except duty position, equipment number, primary training materials, and training devices. Leave these elements blank. Tasks generated in Substep 3.3 can be entered in the table without alteration. However, BCS tasks evaluated in Substep 3.5 may need to have elements changed if certain modification codes were indicated. Use Table 3.6-3 to identify task elements which may require changes.

Table 3.6-2. Proposed System Task List: Blank

MOS/ASI:

Task Number				**Skill Level**	
Task Des					
Duty Pos					
Equip. No.					
Training	**Responsibility** AIT/OSUT	BCT AIT/OSUT PLDC	Institution PIC:PNCOC BIC/BNCOC ANCOC	SNCOC SGMA SVC School	Unit SOJT Self Study SCHDLD TNG
	Prim. Mater				
	Devices				

Table 3.6-3. Proposed System Task Element Changes by Modification Code

Modification Code	Task Element
MIN	Task Description
SKI	Skill Level
MAJ	Task Number* Task Description

*see Substep 3.3 for a description of how to create new task numbers

Make no changes as a result of using the remaining modification codes.

2 Obtain the Proposed System equipment lists and identify which equipment is associated with the tasks. Add one or more of the Proposed System equipment identification codes to the equipment number part of Table 3.6-2.

3. Use the duty positions identified in Substep 3.4. If none has been identified, identify duty positions in accordance with Substep 2.2. Once duty positions are identified, assign a duty position(s) for each task and enter it on Table 3.6-2. If the skill level of the duty position does not coincide with the skill level of a task, do not change the task's skill level.

4. Consult sources which describe the proposed training concept for the new system. Identify in these sources any training devices and training products to be developed as a part of the system. The best source for this information is

the Individual and Collective Training Plan (ICTP). Training Device Requirements (TDRs) and Training Device Letter Requirements (TDLRs) identify training devices, and, if properly written, identify "tasks" to be trained on the device.

From analysis of these documents and from any further information obtained from the TSM or combat developer, assign the proposed training devices and training products to the tasks on Table 3.6-2. Do not assign the candidate training devices identified in Substep 3.16 (Identify Other Training Resources).

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Assign Tasks to Training

Objective

The purpose of this substep is to produce a final list of Proposed System tasks which have been selected for training. The comparable tasks identified from trainer's guides and soldier's manuals are assumed, in the initial HARDMAN application, to be selected for training. Additional selection models can be applied as a part of Tradeoff Analysis (Step 6).

Input

The Proposed System tasks developed in Substep 3.6 constitute the only HARDMAN input to this substep. Training assignments criteria and models from selected TRADOC schools or a model described in TRADOC Pam 351-4 are input from sources outside of HARDMAN.

Product

This substep produces a final list of Proposed System tasks which have been selected for training.

Logic

Figure 3.7-1 depicts the logic flow for this substep. During the initial application of the HARDMAN training analysis, it is assumed that all tasks identified have been assigned to training. The assumption is made because most of these tasks will have been taken from Army trainer's guides and soldier's manuals. All tasks, by their inclusion in these resources, have been determined by their proponent school to be "critical" tasks and, hence, require training.

Inasmuch as no readily available training assignment data or universally applied model for making train/no train decisions exist, it is impossible to determine what impact the new system has

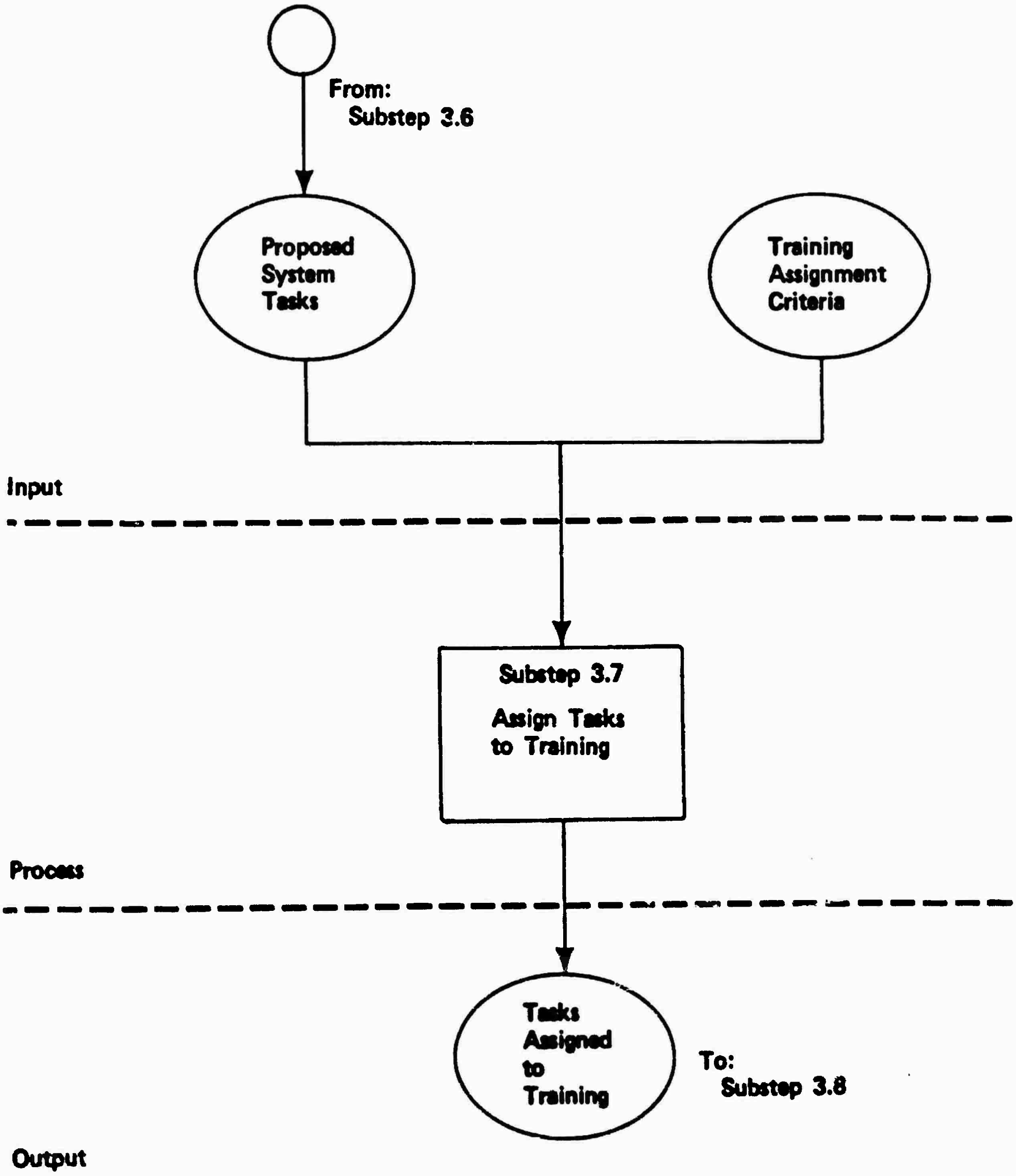

Figure 3.7-1. Assignment of Tasks to Training Logic.

on these original training decisions. Therefore, these original decisions are used without alteration.

However, a number of different methods exists for making these decisions. These methods are used throughout the TRADOC school system and are described in TRADOC Pam 351-4 (Job and Task Analysis Handbook). For more refined analyses of the assignment of tasks to training, application of one of these models is recommended as part of Step 6 (Tradeoff Analysis).

Action Step

Requirements

Requirements are placed upon the analyst only when a training selection model is to be employed as a part of Tradeoff Analysis. When this occurs, the analyst participates in the selection of the model, gathers the data required by the model, and applies it to the Proposed System tasks.

Objective

The purpose of this step is to examine all tasks and ascertain that they are appropriate for training.

Procedures

The procedures employed in this substep are specific to the training selection model and criteria chosen and, thus, cannot be fully described here. However, each procedure contained in TRADOC Pam 351-4 (Job and Task Analysis Handbook) is briefly summarized below. Most TRADOC schools employ one of these procedures or a derivative of one.

- **Eight-Factor Model.** This model, contained in TRADOC Pam 350-30 (Interservices Procedures for Instructional System Development), is the most data-intensive of all the models. As such, it requires a large data collection and analysis effort. Accordingly, if used, it is best employed late in the acquisition process. The factors used in the model are:

—Percent performing
—Percent time spent performing
—Consequences of inadequate performance
—Task delay tolerance
—Frequency of performance
—Task learning difficulty
—Probability of deficient performance
—Immediacy of performance

- **Four-Factor Model.** This model incorporates four factors from the previous model:

—Percent performing
—Consequence of inadequate performance
—Task delay tolerance
—Task learning difficulty

It requires less data collection and analysis but still involves a great deal of time to administer.

- **Training Emphasis Scale.** This model combines several factors into a simple, one-factor rating scale. This scale requires the supervisor to estimate whether a task requires training. The supervisor's determination is based on evaluation of the task's importance to the MOS.

- **Comprehensive Occupational Data Analysis Program (CODAP).** Traditionally, the Army Occupational Survey Program has produced a rank ordering of tasks depending on the prioritization scheme established by the CODAP. CODAP data prepared by task rank order are based on (1) percentage of soldiers performing the tasks and (2) the scale of relative time spent. These data indicate tasks which require an extensive amount of time on the job in terms of actual performance.

- **Difficulty, Importance, and Frequency (DIF) Model.** In this model, the supervisor and incumbent are asked three questions about each task:

  (1) What is the difficulty of this task in terms of learning and performance?

  (2) What is the relative importance of this task?

  (3) How frequently is this task performed?

The sophistication and sensitivity of this technique can be increased by incorporating degrees of difficulty, importance, and frequency (DIF). Use of more detailed levels of training also makes this technique more robust.

- **Wartime/Peacetime Model.** This model resolves some of the inadequacies of the other models in terms of isolating tasks to be performed in combat. This model simply proposes that a training decision maker must know what tasks are performed in combat, since many of these tasks will never be performed in peacetime. The grouping of wartime and peacetime tasks is prepared by a committee of senior officers and noncommissioned officers familiar with the MOS, combat, and future threat.

Each of the above models is summarized in Table 3.7-1. This table is taken verbatim from TRADOC Pam 351-4 (Job and Task Analysis Handbook).

Table 3.7-1. Task Selection Models

Model	Advantages	Disadvantages	Major Attributes
8-Factor	Very comprehensive	Data collection - difficult; Data analysis - difficult; Weighting of factors - awkward, time-consuming	Extensive data collection; data useful in design
4-Factor	Fairly comprehensive	Data collection - difficult; Data analysis - difficult; Weighting of factors - awkward, time-consuming	More manageable than 8-factor model
Training Emphasis Scale	1-factor rating scale, combines several factors; high correlation with 4-factor model; well-received by the field; administered to supervisors, small sample (40)	Data not collected from incumbents	Single-factor; ease of administration; simple rank ordering
CODAP (time spent)	Rank orders tasks on O/P time performing; conducted by ADSP; large sample; surveys MOS additional data available	Prioritizes tasks on one factor (percent performing)	Surveys MOS (whole Army); simple rank ordering
DIF	3 straightforward factors; ease of administration; small sample (40); acceptable analysis of data - simple; uses input from supervisors and incumbents; degree of complexity - adjustable	Crude instrument with Gross Task Selection Recommendation	Simple rank ordering (by category); little time required
Wartime/ Peacetime	Isolates combat and peacetime tasks; data easily obtained	Ignores other relevant job analysis data	Keys on combat tasks

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Assign Tasks to Training Settings

Objective

In this substep, the initial training setting assignment determined through comparability analysis is verified, and final training setting decisions are made. Through this substep, it is possible to apply specific training setting models as a part of Tradeoff Analysis.

Input

The Proposed System tasks selected for training in Substep 3.7 are the only HARDMAN data needed for this substep. Training setting selection criteria and models from selected TRADOC schools or a model described in TRADOC Pam 351-4 are other possible input.

Products

This substep produces a final list of Proposed System tasks which have been assigned to training settings. An example of this list is shown in Table 3.8-1.

Table 3.8-1. Sample List of Training Settings by MOS/ASI, Skill Level, Task Number and Title

Training Setting: Advanced Individual Training, One-Station Unit Training

MOS/ASI	Skill Level	Duty Position	Task Number	Task Description
13T	10	Mission Payload Operator	061-266-1700	Take radio set AN/PRC-68 out of operation
13T	10	Mission Payload Operator	061-266-1701	Establish and maintain communications with FDC
13T	20	Launch Recovery Team Chief	061-180-2001	Inspect launch and recover vehicle emplacement
13T	20	Launch Recovery Team Chief	071-328-5302	Supervise maintenance on individual and TOE equipment

Training Setting: Basic Technical Course

MOS/ASI	Skill Level	Duty Position	Task Number	Task Description
13T	30	Section Chief	061-273-1003	Initialize the DMD AN/PSG-2A
13T	30	Section Chief	061-410-3013	Plan mission waypoints/flight maneuvers

Logic

Figure 3.8-1 depicts the logic flow for Assign Tasks to Training Settings. During the initial application of the HARDMAN training analysis, the training settings identified in the existing comparable tasks are assumed to be

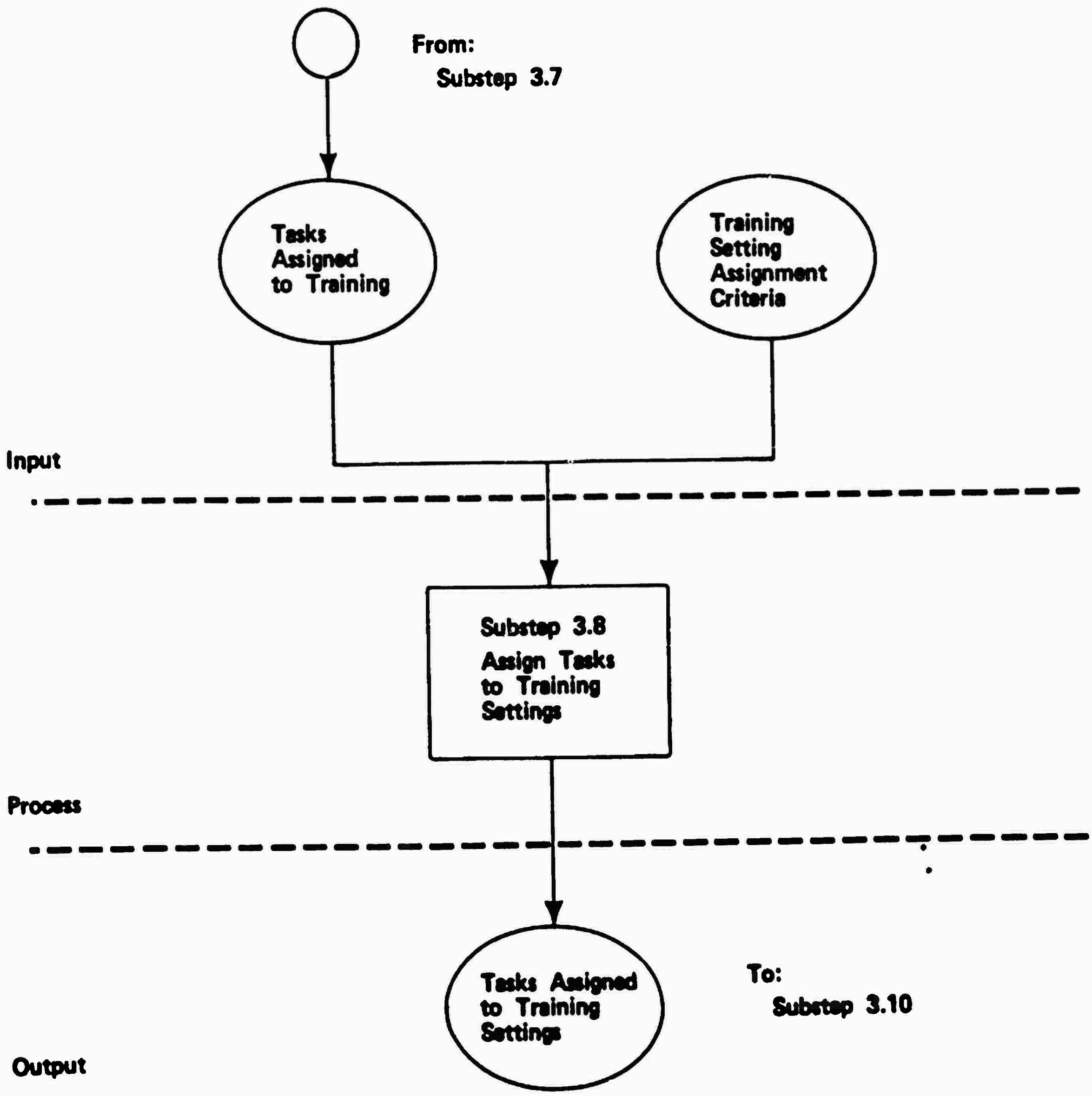

Figure 3.8-1. Logic flow for Assign Tasks to Training Setting.

appropriate for the new tasks. In this step, the Proposed System tasks are listed under each training setting by MOS/ASI, skill level, and duty position.

Objective

The purpose of this list is to identify any discrepancies between the training setting assignments and the skill level and duty position assignments. The sorting is also done to determine whether sufficient need exists for conducting courses of requirements.

Changes in the task assignment to training settings are made as part of Step 6 (Tradeoff Analysis). There, specific new assignments can be made based on duty positions, or a specific training setting selection model can be employed. Many TRADOC schools have their own model, or the analyst can use one described in TRADOC Pam 351-4 (Job and Task Analysis Handbook).

Action Step

Requirements

The analyst is required to list all Proposed System tasks sorted by training setting. Also included in this list are the MOS/ASI, skill level, and duty position. An additional requirement to perform a training setting selection analysis may be needed as part of Tradeoff Analysis.

Objective

The purpose of this action step is to sort all tasks by training setting, MOS/ASI, skill level, and duty position in order to evaluate the requirement for

Procedures

The analyst obtains the Proposed System tasks assigned to training in Substep 3.7. All tasks are sorted by training setting. Tasks within each training setting are sorted by MOS/ASI, skill level, and duty position.

Ideally, all tasks listed under each training setting should cluster under the same MOS/ASI, skill level, and duty position. If this does not occur, the discrepancies should be further analyzed to determine their origin.

However, of primary concern in this substep are the number and characteristics of tasks that occur under each training setting. The number of tasks that appear may or may not provide sufficient justification for conducting a course of instruction. This information should be input to Substep 3.9 (Identify Existing Courses of Instruction) for comparison to existing courses of instruction. A decision is then made on whether to have a course for the MOS at that skill level.

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Substep Group 3B

Course Requirements Analysis

Overview

The need to train soldiers in system operation and maintenance typically constitutes the largest training resource requirement for a weapon system. This requirement is especially high for courses of instruction conducted in formal school settings. Differences in the number of course requirements and in their overall length of instruction provide one means of assessing the overall differences in alternative system designs and provide a means of measuring the impact on the Army's training resources.

During this phase, existing and new courses of instruction are identified for each system alternative. Each existing course is evaluated to determine the impact of system design. New courses of instruction are then created. Quasi-programs of instruction are developed to capture the essential characteristics and resource requirements of each system's courses of instruction.

When a detailed TRRA is conducted, the tasks developed in Task Comparability Analysis (Substep Group 3A) are a means for conducting this course evaluation. These tasks are then recorded as part of the quasi-POI.

The results of this substep group are input to Substep Group 3C (Training Cost and Resources Determination). There, aggregated types of instruction, hours of instruction, and numbers of groups are used to calculate training course cost, instructor requirements, and training course man-days requirements.

Logic

Figure 3B-1 provides an overview of the logic used to identify and develop courses of instruction. This figure shows the major input, processes, and output required for this substep group. Included as input to this group are (1) data elements generated in other HARDMAN substeps and (2) other required information obtained from training sources and descriptions of the new system.

Sections that follow will describe the two substeps contained in this group:

3.9 Identify Courses of Instruction

3.10 Evaluate Courses of Instruction

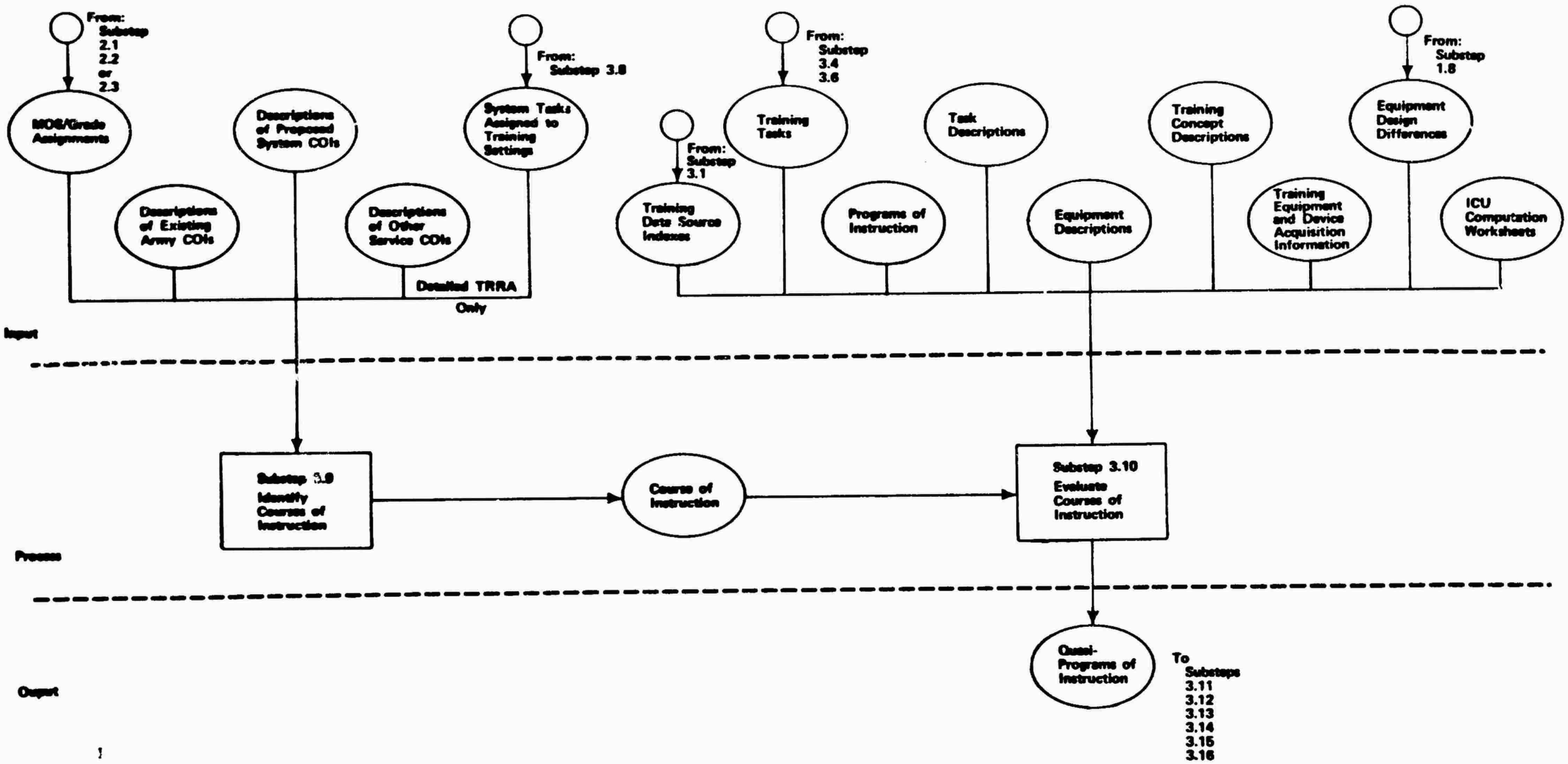

Figure 3B-1. Logic flow for Course Requirements Analysis.

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Identify Courses of Instruction

Objectives

In this substep, existing and new courses of instruction which will be required by the various system alternatives are identified and documented. Identification of these courses facilitates early data gathering and provides a means for assessing the amount and scope of the course analysis required. It also provides a focus for the course evaluations conducted in Step 3.10 (Evaluate Courses of Instruction.)

Input

Input from HARDMAN substeps includes the MOS/Grade assignments from Substeps 2.1, 2.2, or 2.3 plus each system's tasks assigned to training settings from Substep 3.8. The input of tasks assigned to training settings is available only when a detailed TRRA is conducted. Other input includes descriptions of: existing Army courses of instruction, courses conducted by other military services, and Proposed System course requirements.

Products

This substep produces tables of courses of instruction for each system alternative. Each system's table includes the required MOSs/ASIs as well as existing and proposed formal school and training center courses required to support the MOS/ASI. Each course is listed under the skill level at which it is taught.

Table 3.9-1 displays a sample entry for one MOS/ASI. The scope of the study associated with this entry was limited to a maximum skill level of 3. When completed, this table should list all MOSs/ASIs in numerical order and their corresponding course numbers.

Table 3.9-1. Summary of System-Specific Courses by Skill Level

System: ___________

MOS/ASI	Skill Level 1	Skill Level 2	Skill Level 3	Skill Level 4	Skill Level 5
	Course Number	Course Number	Course Number	Course Number	Course Number
63H	611-63H10	None	611-63H30	—	—

Logic

Figure 3.9-1 represents the logic flow for identifying courses of instruction. Only one action step is required to complete this identification.

Once the MOSs have been identified for a system, existing courses of instruction can be identified. This substep needs to be accomplished early so programs of instruction and other training data can be requested in time for analysis in Substep 3.10 (Evaluate Courses of Instruction).

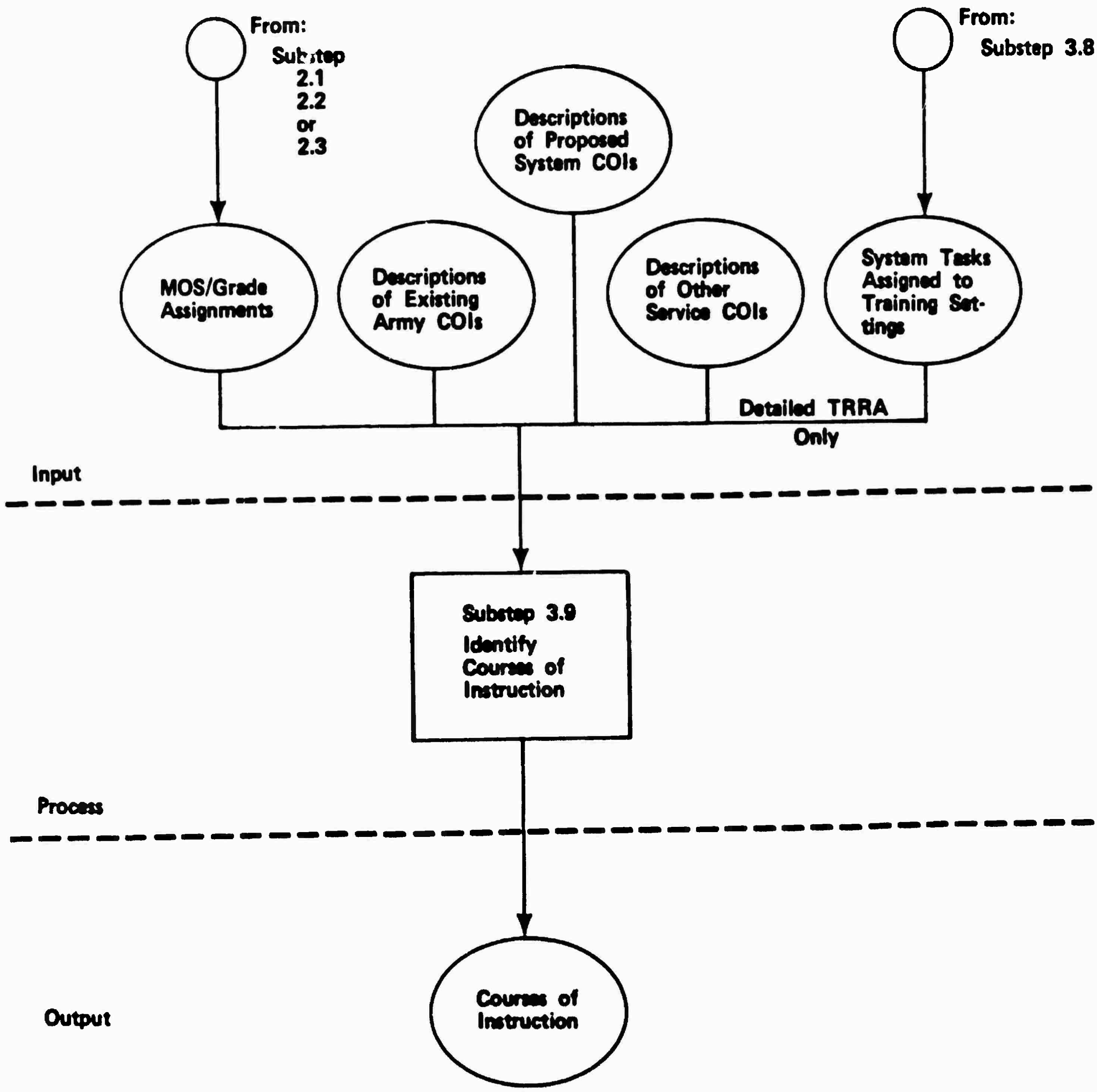


Figure 3.9-1. Logic flow for Identify Courses of Instruction.

However, at this point, the highest skill level required to operate and maintain the system's alternatives may not have been determined. This determination will not occur until the final MOS and paygrade decisions have been made in Substep 2.3 (Determine Final MOS/Grade Assignments), which is relatively late in a HARDMAN application.

Accordingly, it is recommended in this substep that existing courses of instruction be identified up to the maximum skill level requirement of the study. This way, programs of instruction and other training resource data can be requested and received in time for later analysis.

Only technical courses of instruction are identified in most cases. Common leadership and noncommissioned officer courses such as the Primary Leadership Development Course (PLDC) are not included. Only courses affected by the system's equipment design and operational capability should be included.

Besides existing courses, new course requirements (if any) need to be identified. In a general TRRA, new system training documents and personnel are tapped as sources for new course identification.

The detailed TRRA provides the opportunity to determine training settings on a task-by-task basis. Results of these assessments, in addition to the recommendations found in new system sources, provide a more detailed and accurate process for identifying new course requirements.

Regardless of which method is used to determine them, new courses identified for each system alternative need to be as similar as possible. This will permit equal comparisons between systems, as each additional course represents a sizable resource requirement. Step 6 (Tradeoff Analysis) can be applied later to evaluate other course alternatives.

Action Step

Requirements

The analyst identifies course requirements by using each system's MOSs to identify existing courses of instruction and by using new system sources to identify new courses of instruction. Tasks assigned to training settings in Substep 3.8 provide a more accurate assessment of the need for courses.

Objective

The objective of this action step is to identify all existing and new courses of instruction required to train operators and maintainers of each system alternative.

Procedures

To identify all required courses of instruction, the analyst carries out the following procedures:

1. Obtain the latest list of each configuration's MOSs/ASIs. Depending on when Substep 3.9 commences, this list may be obtained from Substep 2.1, 2.2, or 2.3. Preferably, this substep should begin shortly after the completion of Substep 2.1.

2. Determine each MOS's existing training course pipeline. Courses need to be identified up to the maximum skill level requirement of the study. Identify the courses by consulting one or more of the sources listed in Table 3.9-2.

The sources are rank-ordered in terms of their currentness and usefulness in accomplishing this action step. Rating 1 indicates the most current and helpful source. When conflicts among sources occur, use the source with the highest rating.

Table 3.9-2. Course Sources

Rating 1	Directorate of Training and Doctrine (DOTD) at the MOS's proponent school
Rating 2	Army Training Requirements and Resources System (ATRRS)
Rating 3	DA Pam 351-9 EPMS Master Training Plan
	Military Occupational Training Cost Handbook (MOSB)
	AR 611-201 Enlisted Career Management Fields and Military Occupational Specialties

NOTE: Only Noncommissioned Officer Educational System (NCOES) courses and Additional Skill Identifier (ASI) courses are indicated.

Rating 4	DA Pam 351-4 (Formal Schools Catalog)

Record each system's course numbers (see Table 3.9-3). First, list each system's MOSs/ASIs in numeric order, then list the course numbers.

Table 3.9-3. System-Specific Courses by Skill Level

System: ____________

MOS/ASI	Skill Level 1 Course Number	Skill Level 2 Course Number	Skill Level 3 Course Number	Skill Level 4 Course Number	Skill Level 5 Course Number

3. For each existing course identified, obtain the latest program of instruction (POI). POIs are available from the Directorate of Training and Doctrine at the MOS's proponent school. Along with the POI, request TRADOC Form 377-R (ICH Computation Worksheet).

In obtaining programs of instruction for non-Army courses, it may be necessary to contact the other service's school directly. Use the following sources to obtain the description and location of each non-Army course.

- United States Air Force
  Air Force Manual (AFM) 50-5
  USAF Formal Schools Catalog

- United States Marine Corps
  Marine Corps Order (MCO) P1500.12K
  Marine Corps Formal Schools Catalog

- United States Navy
  NAVEDTRA 10500
  Catalog of Navy Training Courses
  (CANTRAC)

4. Identify new course requirements by consulting the following sources. When possible, consult the sources in the order listed.

   (1) Individual and Collective Training Plan (ICTP)

   (2) Qualitative and Quantitative Personnel Requirements Information (QQPRI)

   (3) TRADOC System Manager (TSM) or, if none has been appointed for the system, the Directorate of Combat Developments (DCD) at the proponent school

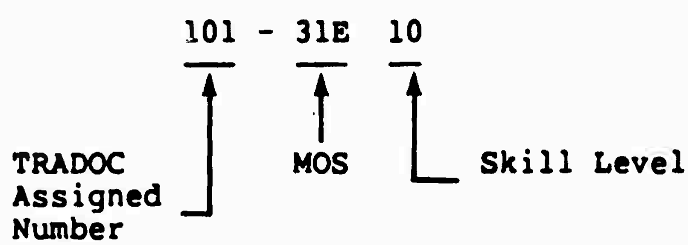
   (4) Project Manager (PM) for the weapon system

From these sources, locate the training strategy and determine if any new institutional course requirements have been identified. When new courses are identified, obtain a copy of each course's POI, if available, and add each course number to all system alternatives on Table 3.9-3.

Courses may not have been identified yet due to the system's recent entry into the materiel acquisition process. If that is the case, assume, as a minimum, that an intial entry training (IET) course at Skill Level 1 will be required for every new MOS. Do not add any other new courses of instruction.

If a detailed TRRA has been conducted and the results of Substep 3.8 (Assign Tasks to Training Settings) are available, contact the TSM or the DCD to reconcile any differences in the number and skill level of courses. Agree to one set of course pipelines to be used by all system alternatives. If desired, evaluate the different pipeline configurations by applying Step 6 (Tradeoff Analysis).

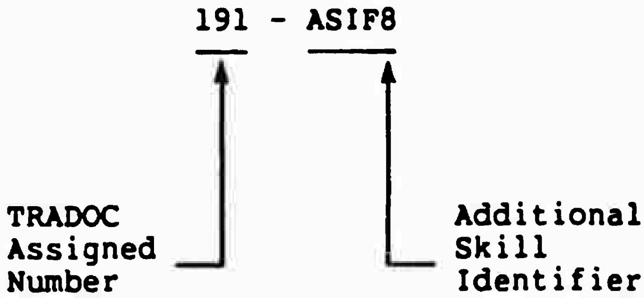
5. If new courses are required, follow the guidelines below to create new course numbers. Most enlisted courses of instruction are numbered in the following manner:



A new course number at Skill Level 1 might be represented as:

XXX-13T10

Enlisted courses of instruction leading to the award of an additional skill identifier are typically numbered as follows:



A new ASI course might be represented as:

XXX-ASIB6

Evaluate Courses of Instruction

Objectives

In this substep, quasi-programs of instruction (POI) are developed for each system alternative's courses identified in the previous substep. The purpose of these quasi-POIs is to evaluate the impact of system designs upon existing courses of instruction and to determine the requirements for new courses of instruction. The lengths of these courses and their hourly instructor requirements provide major input into the training cost and resources analysis that follows.

Input

Input from earlier HARDMAN substeps includes:

- the lists of courses identified for each system alternative in Substep 3.9
- the training data source indexes developed for assessing operator and maintainer training impacts in Substep 3.1
- the BCS and Proposed System's tasks determined in Substeps 3.4 and 3.6 (available during detailed TRRA only)
- the equipment design differences developed in Substep 1.8

Additional input to this substep includes:

- existing programs of instruction used for comparability purposes to develop new course modules
- descriptions of tasks and equipment
- the training concept for the new system

—acquisition information on equipment and training devices
—instructor contact hour (ICH) worksheets

Products

This substep produces quasi-programs of instruction which are used later for training resource determination. Part of a quasi-program of instruction is shown in Table 3.10-3.

Logic

The courses of instruction identified in Substep 3.9 provide the focus of the evaluations conducted in this substep. The impact of each system design is assessed by comparing the results of two previous substeps. The MOS/ASI summary produced in either Substeps 2.1, 2.2, or 2.3 is compared to the existing training identified in Substep 3.1.

Each system alternative's equipment is included in these two products. The equipment is a means for comparing operator or maintainer MOSs/ASIs to existing training for operation or maintenance of this same equipment. Discrepancies between these two sources result in further analysis. The analysis leads to the addition, modification, or deletion of modules of instruction. If a detailed TRRA was conducted, the in-depth results of that analysis provide a more accurate assessment of system design impacts.

For each module of instruction identified, key training resource elements are stated. These include the types of instruction, hours of instruction, and the number of groups per instruction type. These elements, when aggregated, provide essential input to the later calculations of training course costs, instructor, and man-days requirements.

Figure 3.10-1 shows the logic flow for evaluating courses of instruction. As is shown in the figure, only one action step is required.

Action Step

Requirements

The analyst evaluates the impact each system design has on courses identified in the previous substep. This evaluation requires a Course Modification Worksheet. The worksheet captures all essential course data required for training estimation and organizes the course modules into a coherent course of instruction.

Objective

The objective of this action step is to evaluate each course of instruction identified in Substep 3.9 and, if necessary, to construct a quasi-POI which reflects the design impacts of each system alternative.

Procedures

To achieve this objective, the analyst carries out the following procedures:

1. For each system alternative, obtain the list of course numbers (Table 3.9-1) identified in Substep 3.9 (Identify Courses of Instruction). Categorize each course of instruction in terms of operator or maintainer.

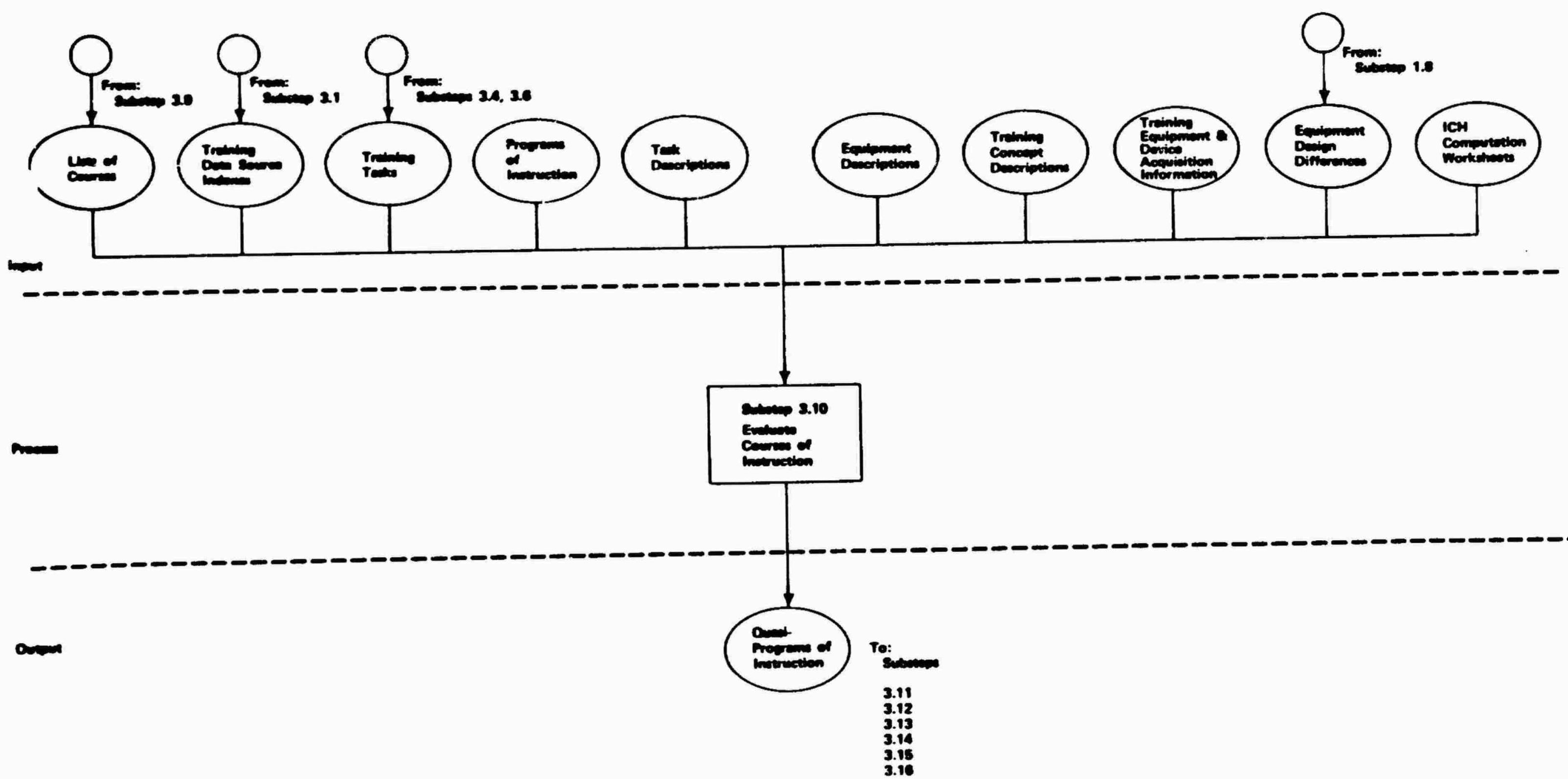


Figure 3.10-1. Logic flow for Evaluate Courses of Instruction.

2. For each course listed, determine whether the course is affected by the system's design. Review the MOS/ASI Summary by Equipment (Table 2.1-1) and determine to which equipment the course's MOSs/ASIs are assigned. Locate this equipment on the appropriate Training Data Source Index (see Table 3.1-1 for operator courses; Table 3.1-2 for maintainer courses).

For all equipment, compare the course number being studied to the POI number found under the heading "Source of Course Information." One of the following situations will apply. If the course being studied is a new course, only Situation 3 will apply.

Situation 1: The course number is the same.

Action: Retain this instruction in the course without modification.

Situation 2: The course number is different for the same MOS/ASI.

Action: No action required. Training for the MOS/ASI is being provided in a course at a higher or lower skill level.

Situation 3: The course number is different.

Action: If the course being studied exists, obtain copies of both programs of instruction. Compare the instruction referenced on the Training Data Source Index to the instruction contained in the program of instruction being studied. Determine whether the referenced instruction is already being taught. Descriptions of the instruction contained in the respective POIs may not be detailed enough to make a proper assessment. For greater clarity, consult one or more of the following sources:

- Soldier's manuals and other task documents which describe in detail the tasks being taught
- Technical manuals, field manuals, draft equipment publications, and other documents referenced in the course annexes and files which specify the operational and maintenance requirements of the equipment
- Course personnel at the school where the course is conducted

If comparable instruction is already contained in the course, do not add the instruction to the course. If it is not included, is only partially included, or is a new course, then new instruction will need to be developed.

Course Modification Worksheet. Table 3.10-1 (Course Modification Worksheet) is used to modify existing courses and to develop new courses of instruction. The worksheet is divided into two sections. The left section is used to record all of the existing course modules (annexes, files, etc.) in building a new course or modifying an existing one.

These existing course modules are obtained from either the existing course or from other courses from which additional instruction will be developed. Modules of instruction added on this portion of the worksheet are entered without any modification and become the basis on which to develop the new instruction.

Table 3.10-1. Course Modification Worksheet Course Number:

Weapon System: **Course Number:** **MOS/ASI:**

Existing Course Modules						New Course					
	Course Annex/File						Course Annex/File				
Task Number	Number	Description	Types of Instruction	Hours	Group	Task Number	Number	Description	Types of Instruction	Hours	Groups

The new or modified course is developed on the right side of Table 3.10-1. All existing and additional course modules are combined into a projected course which will meet the task and skill requirements of the MOS/ASI. Each section contains the same course information:

- —the task number
- —the course annex/file number and descriptive title
- —the types of instruction in the module
- —the number of instructional hours required by each type of instruction
- —the number of groups the class is divided into for each type of instruction

The organization and descriptive format of the modules of instruction added to this worksheet should follow that of the existing course. In the absence of an existing course, the format should follow guidance on POI formats found in TRADOC Reg 351-1 (Training Requirements Analysis System). The instruction added should be entered at the lowest level of detail found, typically, at the POI file level.

In developing new instruction, care should be taken to maintain the philosophy and instructional strategy found in the existing course or an existing comparable course. The existing course is most similar in content and is being taught at the school where the new course would be most likely to be taught. Accordingly, the types of instruction and number of groups found in the courses used for projecting additional instruction are generally changed to reflect the existing course.

Task Number. The first element of new instruction entered on Table 3.10-2 is the task number. Task numbers are available only if a detailed TRRA has been conducted. If no detailed TRRA has been conducted, leave this element blank and begin with the "New Modules Section."

For all tasks identified in Substep Group 3A (Task Comparability Analysis), list each system's tasks by MOS/ASI and skill level. This should be done for only those tasks which were assigned to an institutional training setting in Substep 3.8. For all of these tasks, list the course of instruction (identified in Substep 3.9) in which the task will be taught.

In Substep 3.10, these tasks and their assigned evaluation codes are used to assess the modules in which the tasks were taught. These tasks and their corresponding course modules were originally identified in Substep 2.1 (Identify Existing Training). Each task was evaluated in the task comparability analysis phase, where the impacts of each system alternative were embedded.

Two major impacts on the tasks can occur as a result of the task comparability analysis: (1) tasks are deleted, and (2) tasks are modified. For deleted tasks, no further analysis of their corresponding course module is necessary. They are deleted from their course as well. Course modules for modified tasks should be added, along with their task numbers, to the course. Modifications (if needed) should be made to the hours of instruction or number of groups. These modifications are discussed in the following sections.

New Modules. The next element of the new instruction to be developed is the course/annex file number and description.

Modules are added to Table 3.10-1 at three levels of detail: (1) course, (2) annex, or (3) file. For purposes of describing the course modification process, the term "course module" will be used to refer to instruction at any of these three levels of detail.

The choice of the level of detail depends on (1) the extent of the impact of the new weapon system on an existing course and (2) whether an entirely new course must be built. Data should be input at the highest level possible, as a typical weapon system has many courses of instruction associated with it. Failure to screen course analysis requirements will result in documenting large quantities of unnecessary course information.

Course level is used when the new system design has no impact on the contents of an existing course. In other words, the course is required to instruct an operator or maintainer of the weapon system, but the existing contents of the course adequately meet the requirements of the new system. At this level, only summaries of the types of instruction, including number of hours and groups, are input. Task numbers and detailed course breakouts of annexes and files are not entered.

Annex level is used when the new system design has no impact on an existing annex of a course. At this level, descriptions of the annex and summaries of the types of instruction, including their number of hours and groups, are input. No task numbers are input for these annexes.

File level is used when (1) a new system has an impact on an existing annex of a course and also when (2) a new course must be built. At this level, descriptions of the file and detailed types of instruction, with their number of hours and groups, are input for each file. When a detailed task analysis has been conducted, task numbers are also input for each file.

Example

A certain maintenance course has five annexes: A, B, C, D, and E. Each annex pertains to a different weapon system for which the MOS has maintenance responsibility. The Predecessor System, found in Annex D, is affected by the new weapon system's design.

Course information would be entered at the annex level for annexes A, B, C, and E. Annex D would be entered at the detailed file level.

The training analyst will encounter differences in POI annex and file numbering conventions across the various TRADOC schools and training centers. Within any one proponent school, the numerical organization and descriptive formats employed are generally very consistent.

Therefore, the formats for documenting new instruction should parallel that of the existing course. In the absence of an existing course, the analyst should follow guidance on POI formats found in TRADOC Reg 351-1 (Training Requirements Analysis System) or the formats found in comparable courses of the new course's proponent school.

Example

A new module of instruction is to be added to the 101-31E10 course. The new module provides instruction on diode logic. The module is appropriate to the course's Annex B, which includes radio fundamentals. The Signal School, proponent for this course, numbers its files in the following format:

B01

Annex File Number

Twenty files in this annex are numbered from B01 to B20. The new module best fits after file B16, entitled "Radio Receivers." The new module is given the number "B17." If the existing files B17-B20 are not changed, they are increased by one to become B18-B21.

The narrative description of each instructional module and the nomenclature of equipment mentioned within this description are changed to reflect the new weapon system. This change should be made for both the BCS and the Proposed System courses so comparisons of the systems can be made easily at the file level.

Example

In the 101-31E10 course, the maintenance training for the AN/VRC-12 series radio is to be replaced by that of the new SINCGARS radio. The existing file title reads:

AN/VRC-12 Series Radio: Troubleshooting, Analysis, and Alignment

The new file title should read:

SINCGARS Series Radio: Troubleshooting, Analysis, and Alignment

NOTE: The SINCGARS radio has since been type-classified. If a type-classified nomenclature is available, it should be used.

Types of Instruction. Once the course modules have been developed, the type of instruction for each module is determined. Table 3.10-2 lists the types of instruction available for Army courses.

For new course modules that are added to existing courses, the types of instruction specified by the comparable course modules are altered only to bring them in line with the types of instruction found in the existing course. A module being added to an existing course in both the BCS and a Proposed System(s) is appended the same way to both.

Example

A new course module on diode logic is to be added to the 101-31E10 course. The comparable module was taken from the 041-34Y10 course. The types of instruction indicated for this module include:

PM
PE2
E3

The existing 101-31E10 course does not contain the types of instruction PM (printed materials) or PE2 (practical exercise: nonhardware-oriented). A review of the types of instruction included in the course reveals that programmed instruction (PI) is used. Further investigation shows that the PI is conveyed in printed text form. Accordingly, the type of instruction, PM, is changed to PI in both the BCS and Proposed System courses.

In evaluating PE2, both PE1 and PE3 are found to be used in the 101-31E10 course. A review of the 041-34Y10 POI shows only PE1 and PE2 being used. A further review of this course shows other nonhardware-oriented subject areas such as boolean algebra being taught with PE2, the more instructor-intensive type of instruction. Comparable modules in the 101-31E10 course are taught with PE3. As a result, PE2 is changed to PE3 in the BCS and Proposed System courses.

Table 3.10-2. Types of Instruction and Associated Instructor-to-Student Ratios

Symbol	Type of Instruction	I/S Ratio
C	Conference (or Lecture)	1:Class
CAI	Computer-Assisted Instruction	1:20
CS	Case Study	1:20
D	Demonstration	1:20
DF/SF	*Dual or Solo Flight (Aviator Courses Only)	—
E1	Hardware Performance Examination	1:6
E2	Nonhardware Performance Examination	1:6
E3	Written Examination	1:Class
EL	*Electives	1:Class
F	Film	1:Class
GS	Guest Speaker	1:Class
PE1	Practical Exercise: Hardware Oriented	1:6
PE2	Practical Exercise: Nonhardware Oriented	1:6
PE3	Practical Exercise: Classroom	1:20
PI	Programmed Instruction (Using Programmed Text)	1:20
S	Seminar	1:20
TV	Television	1:Class

*Typically not included in ICH computations

Self-paced (SP) and group-paced (GP) are indicated after the type of instruction symbol, e.g., CAI-SP

NOTE: TRADOC schools are not limited to the above types of instruction. An explanation for any type of instruction not specified in the regulation should be found in the course summary.

Source: TRADOC Reg 351-1, Training Requirements Analysis System (TRAS)

For course modules added to new courses, the types of instruction used in the course should reflect the proposed training concept for the new system. This training concept is found in the Individual and Collective Training Plan (ICTP) and, to a lesser degree, in the Operational and Organizational (O&O) Plan. Additional contact with the TSM or DCD may be required to determine additional details of the intended training concept. However, specific types of instruction to be employed are rarely identified outright by these sources.

Determining the number of systems to be acquired for use in institutional training will assist in gauging the amount of hands-on, hardware training to be conducted. This number also contributes to calculating the number of training devices to be acquired.

Training device requirement documents such as the Training Device Requirement (TDR) and the Training Device Letter Requirement (TDLR) should provide information about how and to what extent training devices are to be employed. Such information assists in determining how often hardware-oriented types of instruction such as practical exercise 1 (PE1) and performance examination (E1) will be used.

Another important source is the programs of instruction developed for operational test (OT) training, new equipment training (NET), and instructor and key personnel (IKP) training. However, care should be exercised in using the types of instruction found in these POIs.

These courses are developed and conducted for different reasons and for different target populations than the new courses being developed in the HARDMAN training analysis. As a result, their types of instruction may not be appropriate.

However, if the OT training course has been developed for testing the training subsystem of the weapon system, then the types of instruction indicated should be used for the new course. If no training concept or guidance of any form is available, then a comparable course from the proponent school should be identified and its types of instruction should be used.

Whenever a module from a non-Army course is incorporated, the training analyst must exercise special care in identifying types of instruction. Often, Navy courses of instruction provide only a breakout of "classroom" instruction versus "laboratory" instruction.

Classroom instruction should be equated to an Army type of instruction where the instructor-to-student ratio is 1:Class. Examples include conference, film, and demonstration. Laboratory instruction is translated to a type of instruction with an instructor-to-student ratio of 1:6. For example, Practical Exercises 1 and 2 have an instructor-to-student ratio of 1:6 (see Table 3.10-2).

It must be noted that Army training tends to be more performance-based than Navy courses are. If large portions of Navy training are used, it may be necessary to proportion the total hours of the Navy types of instruction to those in the existing Army course. This difference is not as extreme in Marine Corps and Air Force courses of instruction.

Hours of Instruction. Next, the hours of instruction required by each new module are determined. When less than an hour is required for a POI file, convert minutes to tenths of hours as follows:

MINUTES	TENTHS
1-5	1
6-10	2
11-15	3
16-20	4
21-25	5
26-30	6
31-35	7
36-40	8
41-45	9
46-50	Full Hours

For course modules which are added to BCS courses, the hours are usually added without alteration. Occasionally, a module will contain instruction on more than is desired and will need to be cut back. When this is required, course personnel in the existing course provide the best source for estimating how much the module hours should be cut.

Example

A heat sensor is to be added to the barrel of a new self-propelled howitzer, and the maintenance course requirements are to be determined. The Predecessor System does not have a heat sensor. However, a towed version of the same caliber does have such a sensor. The POI for the organizational maintenance course is obtained, but the course's files show no readily identifiable training offered on the heat sensor.

The tasks being taught in the course are surveyed; Task 061-271-1463, Maintain Thermal Warning Device, is found. This task is indicated as being trained to soldier's manual standard and is taught in POI file number WM28TG. The title of this file is Purge Fire Control Equipment, M198 Howitzer, and includes five hours of instruction broken down as .4 C, 4.4 PE1, .2 PE2. Included in the file is purging of fire control items, M137 telescope, M138 telescope, M139 alignment device, M17 and M18 quadrants, and the thermal warning device.

An instructor in the course estimates that 1.5 hours of the total time are devoted to the thermal warning device. The hours for the existing module are entered on the left half of Table 3.10-1 without alteration. The same proportion of conference (C) hours to Practical Exercise 1 (PE1) hours are maintained. The new BCS module hours are entered on the right side as:

C	.1
PE1	1.4

Once hours for the BCS course modules have been identified, design impacts of the Proposed System(s) can be assessed. Considerable analyst's judgment is required to assess the differences. Design differences (developed in Substep 1.8, Determine Design Differences) provide the best source for determining equipment differences which may affect training times.

Substantial changes in equipment reliability and maintainability should influence the amount of training required and, in some instances, the need for any training at all. This assessment is made easier and more accurate when a detailed TRRA has been conducted, as the results of the task comparability analysis are available to support this assessment.

When the tasks are available, the task evaluation codes used in the detailed TRRA are used to identify the nature of design impacts between the BCS and the Proposed Systems. On occasion, further analysis will be required to assess these design impacts. In those instances, the soldier's manuals should be obtained for the tasks taught in the BCS course module, and the task actions, conditions, standards, and elements should be evaluated. Comparisons should be made between the BCS tasks and the Proposed System tasks.

Descriptions of the performance of the Proposed System tasks will often be incomplete or lacking entirely. However, the analyst uses whatever task performance sources are available to make the comparison. Some of the reasons for altering the hours of a Proposed System course module include:

- Change in frequency of performance
- Change in complexity/difficulty of performance
- Consequences of inadequate performance

Number of Groups. The last element of the new instruction to be added to Table 3.10-1 is the number of groups for each type of instruction. For course modules being added to existing courses, the number of groups identified for the existing types of instruction are used for the new ones. If a new type of instruction must be added to the existing course, the existing types of instruction with similar instructor-to-student ratios should serve as a precedent to estimate the number of groups.

The existing number of groups used in a course are found on TRADOC Form 377-R (ICH Computation Worksheet). These forms are not part of the POI and must be requested separately.

For new courses of instruction, the number of groups can be estimated by using the recommended instructor-to-student (I/S) ratios in Table 3.10-2. First, determine an optimum class size (OCS) for the new course by finding a comparable course and using its OCS. Next, convert the I/S ratio for each type of instruction by dividing the OCS by the number of students in the ratio.

For example, the OCS for a new course is 12. PE1 with an I/S ratio of 1:6 is required in the course. By dividing the OCS of 12 by 6, the number of groups, 2, is derived. If fractional results are obtained, round to the nearest whole number. Add the number of groups for each type of instruction to Table 3.10-1. Table 3.10-3 shows a partially completed Course Modification Worksheet Example.

3. Once all of the modules of instruction have been documented, summarize the types of instruction

Table 3.10-3. Course Modification Worksheet: Example

Weapon System: SINCGARS **Course Number:** 101-31E10 **MOS/ASI:** 31E10

Existing Course Modules						New Course					
	Course Annex/File						Course Annex/File				
Task Number	Number	Description	Types of Instruction	Hours	Group	Task Number	Number	Description	Types of Instruction	Hours	Groups
	101-31E10:										
113-587-8024 113-620-0001 113-620-0002	B16	Radio Receivers and Examination	C PE1 PE3 E3	6.5 12.0 0.5 2.0	1 4 1 1	113-587-8024 113-620-0001 113-620-0002	B16	Radio Receivers and Examination	C PE1 PE3 E3	6.5 12.0 0.5 2.0	1 4 1 1
		Subtotal		21.0				Subtotal		21.0	
	041-34Y10:										
061-296-1382	34Y10-C1	Boolean Algebra	PM PE2 E3	0.4 3.0 0.6	1 1 1	061-31E-1005	B17	Boolean Algebra	PI PE3 E3	0.4 3.0 0.6	1 1 1
		Subtotal		4.0				Subtotal		4.0	
	101-31E10:										
031-503-1015 113-620-8009 113-620-9021	B17	AN/GRC-106 Radio: Troubleshooting, analysis, and alignment	C PE1 E1	50.0 70.0 4.0	1 4 4	031-503-1016 113-620-8009 113-620-8021	B18	AN/GRC-106 Radio: Troubleshooting, analysis, and alignment	C PE1 E1	50.0 70.0 4.0	1 4 4
		Subtotal		124.0				Subtotal		124.0	

entered. Construct a one-time list of all types of instruction with different number of groups, then total the number of hours. Table 3.10-4 shows an example of how the list should look when completed.

Table 3.10-4. Type of Instruction Summary for 101-31E10 Course

Type of Instruction	Hours	Groups
C	214.3	1
TV	3.1	1
D	1.5	1
F	0.5	1
PI	25.3	1
PE1	483.7	4
PE3	15.6	1
E1	62.0	1
E3	20.0	1
Academic Hours	825.5	
Administrative Hours		
Total Hours	______	

Total Hours represents the total academic hours of the course. Administrative time in the form of commandant's/commander's time, in-processing/out-processing, payday activities, etc., are then added. For most existing courses, the administrative hours are used without change.

However, if more than a week of academic time is added to the course, consideration should be given to prorating additional time. If the course is new, apply the formula used in TRADOC Reg 351-1 for calculating administrative time.

The formula is as follows:

$$\frac{\text{Total Academic Hours}}{36} = \text{Administrative Time}$$

The divisor, 36, represents the minimum academic hours per training week required by TRADOC.

Substep Group 3C

Training Cost and Resources Determination

Overview

Determination of training costs and resources provides critical data for comparing system configurations. This analysis also serves as a means for determining the system's impact on scarce and cost-intensive Army training resources.

Many different parameters can be measured to depict the resources required for training. Selection of the resource parameters considers three elements: (1) the training data available for analysis, (2) the nature and scope of the training impacts to be studied, and (3) the level of training resource estimation needed to make decisions at each milestone in the materiel acquisition process.

In this phase, estimates of the training resources needed to produce the "steady-state" replacement personnel are calculated. Training resources are assessed only for system-specific courses.

The term "system-specific course" refers to the Advanced Individual Training (AIT) and additional skill identifier (ASI) courses for all MOSs assigned to equipment in the Predecessor, Baseline Comparison, and Proposed Systems. The term also refers to the Noncommissioned Officer Education System (NCOES) warrant and commissioned officer courses provid which provide direct instruction on system-specific equipment. NCOES courses which concentrate on leadership or supervisory skills are not included (e.g., the Primary Leadership Development Course).

During the first HARDMAN application to a particular system, four parameters are usually chosen to depict the Training Resource Requirements:

- Training Man-Days — the length of time needed to train students in a course
- Instructors — the number of trainers needed to conduct Courses of Instruction (COI)
- Course Costs — the amount of money required to train graduates of COIs
- Other Training Resources — a list of candidate training devices used in training

As the system is further defined, subsequent applications or iterations of the analysis permit more detailed examinations of these and other training resource requirements.

Logic

Figure 3C-1 presents an overview of the logic used to determine training cost and resources. This figure shows the major input, processes, and output required for this substep group.

Included as input to this group are (1) data elements generated in other HARDMAN substeps and (2) other required training resource information. Six substeps analyze and calculate results from this input.

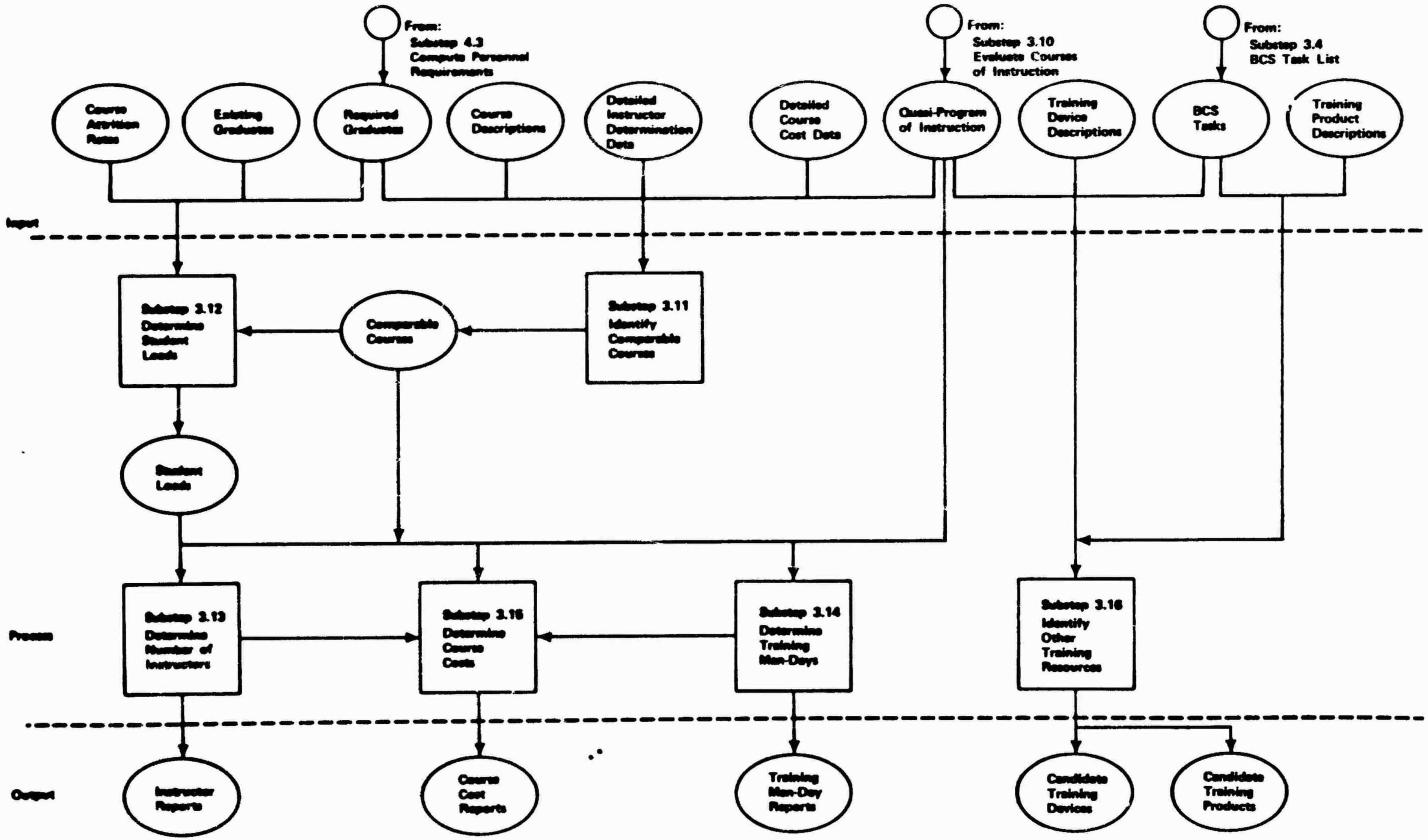


Figure 3C-1. Logic flow for Training Cost and Resources Determination.

Upcoming sections describe these substeps in detail:

3.11 Identify Comparable Courses

3.12 Determine Student Loads

3.13 Determine Number of Instructors

3.14 Determine Training Man-Days

3.15 Determine Course Costs

3.16 Identify Other Training Resources

Identify Comparable Courses

Objective

In this substep, existing or comparable courses are identified for all courses of instruction required for each system configuration. Comparable courses are found for those courses that are totally new, taught in a non-Army school, or have been recently created from a previous course. Cost and other resource parameters of these comparable courses are later used to estimate attrition percentage, detailed course-cost data, optimum class sizes, and type of course.

Input

Input from earlier HARDMAN substeps includes

(1) the quasi-programs of instruction developed in Substep 3.10 and (2) the number of system-specific graduates to be trained as determined in Substep 4.3.

Additional input to this substep includes:

(1) detailed course cost data, which is produced annually by TRADOC Headquarters under Reports Control Symbol ATRM-159, and (2) descriptions of courses of instruction presently being conducted in TRADOC training centers and formal schools.

Product

This substep results in a list of all system-specific courses and, where necessary, a comparable course that is used to estimate cost and other resources. An example of this summary list of comparable courses is shown in Table 3.11-1. The comparable course cost and resource estimates form input for all subsequent substeps except training device identification.

Table 3.11-1. Summary of Comparable Courses

WEAPON SYSTEM: REMOTELY PILOTED VEHICLE   CONFIGURATION: BCS

SYSTEM-SPECIFIC COURSES		COMPARABLE COURSES	
MOSC/ASI	COURSE NUMBER	COURSE NUMBER	PROPONENT SCHOOL/TRAINING CENTER
13T10	XXX-13T10	221-13R10	Field Artillery
13T30	XXX-13T30	043-15E 2/3	Field Artillery
13T10P9	XXX-13TP9	221-ASIX5	Field Artillery
26C10	104-26C10	104-26B10	Field Artillery
31E10	101-31E10	None	Signal
31J10	160-31J10	None	Signal

Logic

Figure 3.11-1 depicts the logic flow for identifying comparable courses. As shown in the figure, the identification process entails one step.

Action Step

Requirements

The TRADOC course-cost program analyzes and reports on the courses of instruction conducted in TRADOC formal schools and training centers. Reports produced by this program cover one fiscal year.

Three instances require identification of comparable courses. First, at any given time, the latest reports available from this program cover Army courses conducted from one to two and a half years earlier. Over this period, new courses may have been added, while others may have been disbanded. Information will not be available on Army courses added since the issuance of the last course-cost reports.

Consequently, the analyst must identify a comparable course which does have a course-cost report. In this manner, data for the existing comparable course can be used to estimate costs and other resource parameters for the new course.

Second, the design impacts of a new weapon system may require creation of new courses. As with the first instance, a comparable course would need to be identified in order to estimate costs and other resource elements.

Finally, for some Military Occupational Specialty (MOS) skill levels, attendance at a non-Army course may be required. Data for these courses are not readily available to the Army training analyst.

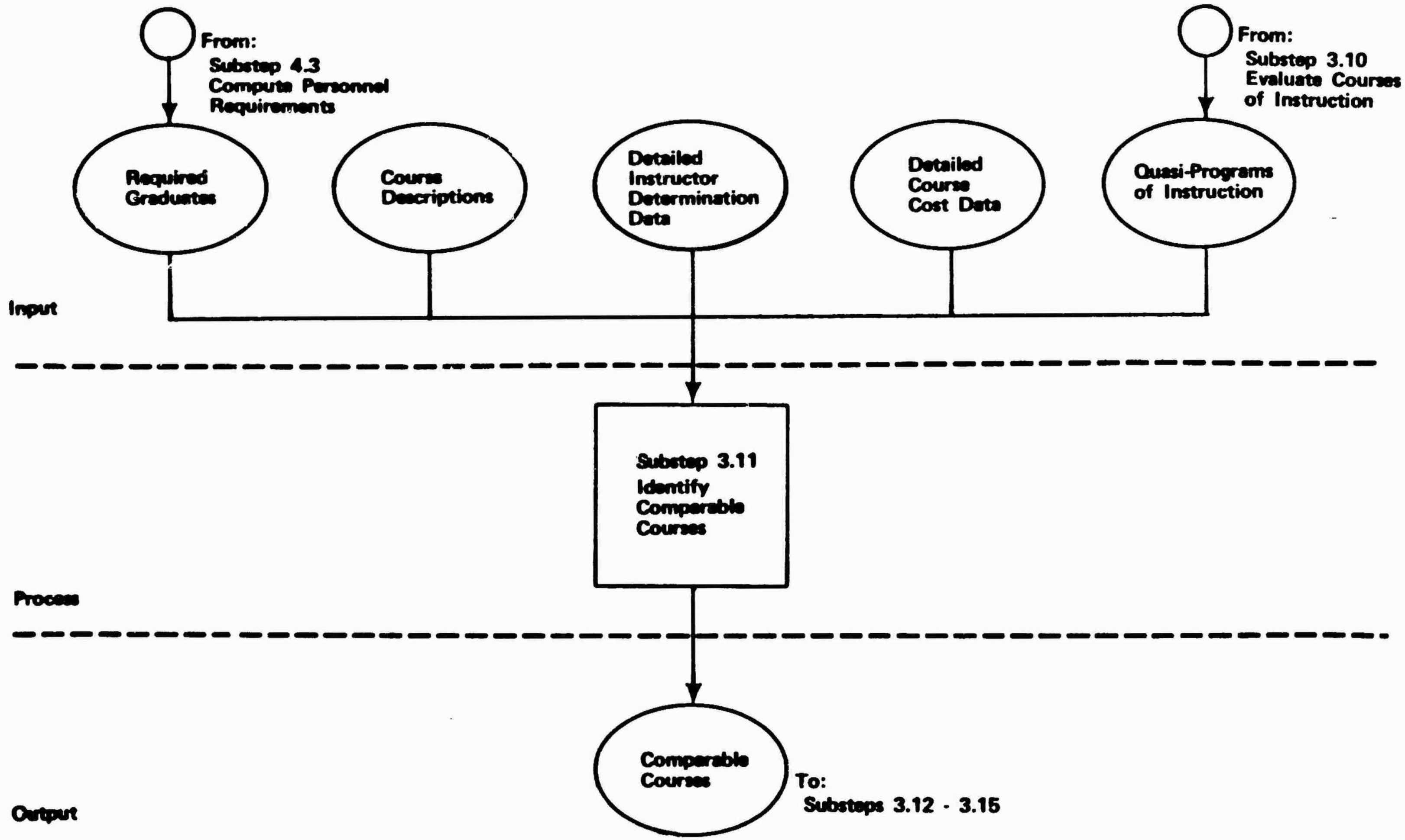


Figure 3.11-1. Logic flow for Identify Comparable Courses.

When available, the data typically lack sufficient detail. Again, the analyst must identify a comparable Army course for estimation purposes.

Objective

The objective of this step is to compare courses that do not have a TRADOC course-cost report with existing courses that do have the necessary cost and supplementary resource information. Descriptions and characteristics of the course that lacks data are compared with those of existing courses to find the closest match.

Procedures

The training analyst compares the program of instruction and all other descriptions of the new course to similar descriptions for the courses found in the MOS Course Cost Reports (ATRM-159 Reports). The following decision-making criteria are applied to evaluate the adequacy of course-cost data. The criteria should be applied in order.

Criterion 1. If the course title and number are the same, even though the length may have changed, use the course-cost data.

Criterion 2. If the course is not found, determine if it had split from another course. If it had, use the other course's cost data.

Criterion 3. If the course is totally new or is taught in a non-Army school, identify a comparable Army course that comes closest to matching the following criteria:

- —taught at similar/same school
- —in similar/same career management field
- —similar course length

—similar number of graduates per year
—same maintenance level
—same instructional strategy (self-paced, hands-on, etc.)
—similar course content (i.e., trains similar equipment with similar task and skill requirements)
—similar course attrition rate
—Armed Services Vocational Aptitude Battery subtest and score

The most important criteria are similar course length and similar number of graduates per year. Additional HARDMAN applications experience is needed prior to assigning relative weights to the above criteria.

After thoroughly investigating the above criteria, the training analyst consults subject-matter experts (SMEs) in the Directorate of Training Developments (DOTD) at the school most likely to be proponent for the course or courses of its type. The analyst discusses the recommended comparable course(s) with the SMEs, then decides on the best course to use for estimation purposes.

Examples

Criterion 1

Situation: The current program of instruction for the 160-31S10 course specifies a length of 14 weeks and 2 days. The TRADOC course-cost report (ATRM-159) for this same course specifies a length of 31 weeks.

Decision: Because only length has changed, the analyst would use the TRADOC report associated with 160-31S10 to estimate costs and resources for the course's new version.

Criterion 2

Situation: Course 611-63D10 is currently being conducted at the Field Artillery School, but no reference to it can be found in the TRADOC course-cost reports. Further investigation reveals that Career Management Field (CMF) 63, to which MOS 63D belongs, was reorganized a few years ago. At that time, MOS 63D split from MOS 63C. The Skill Level 1 course for MOS 63C was 611-63C10. This course number is found in the TRADOC course-cost reports.

Decision: Because 611-63D10 had split from 611-63C10, the analyst would use the 611-63C10 cost and resource information available through the TRADOC course-cost program to estimate cost and resources for 611-63D10.

Criterion 3

Situation: The Army's new remotely piloted vehicle (RPV) will require the addition of a new operator Military Occupational Specialty. New courses of instruction will be needed to train the soldiers who will perform the duties of this new MOS. An investigation of potential courses results in the information presented in Table 3.11-2.

A comparison of the three possible matches leads to an obvious preference for 221-13R10. Closer similarities in terms of course length, number of graduates, instructional strategy, and course content exist between XXX-13T10 and 221-13R10.

RPV SMEs in the Directorate of Training Developments at the Field Artillery School are consulted. The SMEs agree that, of the courses presently being taught at the School, 221-13R10 most closely matches the proposed RPV operator course.

Table 3.11-2. *Example of the Application of Criterion 3 to a New Course*

CRITERIA	PROPOSED COURSE	CURRENT COURSES OF INSTRUCTION		
	XXX-13T10 RPV OPERATOR	221-13R10 FIREFINDER OPERATOR	043-15D10 LANCE MISSILE CREWMAN	042-13M10 MLRS CREWMAN
SCHOOL WHERE TAUGHT	Field Artillery	Field Artillery	Field Artillery	Field Artillery
CAREER MANAGEMENT FIELD	13	13	13	13
LENGTH OF COURSE	Approximately 16 weeks	8.6 weeks	5.0 weeks	8.6 weeks
NUMBER OF GRADUATES PER YEAR	Approximately 232	244	651	79
MAINTENANCE LEVEL(S)	NA	NA	NA	NA
INSTRUCTIONAL STRATEGY USED	Pacing unknown, training to consist of formal classroom instruction, lab/hardstand exercises, GCS simulator, crew drill and actual flight.	Group paced, extensive use of Firefinder Trainer in classroom; course ends with lengthy training exercise using actual equipment.	Group paced, no evidence of simulators being used, heavy reliance on training with actual equipment.	Group paced, Fire Control Panel Trainer used teaching computer, operation, remainder of course is equipment-based.
DESCRIPTION OF COURSE CONTENT	Provides the necessary skills to select an RPV site, emplace, orient, check, adjust, operate and march order the RPV system, operate tactical communications equipment, perform preventive maintenance on the RPV system, request and adjust indirect fire missions, lase for precision guided munitions (PGM) and interpret real time imagery.	Provides the knowledge to select and evaluate a radar site, emplace orient, check, adjust, and operate and march order, perform preventive maintenance on the AN/TPQ-36, AN/TPQ-37, and AN/TSP-25A Radar Sets and ancillary equipment during day or night; locate weapons; and perform radar gunnery missions.	Provides instruction on identification and description of the major end items of equipment of the Lance Missile System, their functions and components; assembly and transport for the Lance System; firing platoon procedures, to include emplacement, sighting, and laying operations; launcher specialist duties, and preparing for action; daily preventive maintenance procedures; field training exercises encompassing radio operations and associated tasks for Lance missile field operations; and finally, tactical nuclear instruction.	Provides introduction to MLRS tactics and doctrine. Fire control system operations. Ammunition resupply procedures. Organizational maintenance. Vehicle operations of the self-propelled loader/launcher and resupply vehicle.

Decision: Because the 221-13R10 course best meets the criteria, the analyst would use its cost and resource information (available through the TRADOC course-cost program) to estimate the cost and resources for the XXX-13T10 course.

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Determine Student Loads

Objective

Student load, or number of students input for training in a course of instruction, is one of the major factors used in calculating training man-day, instructor, and cost requirements. This substep has two primary purposes. First, the number of graduates required for each system configuration is adjusted by the attrition percentage of the existing or comparable course. Second, the number of graduates required by the Predecessor System is determined.

Input

Each new system's MOS requirements are input by paygrade from Substep 4.3 of the Personnel Requirements Analysis. Additional input to this substep includes (1) attrition data for existing and comparable courses and (2) information on Predecessor System graduate requirements.

Product

Results of this substep include (1) course attrition percentage, calculated from attrition data on the existing or comparable courses; (2) Predecessor System normalized graduates, determined from existing normalized graduates; and (3) system-specific student loads, calculated from the application of the attrition percentage to the required number of BCS and Proposed System graduates. Table 3.12-1 summarizes the student load data that are produced in this substep.

Table 3.12-1. Summary of Student Load Data

CONFIGURATION: BCS

SYSTEM-SPECIFIC COURSES		COMPARABLE COURSES	STEP 1	STEP 2		STEP 3		
MOSC/ ASI	COURSE NUMBER	COURSE NUMBER	COURSE ATTRITION PERCENTAGE	PREDECESSOR SYSTEM NORM GRADS	OTHER NORM GRADS	PAYGRADE	INTAKE TO PAYGRADE	STUDENT LOADS
31E10	101-31E10	None	.27	47	269	3	45	430

Logic

The personnel requirements determined in HARDMAN Step 4 are input to this substep. These requirements equal the number of system-specific personnel needed to operate and maintain the various system configurations.

The personnel quantities represent the end of the training pipeline. They do not take into account the number of students who will fail to complete training. Therefore, a projected attrition percentage must be applied to these personnel requirements. By adjusting the requirements to account for attrition, a more accurate projection of cost and resource requirements can be obtained.

Figure 3.12-1 represents the logic flow for calculating student loads. The three action steps required to determine student loads involve calculating course attrition percentages, determining Predecessor System normalized graduate requirements, and calculating BCS and Proposed System student loads.

Action Steps

Action Step 1: Calculate Course Attrition Percentage

Requirements

The analyst calculates course attrition percentages using data on TRADOC Form 812-R.

Objective

In this step, an attrition percentage is calculated for each system's courses.

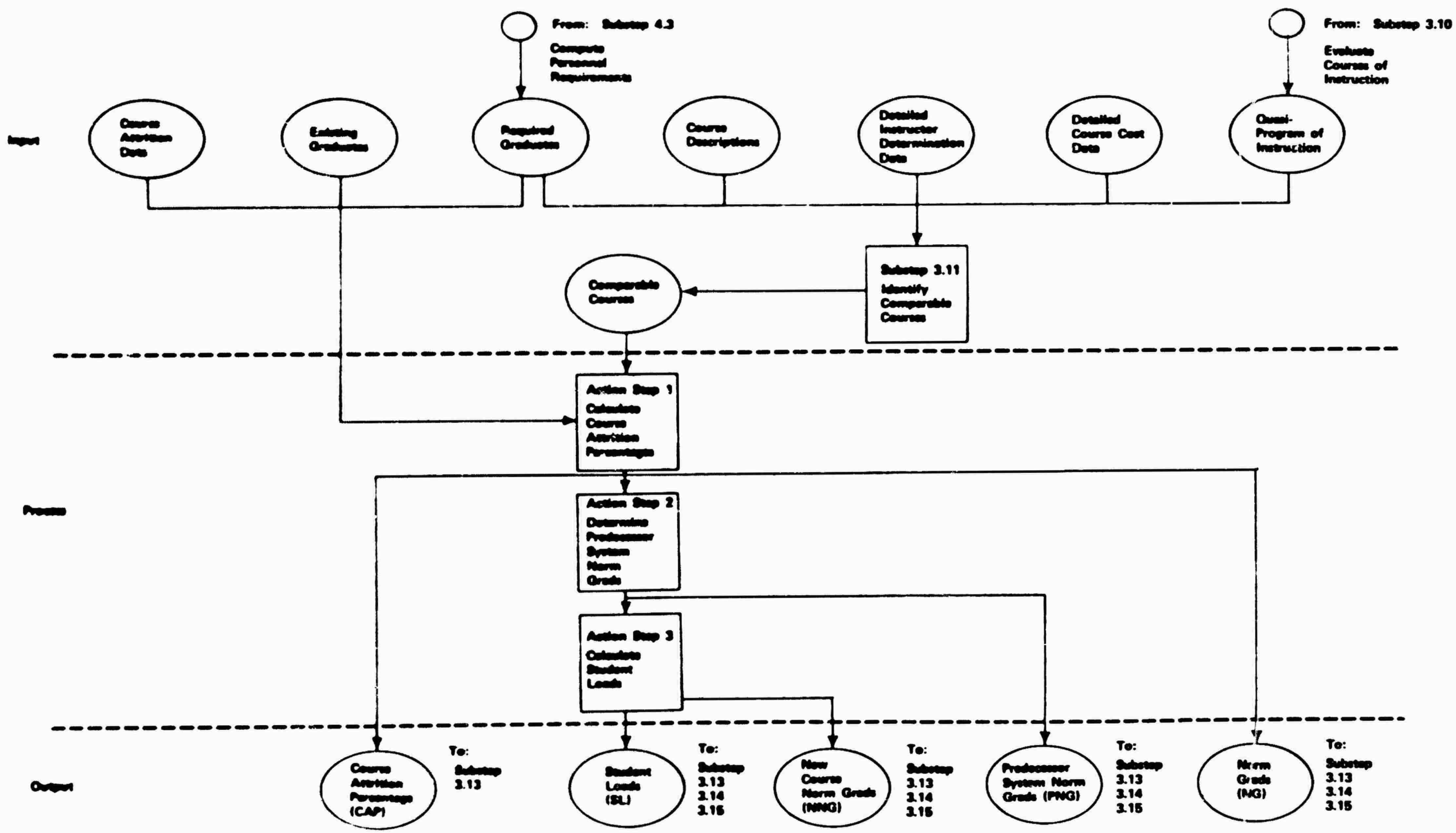

Figure 3.12-1. Logic flow for Determine Student Loads.

Procedures

For each system, the analyst locates the course or its comparable course on a TRADOC Form 812-R (Cost Analysis Program MOS/FMS Training Costs). The key data on this form are located in columns f, h, j, and l (see excerpt in Table 3.12-2).

Table 3.12-2. Example: TRADOC Form 812-R

COURSE TITLE a	COURSE NUMBER b	STUDENTS I.J TRAINING 1 OCT		STUDENTS I.J TRAINING 30 SEP		ACTUAL GRADS		ATTRITION	
		US f	FGN g	US h	FGN i	US j	FGN k	US l	FGN m
Field Radio Repairer	101-31E10	214		298		274		116	

With these data or their equivalent, the analyst calculates an attrition percentage for each course. The attrition percentage is computed by using the following equation:

$$CAP = \frac{AT}{NG + AT}$$

Where:

CAP = Course Attrition Percentage (to 2 decimal places)

AT = Attrition (number of drop-outs; given in column l)

NG = Normalized Graduates

Normalized graduates are typically referred to as "norm grads." This term will be used throughout the Handbook to refer to the number of students who satisfactorily completed the course, adjusted for carryovers. In other words, norm grads equal the number of actual grads minus half of the number of students in training in the beginning of the fiscal year plus half the number of students in training at fiscal year's end.

Norm grad data can be obtained directly from the top of the MOS Course Cost Report (also known as the ATRM-159 Report). These figures can also be calculated separately using data on TRADOC Form 812-R. When calculated separately, the number of norm grads is determined by the following equation:

$$NG = AG + (-.5\ BS + .5\ ES)$$

Where:

NG = Norm Grads
AG = Actual Grads (column j)
BS = Beginning Students (column f)
ES = Ending Students (column h)

Examples

Example 1

In fiscal year 1982, the 101-31E10 course had 316 norm grads and 116 students who failed to complete training. The course attrition percentage is calculated as follows:

$$\text{CAP} = \frac{116}{316 + 116}$$

$$= .27$$

The above calculation shows that approximately 27 percent of the total enrollment failed to complete the course. The analyst should round all attrition figures to the nearest hundredth (e.g., .234 to .23, .086 to .09) to indicate percentages more clearly.

Example 2

Had the number of norm grads not been obtained from the MOS Course Cost Report, data from TRADOC Form 812-R (see Table 3.12-2) would have been used to calculate NG:

$$\text{NG} = 274 + [-.5\ (214) + .5\ (298)]$$

$$= 274 + (-107 + 149)$$

$$= 316$$

Action Step 2: Determine Predecessor System Norm Grads

Requirements

Predecessor System norm grads are determined in order to identify other system graduates and to provide reports of Predecessor System training resource requirements.

Objectives

The purposes of this step are (1) to identify the number of graduates presently being trained for the Predecessor System and (2) to use this number to determine all other graduates.

Procedures

The training analyst would:

1. Obtain the norm grads information for each system's courses from the TRADOC Cost Analysis Program.

2. Determine how many students who attended the courses were trained solely to operate or maintain the Predecessor System. Reduce the norm grads for each course by that amount. Apply the following calculation:

$$ONG = NG - PNG$$

Where:

ONG = Number of Other Norm Grads

NG = Number of Existing Course Norm Grads

PNG = Number of Predecessor System Norm Grads

Predecessor System norm grad information can be obtained from several sources. A number of conditions may arise:

Condition 1: If any MOS is system-specific to the weapon system, the norm grads for the course constitute the Predecessor System norm grads.

Condition 2: If any MOS operates or maintains a small number of different weapon systems, it may be possible to determine the Predecessor System's student requirements by contacting course personnel. The analyst would obtain an estimate of what percentage of the graduates receive assignments to units supporting the different weapon systems.

Condition 3: A better estimate may be achieved if the course has system-specific tracks of instruction. For instance, the 13B10-OSUT course teaches the operation of towed and self-propelled howitzers. Approximately 25 percent of the trainees receive training through the towed track, while 75 percent attend the self-propelled track. Of the 75 percent in the self-propelled program, approximately 50 percent receive training for the M109. The remaining 25 percent receive training for the M110. These percentages easily translate into estimates of Predecessor System graduates.

Condition 4: Information for determining the number of Predecessor System students can also be obtained from the HARDMAN Impact Analysis (Step 5) of manpower requirements. One outcome of this analysis is a percentage of the equipment currently serviced by each maintenance MOS. This percentage for the Predecessor System maintainer MOSs can be used to estimate the number of trainees needed for all Predecessor equipment.

Example

The number of 101-31E10 course graduates assigned to repair Predecessor System radios is to be determined. The MOS Course Cost Report for 101-31E10 states that there were 316 norm grads.

Following the guidelines of Condition 2, the 101-31E10 course chief is contacted. The chief estimates that 15 percent of the course graduates receive assignments to units that repair Predecessor System radios. This percentage is multiplied by the number of norm grads to determine the number of Predecessor System norm grads:

$$PNG = 316 \times 15\%$$
$$= 47.4$$
$$= 47$$

The number of Other System Norm Grads is determined by applying the formula:

$$ONG = 316 - 47$$
$$= 269$$

Action Step 3: Calculate Student Loads

Requirements

The number of system-specific personnel undergoing training must be adjusted to account for anticipated attrition. In this way, student loads are determined for each system.

Objective

In this step, student loads are calculated for each system's courses.

Procedures

The training analyst would:

1. Obtain the Intake-to-Paygrade results (from the Personnel Analysis) and the Predecessor System norm grads (from the previous step).

2. Determine the paygrade required for entrance to each course. Use available descriptions of the course, or use Table 3.12-3 to determine the paygrade of the enrollee.

Table 3.12-3. Entry Paygrades for Course Skill Levels

Course Skill Level	Examples of Courses	Entry Paygrade
1	Advanced Individual Training (AIT) One Station Unit Training (OSUT)	E3
2	Primary Technical Courses (PTC) Primary Noncommissioned Officer Courses (PNCOC)	E4
3	Basic Technical Courses (BTC) Basic Noncommissioned Officer Courses (BNCOC)	E5
4	Advanced Noncommissioned Officer Courses (ANCOC)	E6

3. Determine a norm grad total for each new system course by applying the following formula:

$$NNG = SNG + ONG$$

Where:

NNG = Norm Grads for New Course

SNG = System-Specific Norm Grads (from Intake-to-Paygrade results)

ONG = Other System Norm Grads (from Step 2)

4. Determine each course's student load by applying one of the following formulas:

a. For BCS or Proposed System courses:

$$SL = \frac{NNG}{1 - CAP}$$

Where:

SL = Student Load

NNG = Norm Grads for New Course

CAP = Course Attrition Percentage

b. For Predecessor System courses:

$$SL = NG + AT$$

Where:

SL = Student Load

NG = Existing Course Norm Grads

AT = Attrition (number of drop-outs)

Example

The 101-31E10 course is required to train radio maintenance personnel for the BCS of a weapon system under study. The program of instruction's preface clearly states that 31E10 is the specialty trained.

The entry paygrade for a Skill Level 1 course is E3 (see Table 3.12-3). Intake-to-Paygrade results from the Personnel Analysis indicate a requirement for 45 soldiers at this paygrade. Step 2 showed that 47 of the present 316 norm grads maintain Predecessor System radios.

The first calculation is applied with these results:

$$NNG = 45 + 269$$
$$= 314$$

The course attrition percentage derived in Step 1 was 27 percent. Because the course is part of the BCS, the first student load calculation is performed as follows:

$$SL = \frac{314}{1 - .27}$$
$$= 430.1$$
$$= 430$$

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Determine Number of Instructors

Objective

In Substep 3.13, instructor and instructor supervisor requirements are determined for each system's courses of instruction. This substep incorporates the staffing standards found in the Staffing Guide for U.S. Army Service Schools (DA Pam 570-558). These standards are used to determine instructor requirements for courses conducted in TRADOC formal schools.

Input

Input from earlier HARDMAN substeps includes instructor contact hours determined for the courses developed in Substep 3.10 and student loads for these courses as determined in Substep 3.12. Additional input to this substep includes the optimum class size and the type of course as found in the TRADOC Management Engineering Activity data base.

Product

This substep produces the number of instructors and instructor supervisors required to conduct each system-specific course of instruction. Table 3.13-1 shows an example of the instructor requirements produced in this substep.

Table 3.13-1. Instructor Requirements

MOSC/ ASI	Course Number	Existing Course	Predecessor System	BCS	Proposed System
31E10	101-31E10	41	6	6	5

Logic

Figure 3.13-1 represents the logic flow for determining instructor requirements. As shown in the figure, two steps are required in the instructor determination process. The analyst calculates monthly instructor contact hours and instructor requirements.

Action Steps

Action Step 1: Calculate Monthly Instructor Contact Hours

Requirements

The instructor contact hour (ICH) is the primary measurement unit for determining the number of instructors and instructor supervisors. Instructor contact hours equal the man-hour expenditures required by instructor personnel to present instructional material to a class. The calculation of monthly instructor contact hours for each course is required as input to each TRADOC equation used for instructor manpower modeling.

Objective

The objective of this step is to calculate monthly instructor contact hours for each system's courses.

Procedures

The training analyst performs the following steps to calculate monthly instructor contact hours:

1. From Substep 3.10, obtain the type of instructor summary for each course.

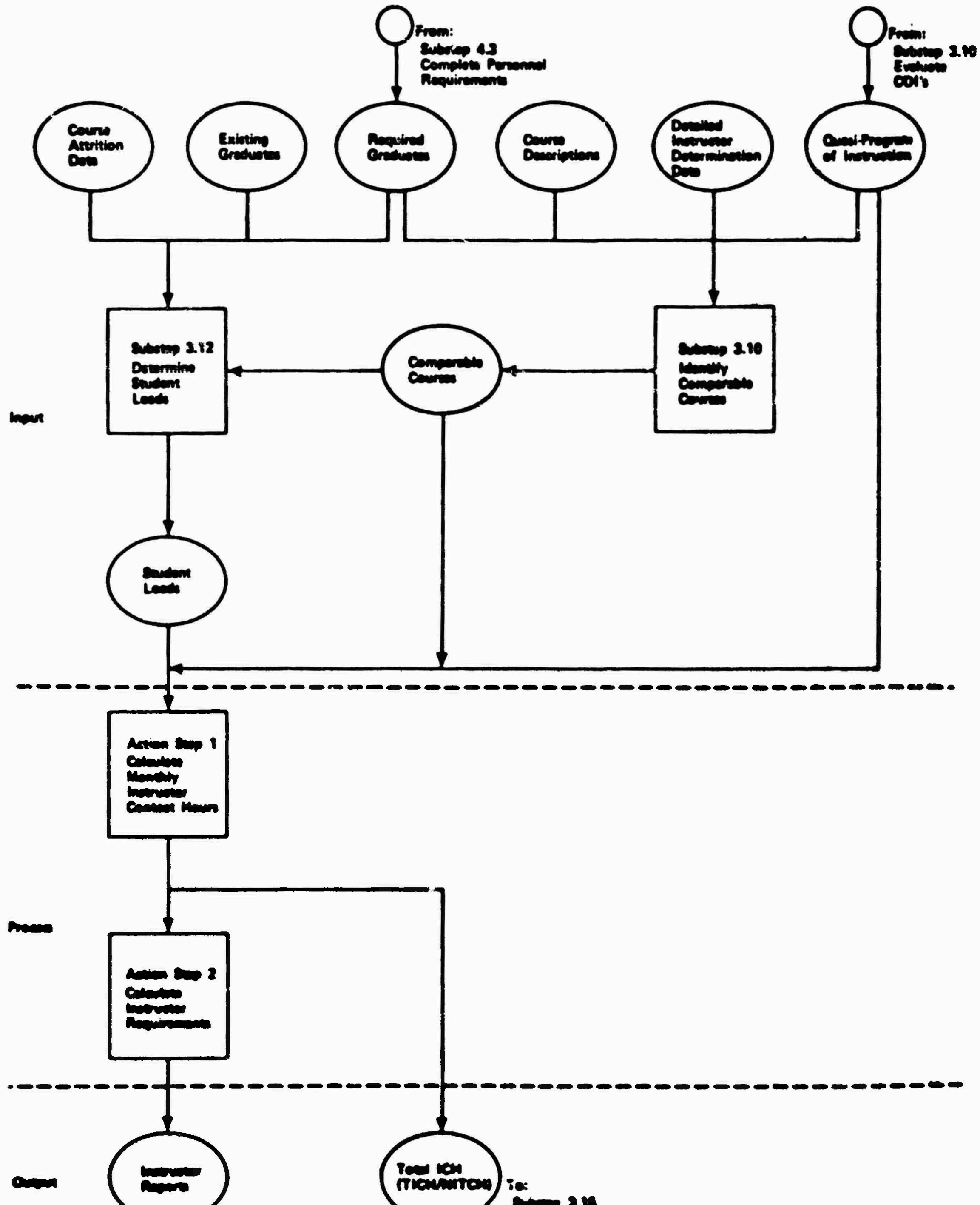

Figure 3.13-1. Logic flow for Determine Number of Instructors.

2. Determine each course's instructor contact hours by applying the following equation:

$$ICH = \sum_{i=1}^{m} \sum_{j=1}^{n} ML_i \times NGP_j$$

where:

ICH = Instructor Contact Hours (One-Time)
ML = Method Length
NGP = Number of Groups Per Method

All instructor contact hours are rounded to the nearest tenth.

3. From the TRADOC Management Engineering Activity (TRAMEA), obtain the optimum class size for each existing or comparable course.

4. From Substep 3.12, obtain the student load for each course.

5. Determine the annual total instructor contact hours for each course by applying the following equation:

$$TICH \text{ or } NTICH = \frac{SL}{OCS} \times ICH$$

where:

TICH = Existing Course Total Instructor Contact Hours
NTICH = BCS or Proposed Systems Total Instructor Contact Hours

ICH = Instructor Contact Hours (One-Time)
SL = Student Load
OCS = Optimum Class Size

6. Determine each course's monthly instructor contact hours by applying the following formula:

$$MICH = \frac{NTICH \text{ or } TICH}{12}$$

where:

MICH = Monthly Instructor Contact Hours
NTICH = New Total Instructor Contact Hours

All monthly instructor contact hours are rounded to the nearest tenth.

Examples

Example 1

Table 3.13-2 shows types of instruction, hours, and groups for the existing 101-31E10 course. Using the first equation, instructor contact hours are calculated in the table.

Table 3.13-2. Existing 101-31E10 Course Information

Type of Instruction	Hours	x	Groups	=	ICH
C	214.3		1		214.3
TV	3.1		1		3.1
D	1.5		1		1.5
F	.5		1		.5
PI	25.3		1		25.3
PE1	483.7		4		1934.8
PE3	15.6		1		15.6

Table 3.13-2. Existing 101-31E10 Course Information [con't.]

Type of Instruction	Hours	x	Groups	=	ICH
E1	62.0		1		62.0
E3	20.0		1		20.0
TOTAL	825.5		12		2277.1

An optimum class size of 20 is obtained from the TRADOC Management Engineering Activity. As determined in Substep 3.12, student load equals 432.

The total instructor contact hours (TICH) is calculated by applying the second equation:

$$TICH = \frac{432}{20} \times 2277.1$$

$$= 49{,}185.4$$

Monthly instructor contact hours are calculated with these results:

$$MICH = \frac{49185.4}{12}$$

$$= 4098.8$$

Example 2

Table 3.13-3 shows types of instruction, hours, and groups oi the BCS 101-31E10 course. Using the first equation, calculation of instructor contact hours is shown in the table.

Table 3.13-3. BCS 101-31E10 Course Information

Type of Instruction	Hours	x	Groups	=	ICH
C	179.8		1		179.8
TV	3.5		1		3.5
D	1.5		1		1.5
F	.5		1		.5
PI	36.4		1		36.4
PE1	440.2		4		1760.8
PE3	30.1		1		30.1
E1	62.8		1		62.8
E3	21.2		1		21.2
Total	776.0		12		2096.6

The TRAMEA optimum class size is 20, and the student load determined in Substep 3.12 is 430.

The number of New Total Instructor Contact Hours (NTICH) is determined by applying the second equation:

$$NTICH = \frac{430}{20} \times 2096.6$$

$$= 45{,}076.9$$

Monthly instructor contact hours are calculated:

$$MICH = \frac{45076.9}{12}$$

$$= 3756.4$$

Action Step 2: Calculate Instructor Requirements

Requirements

Calculation of instructor requirements is based on the results of a staffing standard study conducted by the TRADOC Management Engineering Activity (TRAMEA). This standard, which is represented in Action Step 2's manpower models, applies to all Army schools organized under the TRADOC School Model (DA Pam 570-558). The standard includes all instructors and instructor supervisors up to but not including the division level.

Objective

Step 2 is intended to identify each course's type and, by applying the appropriate TRAMEA manpower model, to determine the number of instructors required.

Procedures

The training analyst performs the following tasks:

1. From the TRADOC Management Engineering Activity, obtain the course type for each existing or comparable course.

2. Match the course type to the manpower models that follow. Using the monthly instructor contact hours determined in the previous step, calculate the instructor manpower requirements for each course:

a. Officer courses — Course Type Codes 01 through 04:

$$IMR = \frac{66.62 + 1.540\ MICH}{142}$$

b. Enlisted courses — Course Type Codes 05 through 08:

$$IMR = \frac{\frac{MICH}{(1.608 + .0001583\ MICH)} + MICH}{142}$$

c. Enlisted career development course — Course Type Code 09:

$$IMR = \frac{5.198 + 1.477\ MICH}{142}$$

d. Officer/Enlisted courses — Course Type Codes 25 through 48:

$$IMR = \frac{31.84 + 1.402\ MICH}{142}$$

e. Self-paced courses — All Course Type Codes:

$$IMR = \frac{70.62 + 1.403\ MICH}{142}$$

f. Defense Language Institute — All courses:

$$IMR = \frac{211.7 + 1.615\ MICH}{142}$$

g. School of the Americas — All courses:

$$IMR = \frac{55.46 + 1.704\ MICH}{142}$$

h. Academy of Health Sciences —

(1) Courses with 1,000 or fewer monthly contact hours:

$$IMR = \frac{\frac{MICH}{(.2995 + .0006271\ MICH)} + MICH}{142}$$

(2) Courses with over 1,000 monthly contact hours:

$$IMR = \frac{660.4 + 1.478\ MICH}{142}$$

Where:

IMR = Instructor Manpower Requirements
MICH = Monthly Instructor Contact Hours

Instructor manpower requirements are computed to three decimal points.

3. System-specific instructor manpower requirements for each course are calculated by applying one of the following equations:

a. For BCS or Proposed System courses:

$$SIMR = IMR \times \frac{SNG}{NNG}$$

Where:

SIMR = System-specific Instructor Manpower Requirement
IMR = Instructor Manpower Requirement
SNG = System-specific Norm Grads
NNG = Norm Grads for New Course

b. For Predecessor System courses:

$$PIMR = IMR \times \frac{PNG}{NG}$$

Where:

PIMR = Predecessor System Instructor Manpower Requirement

IMR = Instructor Manpower Requirement
PNG = Predecessor System Norm Grads
NG = Existing Course Norm Grads

4. Use Table 3.13-4 to convert fractional manpower requirements to a whole number of instructors.

Table 3.13-4. Fractional Conversion Table

Break Points			Number of Instructors
	-	1.077	1
1.078	-	2.154	2
2.155	-	3.231	3
3.232	-	4.308	4
4.309	-	5.385	5
5.386	-	6.462	6
6.463	-	7.539	7
7.540	-	8.616	8
8.617	-	9.693	9
9.694	-	10.770	10
10.771	-	11.847	11
11.848	-	12.924	12
12.925	-	13.999	13

When a computed instructor manpower requirement exceeds 13.999, the decimal fraction is dropped. For example, a manpower requirement of 15.892 would be converted to 15 instructors.

Example

A course type of 6 is obtained from TRAMEA for the 101-31E10 course. This course type is matched to the manpower models, and the second equation for enlisted courses is identified. Using this equation and the BCS monthly instructor contact hours of 3756.4 from the previous step, the following results are obtained.

$$\text{IMR} = \frac{\dfrac{3756.4}{(1.608 + .0001583(3756.4))} + 3756.4}{142}$$

$$= 38.463$$

System-specific instructor manpower requirements are determined by applying the BCS/Proposed System equation:

$$\text{SIMR} = 38.463 \times \frac{45}{314}$$

$$= 5.512$$

Using Table 3.13-4, the instructor manpower requirement of 5.512 is converted to 6 instructors.

Determine Training Man-Days

Objective

In this substep, the number of training man-days is determined for each system's courses of instruction. Calculation of the training man-days of a new weapon system represents one of the major training resource requirements of the HARDMAN methodology. These training times are subsequently required as input in the calculation of course cost requirements.

Input

Lengths of courses unaffected by design differences of the new weapon system are taken directly from the course's program of instruction. For modified courses, lengths are taken from the quasi-programs of instruction developed in Substep 3.10. Input to Substep 3.14 also includes the number of system-specific students to be trained. The number of such students is expressed as student loads and is input from Substep 3.12.

Product

Output includes the course length in days and the annual training man-days required to conduct each system-specific course. Total training man-day requirements are also determined for each system configuration. Table 3.14-1 displays a summary of the course lengths in days. Table 3.14-2 shows a sample annual training man-day report.

Logic

Figure 3.14-1 depicts the logic flow for the determination of training man-days. As shown by the figure, training man-days are determined in one step.

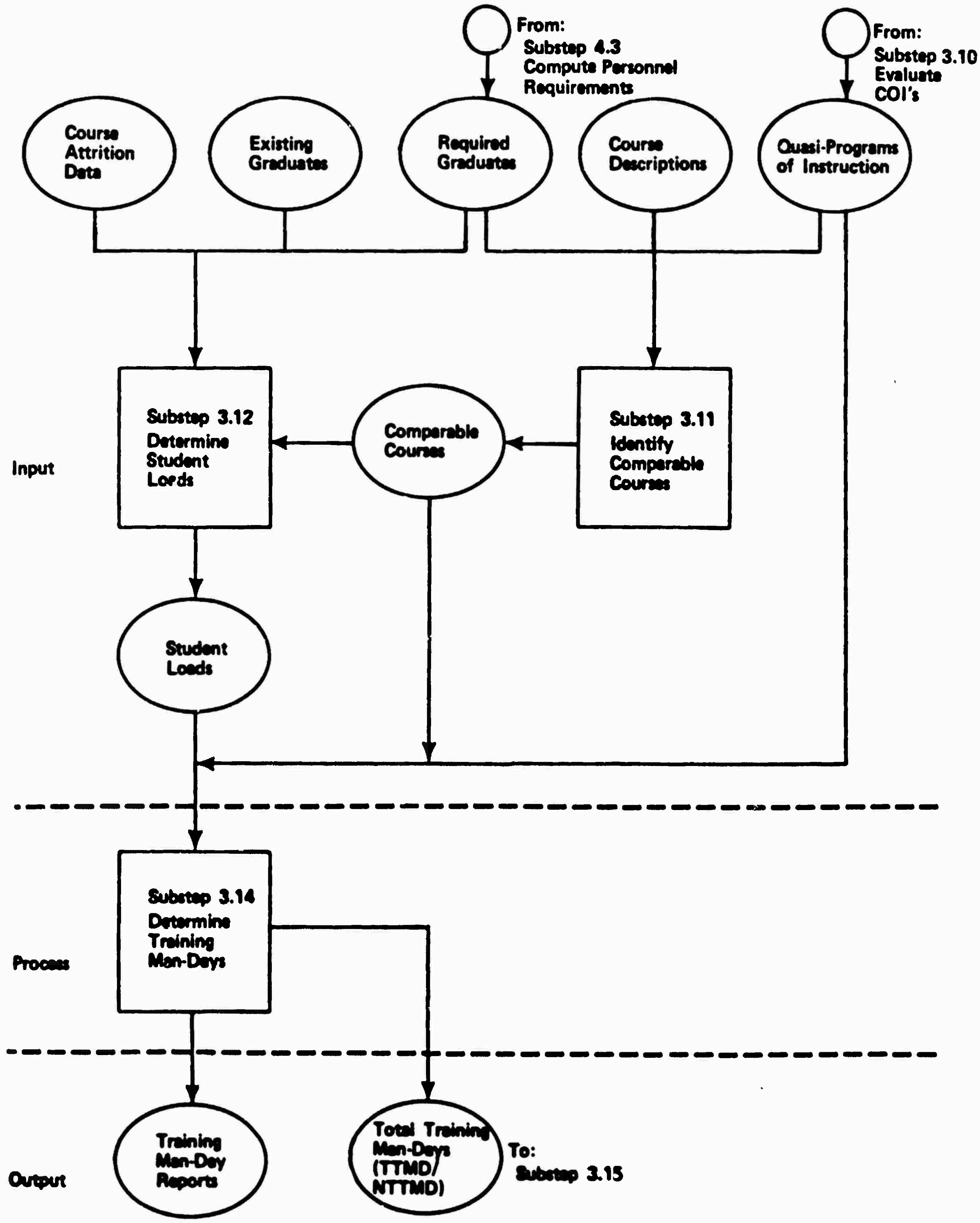

Figure 3.14-1. Logic flow for Determine Training Man-Days.

Table 3.14-1. Summary of Course Lengths

MOSC/ASI	Course Number	Existing Course	Predecessor System	BCS	Proposed System
31E10	101-31E10	148.1	148.1	139.3	135.0

Table 3.14-2. Annual Training Man-Day Requirements

MOSC/ASI	Course Number	Existing Course	Predecessor System	BCS	Proposed System
31E10	101-31E10	55342	8231	7425	7196

Action Step

Requirements

Annual training man-day requirements constitute one of the major ways to measure the design differences of various weapon system configurations. The number of man-days spent in training represents a substantial system-specific cost to the Army, as does time lost from unit assignment. Additionally, the amount of time required for formal training is a primary factor in determining the need for establishing new military occupational specialties and additional skill identifiers.

Objective

The objective of this action step is to calculate annual training man-days requirements for a given weapon system.

Procedures

1. From Substep 3.10, the analyst obtains the course length for each system's courses.

2. The length of training determined in Substep 3.10 includes all academic and administrative time requirements in hours. These lengths need to be converted to days. Additionally, these lengths do not include weekends. The new length of each course is calculated as follows:

$$NCL = 1.4 \times .125 \times CL$$

where:

NCL = New Course Length
CL = Existing Course Length (in hours)

All new course lengths are rounded to the nearest tenth of a day (e.g., 8.34 to 8.3, 24.78 to 24.8).

3. From Substep 3.12, the analyst obtains student load, system-specific norm grads, total number of norm grads, and course attrition percentage for each system's courses.

4. Training man-days for each course are calculated by using one of the following equations:

a. For BCS or Proposed System courses:

$$NTTMD = NCL \times SL\ (1 - .5(CAP))$$

Where:

NTTMD = New Total Training Man-Days
SL = Student Load
CAP = Course Attrition Percentage

b. For Predecessor System courses:

$$TTMD = NCL \times SL(1 - .5\ CAP)$$

Where:

TTMD = Total Training Man-Days
NCL = New Course Length (in days)
SL = Student Load
CAP = Course Attrition Percentage

Training man-days derived from either equation are rounded to the nearest whole man-day (e.g., 816.3 = 816 man-days).

5. System-specific training man-days for each course are calculated by using one of the following equations:

a. For BCS or Proposed System courses:

$$\text{Annual Training Man-Days (BCS/Proposed System)} = NTTMD \times \frac{SNG}{NNG}$$

Where:

NTTMD = New Total Training Man-Days
SNG = Number of System-Specific Norm Grads
NNG = Number of Norm Grads for New Course

b. For Predecessor System courses:

$$\text{Annual Training Man-Days (Predecessor)} = TTMD \times \frac{PNG}{NG}$$

Where:

TTMD = Total Training Man-Days
PNG = Number of Predecessor-System Norm Grads
NG = Number of Existing-Course Norm Grads

Examples

Example 1

The 101-31E10 course is required to train radio maintenance personnel for the BCS of a weapon system under study. As determined in Substep 3.10, 101-31E10 is 796.0 hours long. The first equation is applied with the following results:

$$NCL = 1.4 \times .125 \times 796.0$$
$$= 139.3$$

The following data is obtained from the output of Substep 3.12:

Student Load (SL) = 430
System-specific Norm Grads (SNG) = 45
Total Number of Norm Grads (NNG) = 314
Course Attrition Percentage (CAP) = .27

Because the course is part of the BCS, the equations are applied as follows:

$$NTTMD = 139.3 \times 430 (1 - .5 (.27))$$

$$= 51813$$

$$\text{Annual Training Man-Days (BCS)} = 51813 \times \frac{45}{314}$$

$$= 7425$$

Example 2

The 101-31E10 course trains the radio maintenance personnel for the Predecessor System of a weapon system under study. As determined in Substep 3.10, the existing 101-31E10 is 846 hours long. The first Predecessor System equation is applied with the following results:

$$NCL = 1.4 \times .125 \times 846$$

$$= 148.1$$

The following data are obtained from the output of Substep 3.12:

Student Load (SL) = 432
Predecessor-System
  Norm Grads (PNG) = 47
Existing-Course
  Norm Grads (NG) = 316
Course Attrition
  Percentage (CAP) = .27

Because the course is part of the Predecessor System, the equations are applied as follows:

$$\text{TTMD} = 148.1 \times 432(1 - .5(.27))$$

$$= 55342$$

$$\text{Annual Training Man-Days (Predecessor)} = 55342 \times \frac{47}{316}$$

$$= 8231$$

Determine Course Costs

Objective

In this substep, the analyst calculates the dollar costs of institutional MOS training associated with the system under analysis. Costs are calculated for each course required by the Predecessor System, the BCS, and the Proposed System alternatives. (These courses were developed in Substeps 3.9 and 3.10.)

Costs are one of the most important training resource considerations because they must be budgeted and accounted for by the training establishment. The purposes of this substep are (1) to provide that group with cost information on training required by the system under analysis and (2) to compare these costs for the Predecessor, Baseline Comparison, and Proposed Systems.

Input

For each course, training costs per graduate for existing and/or comparable courses are input from the TRADOC MOS Cost Analysis Program. Additional input includes (1) student loads from Substep 3.12, (2) total training man-days from Substep 3.14, (3) total Instructor Contact Hours from Substep 3.13, and (4) course data from Substep 3.10.

The TRADOC MOS Cost Analysis Program produces annual reports of training costs under Reports Control Symbol ATRM-159. A separate report is produced for each course of instruction at each TRADOC school and training center. Table 3.15-1 shows an example (subsequently referred to as the ATRM-159 report) which will be used

Table 3.15-1. Sample ATRM-159 Report

J2 RCS ATRM-159 (R1)

FY 1982 Cost Per Graduate (FY 84 $)

		OMA	MPA	PA	FHMA
COURSE TITLE	Field Radio Repairer			(25.0 Weeks)	
COURSE NUMBER/MOS	101-31E10			(316.0 Norm Grad)	
DIRECT COSTS		OMA	MPA	PA	FHMA
1.	Direct Mission				
A.	Instructional Dept	2,477	6,642		
B.	Flying Hour				
C.	Other	991	557		
D.	Subtotal	3,468	7,199		
2.	Troop Support				
A.	P9				
B.					
3.	Ammunition				
4.	Equip Item Depr			2,098	
5.	Student Pay & ALWS				
A.	Officer ( )				
B.	Enlisted (E-3)		6,533		
6.	Travel Pay to Course		12		
7.	Per Diem at Course				
8.	TOTAL DIRECT COSTS	3,468	13,744	2,098	
INDIRECT COSTS					
9.	Base Operations	4,775	1,258		
10.	Support Costs				
A.	Training Aids	219	31		
B.	Other	1,256	1,132		103
11.	TOTAL INDIRECT COSTS	6,250	2,421		103
12.	TOTAL DIRECT & INDIRECT	9,718	16,165	2,098	103
13.	TOTAL COST PER GRADUATE	$28,084			
FIXED AND VARIABLE COSTS					
14.	Direct Mission				
A.	Fixed	1,284	2,592		
B.	Variable	2,184	4,607		
15.	Total Direct & Indirect				
A.	Fixed	5,034	4,045	2,098	103
B.	Variable	4,684	12,120		

throughout the remainder of this substep. The report contains course title and number; course length in weeks; number of normalized graduates; and costs arrayed by element of expense (e.g., Instructional Department, Ammunition) and appropriation (e.g., OMA, MPA).

In the action steps that follow, input taken from the ATRM-159 cost array will be identified using this format:

[1A:OMA] or [6:MPA]

where 1A and 6 are line numbers of expense elements on the ATRM-159 report, and OMA and MPA refer to the appropriate column. Referring to Table 3.15-1, these examples would identify values of 2477 and 12, respectively.

Product

Results of this substep include (1) training cost per graduate for each course of instruction and (2) annual costs of training for the number of graduates required by the system under analysis. Annual training costs are displayed for each system alternative using the output format shown in Table 3.15-2.

Table 3.15-2. Training: Annual Costs (in Thousands of Dollars)

			Proposed System Alternatives		
MOS	Predecessor	BCS	Alt 1	Alt 2	Alt 3

Logic

Figure 3.15-1 represents the logic flow for determining course costs. Three steps are required: (1) reallocating/recalculating fixed and variable costs, (2) calculating training cost per graduate, and (3) calculating annual training costs. Each of these steps is repeated for each course for the Predecessor, Baseline Comparison, and Proposed Systems.

Action Steps

Action Step 1: Calculate Fixed and Variable Cost Percentages

Requirements

For direct and indirect costs provided by the ATRM-159 report, the analyst determines what proportion is fixed costs and what proportion is variable.

Objective

The objective of this action step is to calculate eight variables, four each for direct and indirect costs. For convenience, these variables are assigned the following names:

Direct Cost	% Direct Mission
PDOMAF	OMA Fixed Costs
PDOMAV	OMA Variable Costs
PDMPAF	MPA Fixed Costs
PDMPAV	MPA Variable Costs

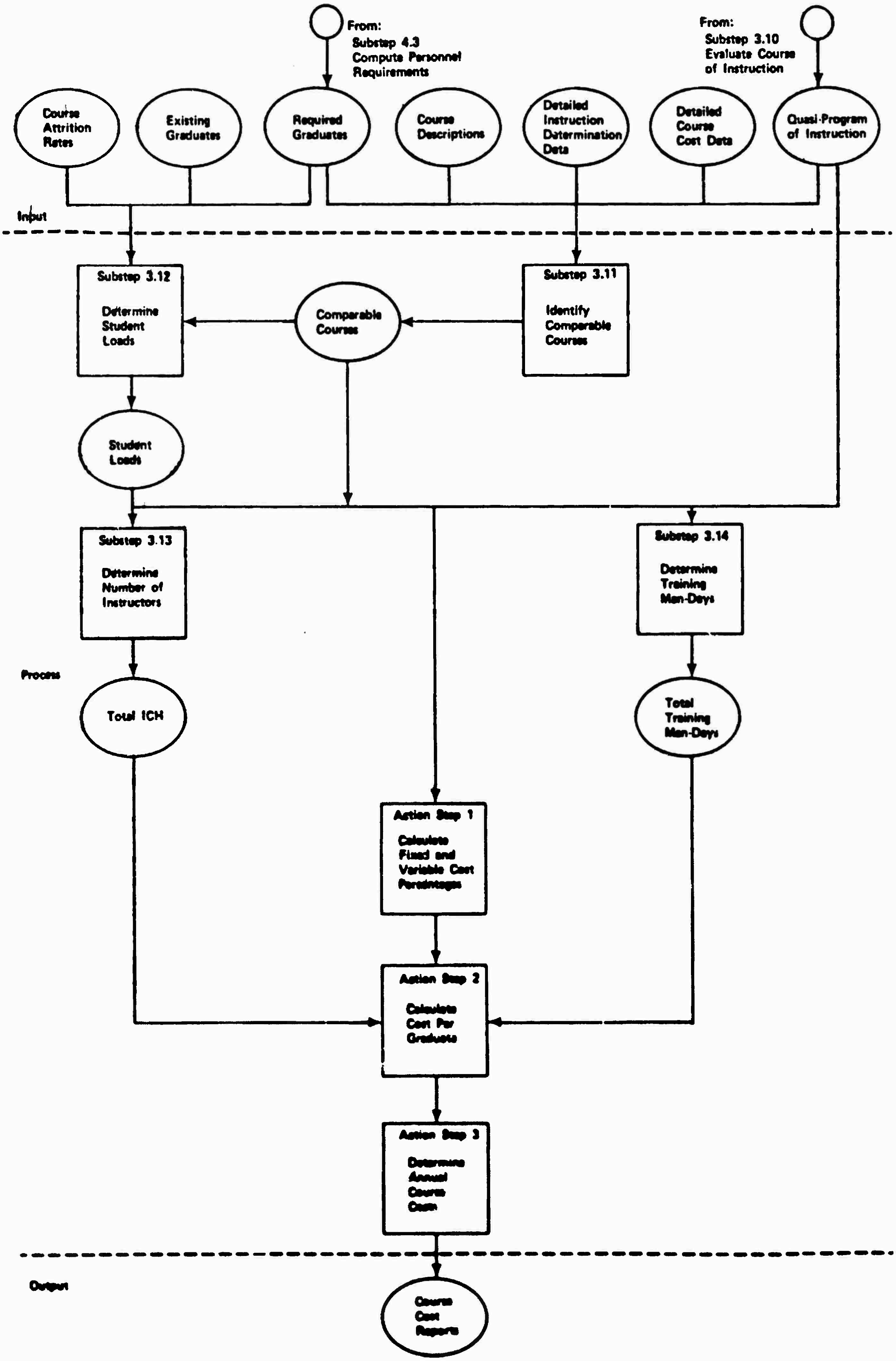

Figure 3.15-1. Logic flow for Determine Course Costs.

Indirect Cost	% Indirect
PIOMAF	OMA Fixed Costs
PIOMAV	OMA Variable Costs
PIMPAF	MPA Fixed Costs
PIMPAV	MPA Variable Costs

Procedures

Eight separate calculations are required, as procedures for obtaining each variable differ with cost element (Direct vs. Indirect), cost type (Fixed vs. Variable), and appropriation (OMA vs. MPA). These calculations will be addressed by the Direct vs. Indirect cost element.

DIRECT COST

Fixed

$$PDOMAF = \frac{[14A:OMA]}{[14A:OMA] + [14B:OMA]}$$

$$PDMPAF = \frac{[14A:MPA]}{[14A:MPA] + [14B:MPA]}$$

Variable

PDOMAV = 1 - PDOMAF

PDMPAV = 1 - PDMPAV

INDIRECT COST

Fixed

$$PIOMAF = \frac{[(15A - 14A - 6 - 2A - 2B):OMA]}{[11:OMA]}$$

$$PIMPAF = \frac{[(15A - 4A - 6 - 2A - 2B):MPA]}{[11:MPA]}$$

Variable

$$PIOMAV = \frac{[(15B - 14B - 7):OMA]}{[11:OMA]}$$

$$PIMPAV = \frac{[(15B - 14B - 7 - 5A - 5B):MPA]}{[11:MPA]}$$

Examples

Example 1 Using values from Table 3.15-1, the following results are obtained:

DIRECT COST

Fixed

$$PDOMAF = \frac{1284}{1284 + 2184} = .37 \qquad PDMPAF = \frac{2592}{2592 + 4607} = .36$$

Variable

$$PDOMAV = 1 - .37 = .63 \qquad PDMPAV = 1 -.36 = .64$$

Example 2 Using values from Table 3.15-1, the following results are obtained:

INDIRECT COST

Fixed

PIOMAF =

$$\frac{5034 - 1284 - 0 - (0 + 0)}{6250} = .60$$

PIMPAF =

$$\frac{4045 - 2592 - 12 - (0 + 0)}{2421} = .595$$

Variable

PIOMAV =

$$\frac{4684 - 2184 - 0}{6250} = .40$$

PIMPAV =

$$\frac{12120 - 4607 - 0 - (0 + 6533)}{2421} = .405$$

Action Step 2: Calculate Cost Per Graduate

Requirement The analyst calculates the cost per graduate for the course under study by using (1) existing course cost information provided in ATRM-159 report and (2) results of Action Step 1 of this substep.

Objective The objective of Action Step 2 is to derive an actual value for each variable within the matrix presented in Table 3.15-3. These variables are again addressed by Direct vs. Indirect costs.

Table 3.15-3. Training Cost Per Graduate Output Variables

DIRECT COSTS	OMA	MPA	PA	FHMA
1. Direct Mission				
A. Instructional Dept.	INDPOMA	INOPMPA		
B. Flying Hours	FLYOMA			
C. Other	ODMOMA	ODMMPA		
2. Troop Support				
A. P 8	TP8OMA	TP8MPA	TP8PA	
B. P 2/3	TP2OMA	TP2MPA	TP2PA	
3. Ammunition			AMMOPA	
4. Equipment Item Depreciation			EQPA	
5. Student Pay & Allowances				
A. Officer		PAYMPA		
B. Enlisted		PAYMPA		
6. Travel Pay to Course	TRVLPOMA	TRVLMPA		
7. Per Diem at Course	PDOMA	PDMPA		
8. Total Direct Costs	TDCOMA	TDCMPA	TDCPA	
INDIRECT COSTS				
9. Base Operations	BOOMA	BOMPA		
10. Support Costs				
A. Training Aids	TAOMA	TAMPA		
C. Other	OSCOMA	OSCMPA		OSCFHMA
11. Total Indirect Costs	TICOMA	TICMPA		OSCFHMA
TOTAL DIRECT AND INDIRECT COSTS	TDICOMA	TDICMPA	TDCPA	OSCFHMA
TOTAL COST PER GRADUATE	TTCPG			

Procedures

DIRECT COSTS

1. Direct Mission

A. Instructional Department

INDPOMA =

$$\left[[1A:OMA] \times \frac{NG}{NNG} \right] \times \left[PDOMAF + \frac{PDOMAV \times NTICH}{TICH} \right]$$

INDPMPA =

$$\left[[1A:MPA] \times \frac{NG}{NNG} \right] \times \left[PDMPAF + \frac{PDMPAV \times NTICH}{TICH} \right]$$

B. Flying Hours

$$FLYOMA = \frac{[1B:OMA] \times \text{Flying Hours (New Course)}}{\text{Flying Hours (Existing Course)}}$$

Note: If the flying hours for the existing and new courses cannot be determined, the analyst uses the value for [1B:OMA] alone.

C. Other

$$ODMOMA = \left[[1C:OMA] \times \frac{NG}{NNG} \right] \times \left[PDOMAF + \frac{PDOMAV \times NTICH}{TICH} \right]$$

$$ODMMPA = \left[[1C:MPA] \times \frac{NG}{NNG} \right] \times \left[PDMPAF + \frac{PDMPAV \times NTICH}{TICH} \right]$$

2. Troop Support

A. P8

$$TP8OMA = \frac{[2A:OMA] \times NG}{NNG}$$

TP8MPA = Same, except substitute [2A:MPA] for [2A:OMA]

TP8PA = Same, except substitute [2A:PA] for [2A:OMA]

B. P 2/3

$$TP2OMA = \frac{[2B:OMA] \times NG}{NNG}$$

TP2MPA = Same, except substitute [2B:MPA] for [2B:OMA]

TP2PA = Same, except substitute [2B:PA] for [2B:OMA]

3. Ammunition

$$AMMOPA = \frac{[3:AMMOPA] \times \text{Ammunition Per Student (New Course)}}{\text{Ammunition Per Student (Existing Course)}}$$

Note: If the ammunition expended per student for the new and existing courses cannot be determined, the analyst uses the value for [3:AMMOPA] alone.

4. Equipment Item Depreciation

$$EQPA = \frac{[4:EQPA] \times NG}{NNG}$$

5. Student Pay

A. $$PAYMPA = \frac{[5A:PAYMPA] \times NTTMD}{CL \times NNG}$$

where CL is the Class Length taken from the upper right corner of the ATRM-159 report. To work properly in this equation, the value from the ATRM-159 report must be expressed in days. The conversion is as follows:

Class length (ATRM-159) is in the form (X.Y weeks), then:

CL (days) = (7 x X) + (Y/2)

B. PAYMPA = Same, except substitute [5B:PAYMPA] for [5A:PAYMPA]

Note: Only one value is calculated for PAYMPA. That value is based on whether the typical student is officer (use 5A) or enlisted (use 5B).

6. Travel Pay to Course

TRVLPOMA = [6:OMA]

TRVLPMPA = [6:MPA]

7. Per Diem at Course

$$\text{PDOMA} = \frac{[7:\text{OMA}] \times \text{NTTMD}}{\text{CL} \times \text{NNG}}$$

PDMPA = Same, except substitute [7:MPA] for [7:OMA]

8. Total Direct Costs

TDCOMA = INDPOMA + FLYOMA + ODMOMA + TP8OMA + TP2OMA + TRVLPOMA + PDOMA

TDCMPA = INDPMPA + ODMMPA + TP8MPA + TP2MPA + PAYMPA + TRVLPMPA + PDMPA

TDCPA = TP8PA + TP2PA + AMMOPA + EQPA

INDIRECT COST

9. Base Operations

$$\text{BOOMA} = \left[[9\text{:OMA}] \times \frac{\text{NG}}{\text{NNG}} \right] \times \left[\text{PIOMAF} + \frac{\text{PIOMAV} \times \text{NTTMD}}{\text{TTMD}} \right]$$

$$\text{BOMPA} = \left[[9\text{:MPA}] \times \frac{\text{NG}}{\text{NNG}} \right] \times \left[\text{PIMPAF} + \frac{\text{PIMPAV} \times \text{NTTMD}}{\text{TTMD}} \right]$$

10. Support Costs

A. Training Aids

TAOMA = Same as BOOMA, except substitute [10A:OMA] for [9:OMA]

TAMPA = Same as BOMPA, except substitute [10A:MPA] for [9:MPA]

B. Current versions of the ATRM-159 report contain no 10B line. Apparently, this is a typographical error. In future reports, Other Support Costs may appear on line 10B rather than 10C.

C. Other

OSCOMA = Same as BOOMA, except substitute [10C:OMA] for [9:OMA]

OSCMPA = Same as BOMPA, except substitute [10C:MPA] for [9:MPA]

$$\text{OSCFHMA} = \frac{[10\text{C:OSCFHMA}] \times \text{NG}}{\text{NNG}}$$

11. Total Indirect Costs

TICOMA = BOOMA + TAOMA + OSCOMA

TICMPA = BOMPA + TAMPA + OSCMPA

TOTAL DIRECT AND INDIRECT COSTS

TDICOMA = TDCOMA + TICOMA

TDICMPA = TDCMPA + TICMPA

TOTAL TRAINING COST PER GRADUATE

TTCPG = TDICOMA + TDICMPA + TDCPA + OSCFHMA

Example

This example calculates costs for a BCS course supporting MOS 31E, Field Radio Repairer. It uses the existing 31E course, whose ATRM-159 report is displayed in Table 3.15-1.

This example uses previously calculated values for variables as follows:

Existing Course:	BCS Course:
TTMD = 55342	NTTMD = 51813
TICH = 49185	NTICH = 45077
NG = 316	NNG = 314
	PDOMAF = .37
	PDOMAV = .63
	PDMPAF = .36
	PDMPAV = .64
	PIOMAF = .60
	PIOMAV = .40
	PIMPAF = .595
	PIMPAV = .405

DIRECT COSTS

1. Direct Mission

A. Instructional Department

$$INDPOMA = \left[2477 \times \frac{316}{314} \right] \times \left[.37 + \frac{.63 \times 45077}{49185} \right]$$

$$= 2493 \times (.37 + .577)$$

$$= 2361$$

$$INDMPA = \left[6642 \times \frac{316}{314} \right] \times \left[.36 + \frac{.64 \times 45077}{49185} \right]$$

$$= 6684 \times (.36 + .587)$$

$$= 6330$$

B. Flying Hour

$$FLYOMA = 0$$

C. Other

$$ODMOMA = \left[991 \times \frac{316}{314} \right] \times \left[.37 + \frac{.63 \times 45077}{49185} \right]$$

$$= 997 \times (.37 + .577)$$

$$= 944$$

$$ODMMPA = \left[557 \times \frac{316}{314} \right] \times \left[.36 + \frac{.64 \times 45077}{49185} \right]$$

$$= 561 \times (.36 + .587)$$

$$= 531$$

2. Troop Support

A. P8

$$TP8OMA = 0 \times \frac{316}{314} = 0$$

$$TP8MPA = 0 \times \frac{316}{314} = 0$$

$$TP8PA = 0 \times \frac{316}{314} = 0$$

B. P 2/3

TP2OMA = 0

TP2MPA = 0

TP2PA = 0

Using the same equations as for TP8

3. Ammunition

AMMOPA = 0

4. Equipment Item Depreciation

$$EQPA = 2098 \times \frac{316}{314} = 2111$$

5. Student Pay

Enlisted course; use equation for line 5B:

$$CL\ (days) = (7 \times 25) + (0/2) = 175$$

$$PAYMPA = \frac{6533 \times 51813}{175 \times 314} = 6160$$

6. Travel Pay to Course

TRVLPOMA = 0

TRVLPMPA = 12

7. Per Diem At Course

$$PDOMA = \frac{0 \times 51813}{175 \times 314} = 0$$

PDMPA = 0, using the same equation

8. Total Direct Costs

$$TDCOMA = 2361 + 0 + 944 + 0 + 0 + 0 + 0 = 3305$$

$$TDCMPA = 6330 + 531 + 0 + 0 + 6160 + 12 + 0 = 13033$$

$$TDCPA = 0 + 0 + 0 + 2111 = 2111$$

INDIRECT COSTS

9. Base Operations

$$BOOMA = \left[4775 \times \frac{316}{314} \times .60 + \frac{.40 \times 51813}{55342} \right]$$

$$= 4805 \times (.60 + .375)$$

$$= 4685$$

$$BOMPA = \left[1258 \times \frac{316}{314} \times .595 + \frac{.405 \times 51813}{55342} \right]$$

$$= 1266 \times (.595 + .379)$$

$$= 1233$$

10. Support Costs

A. Training Aids

$$TAOMA = \left[219 \times \frac{316}{314} \right] \times \left[.60 + \frac{.40 \times 51813}{55342} \right]$$

$$= 220 \times (.60 + .375)$$

$$= 214$$

$$TAMPA = \left[31 \times \frac{316}{314} \right] \times \left[.595 + \frac{.405 \times 51813}{55342} \right]$$

$$= 31 \times (.595 + .379)$$

$$= 30$$

C. Other

$$OSCOMA = \left[1256 \times \frac{316}{314}\right] \times \left[.60 + \frac{.40 \times 51813}{55342}\right]$$

$$= 1264 \times (.60 + .375)$$

$$= 1232$$

$$OSCMPA = \left[1132 \times \frac{316}{314}\right] \times \left[.595 + \frac{.405 \times 51813}{55342}\right]$$

$$= 1139 \times (.595 + .379)$$

$$= 1109$$

$$OSCFHMA = 103 \times \frac{316}{314}$$

$$= 104$$

11. Total Indirect Costs

TICOMA = 4685 + 214 + 1232 = 6131

TICMPA = 1233 + 30 + 1109 = 2372

TOTAL DIRECT AND INDIRECT COSTS

TDICOMA = 3305 + 6131 = 9436

TDICMPA = 13033 + 2372 = 15405

TOTAL TRAINING COST PER GRADUATE

TTCPG = 9436 + 15405 + 2111 + 104

= 27056

Action Step 3: Determine Annual Course Costs

Requirement

The analyst calculates the annual costs of training associated with a system alternative using the Total Training Cost per Graduate and the annual number of graduates required by each system alternative.

Objective

The objective of this action step is to calculate the value which will be displayed in Table 3.15-2 as the output of Substep 3.15.

Procedures

1. Annual training costs for each system alternative are calculated using one of the following equations:

a. BCS and Proposed System courses:

Annual Training Costs = TTCPG x SNG

b. Predecessor System course:

Annual Training Costs = [13:] x PNG

2. The analyst enters these values on Table 3.15-2 and repeats the enter substep for each course supporting a system alternative.

Example

Using 101-31E10 course information, the following values are calculated:

a. BCS

Annual Training Costs = $27056 x 45

= $1,217,520

b. Predecessor

Annual Training Costs = $28084 x 47

= $1,319,948

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Identify Other Training Resources

Objectives

In this substep, requirements are estimated for other training resources that contribute significantly to the overall costs of a new weapon system. Some of these requirements include the acquisition of major training devices and the development and production of resident and exportable training products.

These estimates provide initial input to the instructional design process. They also provide initial training product and device estimates for resource planning purposes.

Input

When a detailed TRRA has been conducted, the BCS Task List and training devices or products identified for each task are input from Substep 3.4. A detailed TRRA is required to identify candidate training products.

The quasi-programs of instruction developed in Substep 3.10 are input to the training device identification step. All available descriptions of training devices and products are also input to this substep.

Products

This step produces descriptive lists of training device and training product requirements. Devices or products may be found in more than one source and in support of more than one task but should be presented only once on each candidate list. Table 3.16-1 displays the information contained in the description of candidate training devices.

Table 3.16-1. Candidate List of Training Devices

MOS: 13B

Training Device	Description	Purpose	Comparable Devices	References
1. Onboard Fire Control System (OBFCS) Simulator	Three Dimensional, Programmable.	Provide OBFCS operator training for fire direction support, position location/navigational system operation, digital communication procedures, and other vehicle subsystems controlled by the OBFCS.	MLRS Fire Control Panel (FCP) Trainer with added navigation and digital communication capabilities.	HB 9-1425-646-10 Operator's Handbook: Fire Control Panel Trainer. Training Device Requirement: MLRS Fire Control Panel Trainer.

Table 3.16-2 shows a typical list of training products.

Table 3.16-2. Candidate List of Training Products

MOS: 31E

Product: Army Correspondence Course Programs

Product Code	Product Title
101-113-7251-A	Troubleshoot RT-524/VRC or RT-246/VRC
101-113-7275-A	Test Transmitter RF Signal Distribution

Product: Graphic Training Aids

Product Code	Product Title
GTA 11-2-1 (T,C)	Resonance

Product: Training Extension Courses

Product Code	Product Title
101-113-7343-A	Perform Short-Circuit Tests
101-113-7404-A	Perform Interphone Frequency Response Test of C-2329*/GRA-39

Logic

Figure 3.16-1 shows the logic flow for identifying other training resources. As shown in the figure, two different resources are identified: training devices and training products. Each of these steps is independent of the others.

Action Steps

Action Step 1: Identify Candidate Training Devices

Requirements

Two critical reasons can be cited for conducting early estimations of new weapon systems' training device requirements. First, the development and procurement costs of training devices and simulators are typically the major training-related cost of a new weapon system.

In major device procurements, this cost is significant. The cost of one training device often exceeds the per-unit cost of the weapon system itself. Additionally, as a long-lead procurement item, this cost must be programmed many years in advance.

Second, the acquisition process for major training devices is similar in nature and complexity to that of the materiel acquisition process (MAP). The need to conduct timely conceptualization, development, and procurement of training devices is as compelling as the need to do so for weapon systems. Consequently, the training device acquisition process must begin as early as possible in order to have the devices completed by the time the weapon system is fielded.

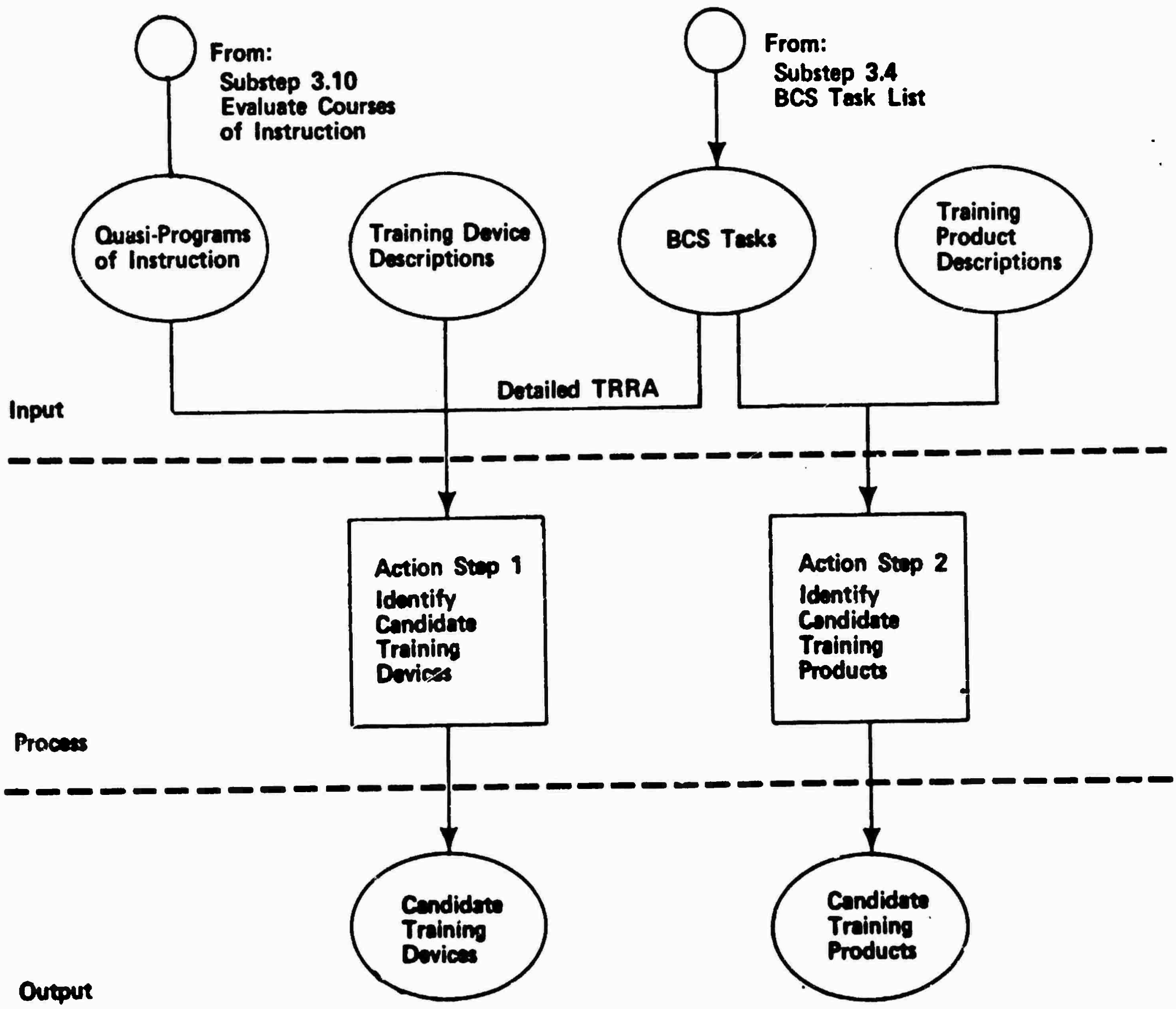

Figure 3.16-1. Logic flow for Identify Other Training Resources.

Even more important is the prevailing need in the acquisition community to develop weapon systems and their training devices at the same time. This way, training devices and the training subsystem they are a part of can be thoroughly evaluated as early as the weapon system's first operational test (OT I).

Objective

In this step, the analyst produces a descriptive list of candidates which could potentially support the new system's operational and maintenance training requirements.

Procedures

To achieve this objective, the analyst carries out the following procedures:

1. Candidate training device requirements can be identified during both detailed and general training resource requirements analyses (TRRA). However, each level of TRRA application provides different sources of training device information.

a. For a Detailed TRRA, the analyst would:

For every MOS, obtain the BCS Task List and training devices identified for each of those tasks. This list was developed in Substep 3.4. Training devices for tasks are listed on the BCS Task List under the heading "Primary Training Materials." Army training devices are usually identified by an alphanumeric code that begins with "DVC" (e.g., DVC 01-104).

For each MOS, develop a list of all training devices. Determine the title of each training device by consulting the references in the Trainer's Guide or Soldier's Manual from which the task was derived.

From Substep 3.10, obtain the BCS quasi-programs of instruction. For each system-specific instructional module, obtain the program of instruction from which it was derived. Identify training devices used in those modules. Add any appropriate training devices to the candidate list that were not previously identified.

b. For a General TRRA, the analyst would:

From Substep 3.10, obtain the BCS quasi-programs of instruction. From each system-specific module of instruction, obtain the program of instruction from which it was derived. Identify training devices used in these modules. Develop a list of all training devices for each MOS.

2. Table 3.16-1 lists the type of descriptive information needed on each training device. Obtain this information by consulting the following sources:

- DA Pam 310-12, Index and Description of Army Training Devices

- TRADOC Pam 71-9, Catalog of TASO Training Devices

- U.S. Army Comprehensive Plan for Training Devices

- Subject-matter experts at the Directorate of Training and Doctrine or training departments at the task's or course module's proponent school

- Instructional materials catalogs from local schools and/or Training and Audiovisual Support Centers (TASC)
- Army Extension Training Information System (AETIS)
- Training device technical manuals
- Subject-matter experts and publications from Project Manager for Training Devices (PM TRADE)
- Manufacturers' literature describing fielded training devices
- Other service training device catalogs

3. Survey these sources further, identifying any other devices developed to support training for comparable weapon systems or system components. If appropriate, add these training devices and their descriptions to the list of candidates.

Action Step 2: Identify Candidate Training Products

Requirements

Training support required by a weapon system encompasses many different training elements. In addition to courses of instruction and major training devices/simulators, a wide array of other Army training products and literature exists. These products are expensive to develop, maintain, and disseminate to a weapon system's operators and maintainers.

The estimation of these products serves as an additional measure of a weapon system's resource requirements. It also provides early input to the Army's budgeting process. Such input is made for a new weapon system through the completion of an Individual and Collective Training Plan (ICTP).

Objectives

In this step, a list of candidate training products is compiled for the weapon system under study. This list includes appropriate training materials and literature available from the Predecessor System (if any) and products required by comparable equipment components that may represent developmental requirements.

Procedures

To identify candidate training products, the analyst carries out the following procedures.

1. Candidate training product requirements can be identified only during a detailed training resource requirements analysis (TRRA). This stems from the fact that tasks identified in that type of TRRA provide the only means for estimating an MOS's full range of training needs.

From Substep 3.4, obtain the BCS Task List for each MOS and the training products identified for each task. Training products are listed on the BCS Task List under the heading "Primary Training Materials." Army training products and literature are identified by a unique alphanumeric code. Examples of these codes are given in Table 3.16-3.

Table 3.16-3. Training Products and Their Codes

Code	Training Product/Literature	Example
ACCP	Army Correspondence Course Programs Correspondence Course Subcourses	113-I53-148-028 SS0309
ARTEP	Army Training and Evaluation Programs	ARTEP 11-35
DA Pam	Department of Army Pamphlets	DA Pam 10-5
FM	Field Manuals	FM 11-66
FS	Filmstrips	FS 16-211
GTA	Graphic Training Aids	GTA 11-2-1 (T,C)
JB	Job Books	TC 11-31E1/2 JB
MF	Miscellaneous Films	MF 11-147
RCSC	Reserve Component School Course Materials	690-63J10-RC
REM	Resident Exportable Materials	IMA ST 31-187
SB	Supply Bulletins	SB 710-1-1
SFS	Sound Filmstrips	SFS 19-14
SL	Slide Kits	SL 32-7-1
SPA	Skill Performance Aids	040-061-7049-L
SQT	Skill Qualification Tests	31E1-V5
STP	Soldier Training Products	STP 34-96D1-SM
TB	Technical Bulletins	TB 750-1
TC	Training Circulars	TC 11-4
TEC	Training Extension Courses	101-113-4775-A
TF	Training Films (Doctrine)	TF 11-2747
TM	Technical Manuals	TM 11-5815-334-12
TVT	Television Videotapes	TVT 6-103

For each MOS, develop a list of all training products. Determine the title of each product by consulting the references in the Trainer's Guide or Soldier's Manual from which the task was derived.

2. Survey the sources found on Table 3.16-4 to identify any other training products that may exist. Training products developed to support existing or comparable weapon systems or system components should be surveyed. If appropriate, add these products to the candidate list.

The sources included on Table 3.16-4 are as follows:

ITPP (AETIS)	Individual Training Plan Proposal of the Army Extension Training Information System
TRADOC Pam 310-3	TRADOC Armywide Training and Doctrinal Literature
DA Pam 108-1	Index of Army Motion Pictures and Related Audio-Visual Aids
DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms
DA Pam 350-100	Consolidated MOS Catalog
DA Pam 350-XXX-X	Extension Training Material Catalogs (series)
DA Pam 351-20	Army Correspondence Course Program Catalog
TRADOC Pam 350-33	Educational Video Tape Catalog

Table 3.16-4. Sources of Training Products Descriptions

Code	Training Product/Literature	ITPP	TRADOC Pam 310-3	DA Pam 108-1	DA Pam 310-1	DA Pam 350-100/ 350-XXX-X	DA Pam 351-20	TRADOC Pam 350-33
ACCP	Army Correspondence Course Programs	•					•	
ARTEP	Army Training & Evaluation Programs		•		•			
DA Pam	Department of Army Pamphlets		•		•			
FM	Field Manuals	•	•		•			
FS	Filmstrips	•		•		•		
GTA	Graphic Training Aids	•		•		•		
JB	Job Books	•			•			
MF	Miscellaneous Films	•		•		•		
RCSC	Reserve Component School Course Materials	•						
SB	Supply Bulletins				•			
SFS	Sound Filmstrips	•		•		•		
SL	Slide Kits	•		•		•		
SPA	Skill Performance Aids	•						
SQT	Skill Qualification Tests	•						
STP	Soldier Training Products				•			
TB	Technical Bulletins		•		•			
TC	Training Circulars	•	•		•			
TEC	Training Extension Courses	•				•		
TF	Training Films (Doctrine)	•		•		•		
TM	Technical Manuals		•		•			
TVT	Television Videotapes	•		•		•		•

STEP 4

Personnel Requirements Analysis

Purpose

The purpose of the Personnel Requirements Analysis is to estimate the number of personnel needed by each Military Occupational Specialty (MOS) which are required to sustain system specific manpower requirements. This information is essential for evaluating the impact of an emerging system's requirements on the Army's personnel resources, taking into consideration the quantity (number) and quality (paygrade) of the individuals available. It allows comparisons to be made among the systems in order to identify those MOSs which are high drivers of resources.

Within the HARDMAN analysis, personnel requirements by MOS and paygrade developed as part of this analysis constitute a principal input into Step 3 (Training Resource Requirements), Step 5 (Impact Analysis) and, if necessary, Step 6 (Tradeoff Analysis). Input and products are discussed in detail at the beginning of each substep. Figure 4-1 reflects the Personnel Requirements Analysis Logic Flow.

Manpower and personnel requirements are significantly different concepts. A manpower requirement states the necessary requirements, identified by skill, needed for direct performance of a specific set of mission-oriented tasks for a particular weapon system. Calculation of a manpower requirement is based on workload required for the tasks.

A personnel requirement estimates the number of people carried within the MOS and paygrade to offset various losses from the manpower requirement over a specified period of time. During a standard time period (one year), it is assumed that a manpower requirement remains constant ("steady-state").

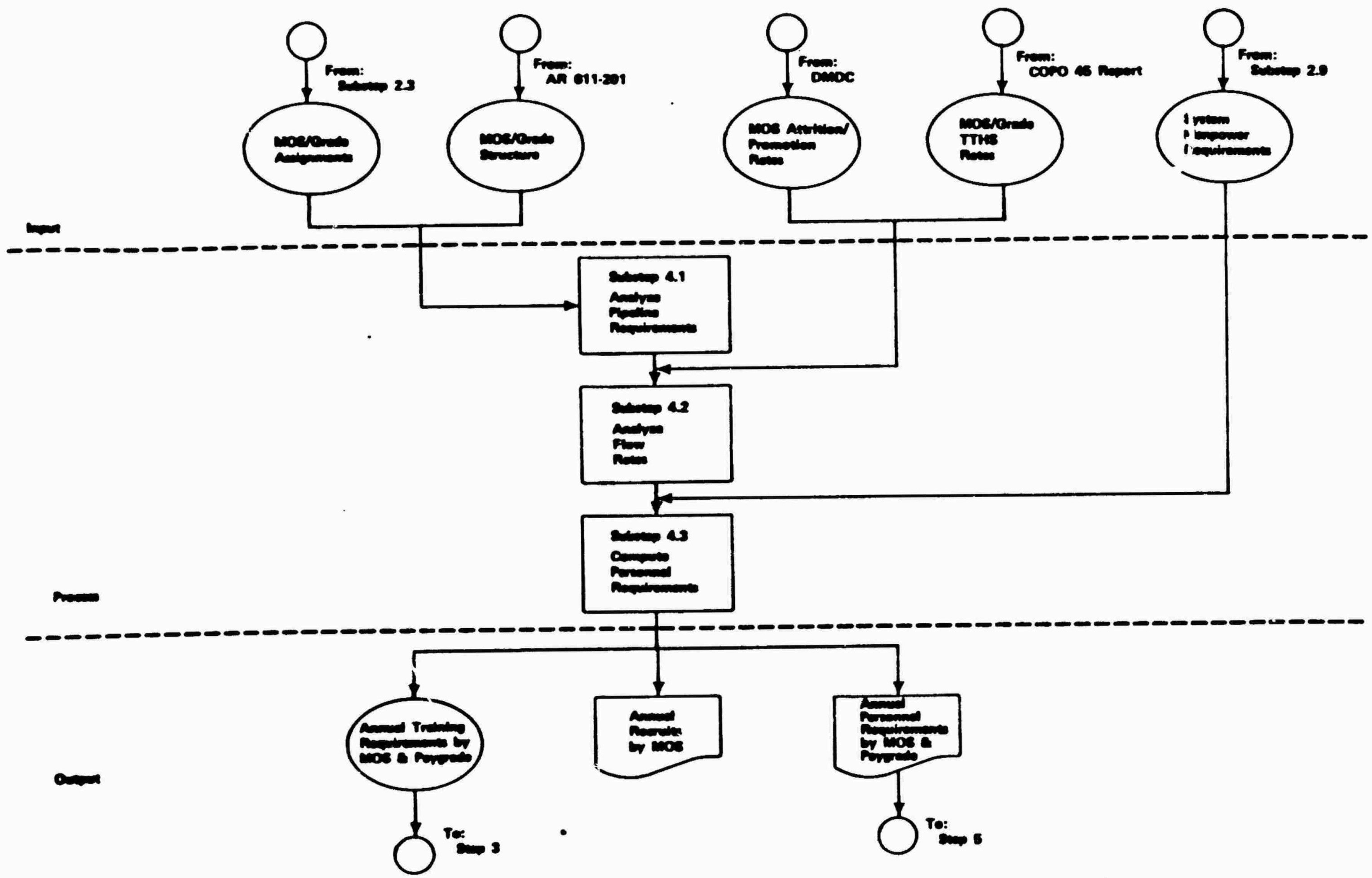

Figure 4-1. Logic flow for Personnel Requirements Analysis.

Objectives

The two major objectives of the Personnel Requirements Analysis are:

- To determine personnel flow rates for the MOSs that comprise the Predecessor (if one exists), Baseline Comparison, and Proposed Systems
- To determine the number of personnel required to enter each paygrade within an MOS to support system specific manpower requirements for the Predecessor, Baseline Comparison, and Proposed Systems; the annual E-1 requirements constitute the training load for initial MOS training

Figure 4-2 illustrates the logic upon which the Army personnel system is based. The Personnel Requirements Analysis must determine the size and structure of the personnel pipelines in steady-state condition by estimating the losses that occur to a paygrade. The primary types of losses are promotion and attrition. Promotion rate is the rate at which an MOS advances from one paygrade cell to another. Attrition rate is the rate at which individuals leave a particular MOS/paygrade cell.

Two types of attrition exist: (1) individuals who exit the Army and (2) individuals who migrate from one MOS to another. Personnel who are trainees, transients, holdees, or students (TTHS) are classified as overhead. Individuals within this category are not a direct loss to the Army or paygrade, but they do constitute a substantial loss to the operational force of that MOS/paygrade. Therefore, they must be compensated for .

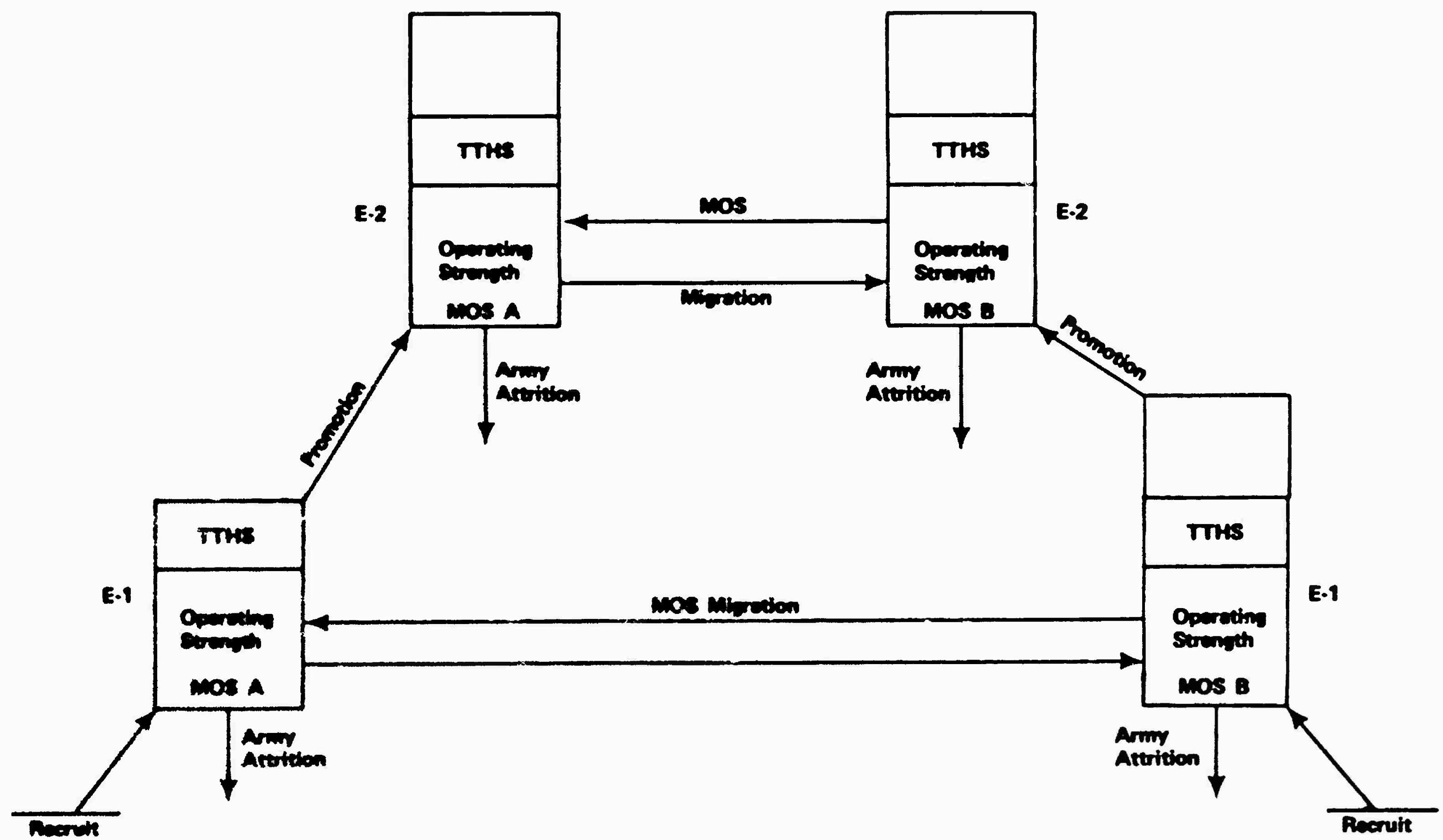

Figure 4-2. Logic flow for Army Personnel System.

The primary output of Personnel Requirements Analysis is the number of personnel which must be trained per year to support manpower requirements. Its secondary output is a personnel structure.

Interrelationships

Figure 4-3 presents an overview of the relationships between Personnel Requirements Analysis and other HARDMAN analyses. This analysis requires input from Step 2 (Manpower Requirements Analysis) and provides input to Step 3 (Training Requirements Analysis) and Step 5 (Impact Analysis).

Feedback information is exchanged interactively with Step 5 and, if necessary, with Step 6 (Tradeoff Analysis) to refine system manning requirements as well as show the impact of changes in design, system manning, or policy on personnel requirements.

Assumptions/ Constraints

The following assumptions and constraints apply to the Personnel Requirements Analysis.

- All system-specific manpower requirements will be met.
- A person must eventually be promoted or otherwise exit a paygrade.
- Assignment policy is not variable (i.e., individuals in one paygrade may not be assigned to a requirement with a different paygrade).
- Promotion rates may change, based on increased/decreased demand for a MOS as a result of system fielding/retirement.
- Rates for the entire MOS accurately reflect flows for subpopulations of the MOS.

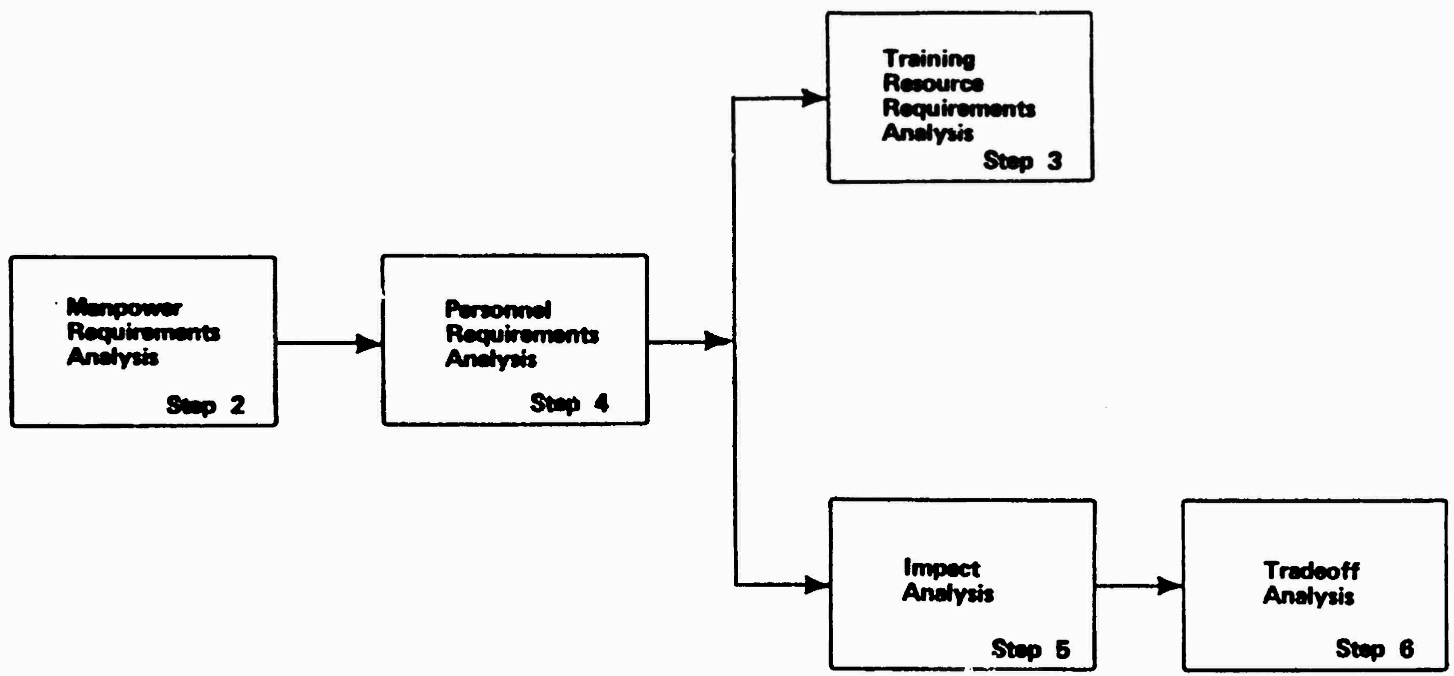

Figure 4-3. Relationship of Personnel Requirements Analysis to other HARDMAN steps.

Substeps

The Personnel Requirements Analysis is conducted in three substeps: Analyze Pipeline Requirements (Substep 4.1), Analyze Flow Rates (Substep 4.2), and Compute Personnel Requirements (Substep 4.3). Each substep represents a separate requirement necessary to identify the steady-state personnel pipeline requirements to sustain a system when fielded.

Based on the input from Substep 2.3 (Determine Final MOS/Grade Assignments), the personnel flow (career path) for each MOS is determined in Substep 4.1. In Substep 4.2, rates associated with these flows are analyzed to insure that each conforms to a standard norm so personnel requirements by MOS/paygrade can be determined. These requirements are computed in Substep 4.3.

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Analyze Pipeline Requirements

Overview

All Military Occupational Specialties are not structured the same. While some contain positions for Skill Levels 1 (E3-E4) through 5 (E8-E9), others may be structured with only two or three skill levels and become "feeder" MOSs to another MOS at a higher skill level. Related MOSs are grouped within a career management field (CMF) which is structured to be supportable by annual input of personnel during their first term of enlistment. Thus, before determining total personnel sustainment requirements for a system, the career path must first be determined.

Objective

The objective of Substep 4.1 is to identify the career path for each MOS and paygrade identified in Substep 2.3 (Determine Final MOS/Grade Assignment).

Input

Input to accomplish this substep is required from two sources: the MOS/Grade assignments for each system comprising the analysis from Substep 2.3 and the MOS career paths extracted from AR 611-201 (Enlisted Career Fields and Military Occupational Specialties).

Product

The product of this substep is the identification of career paths for each MOS/paygrade identified in Substep 2.3. This information is input to Substep 4.2 (Analyze Flow Rates).

Logic

Figure 4.1-1 reflects to logic used to identify the career path for each MOS/Grade identified as a result of the analysis conducted in Substep 2.3.

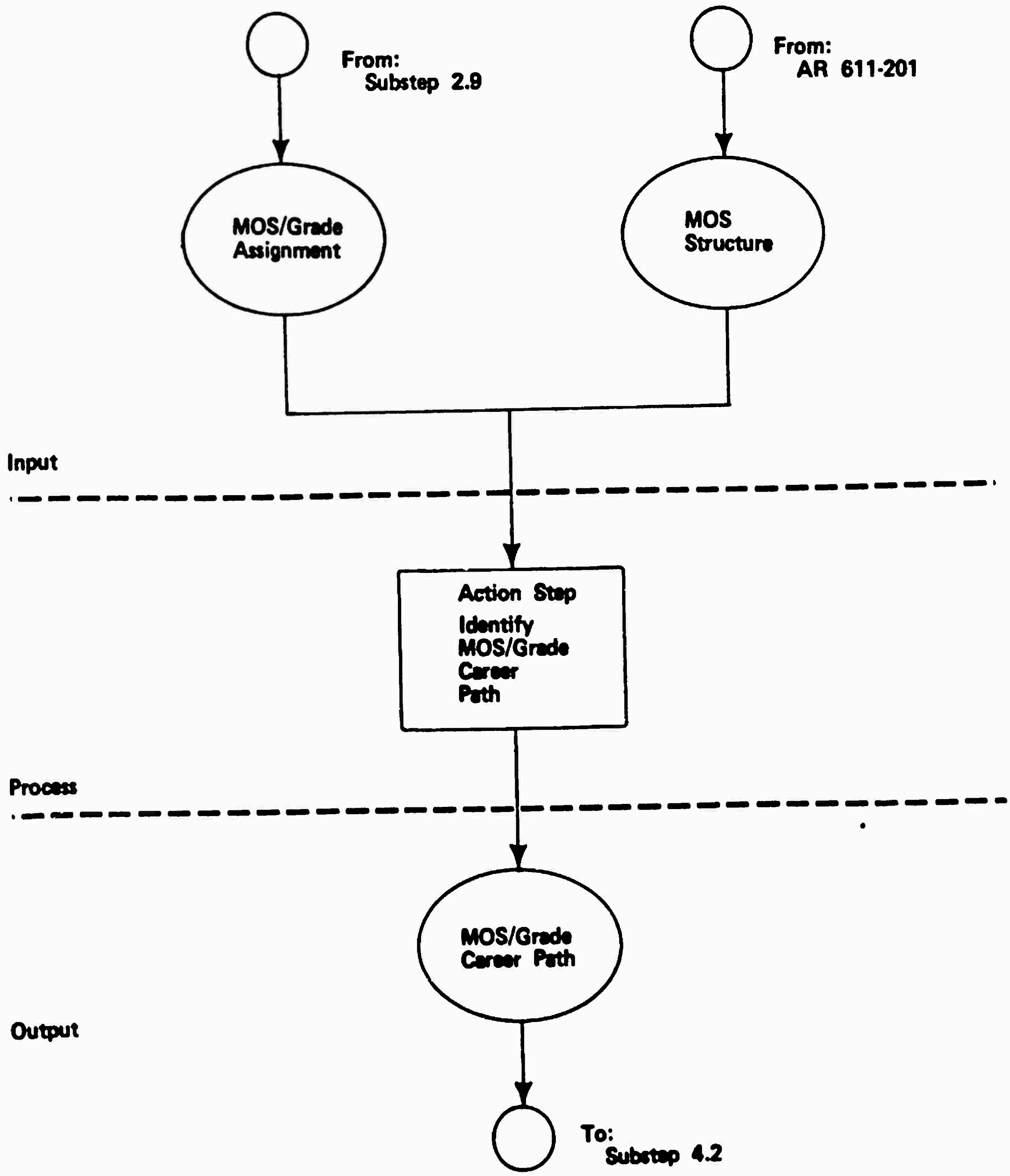

Figure 4.1-1. Logic flow for Analyze Pipeline Requirements.

Action Step

Requirements

Using the CMF structure in AR 611-201, the analyst constructs the career path for each MOS under study.

Objective

The objective is to identify the career path for each MOS for each system in the study.

Procedure

For each MOS identified as operators and maintainers for each system in the analysis, the analyst extracts the career path from the appropriate CMF structure found in AR 611-201. Figure 4.1-2 provides an example of the career path for MOS 41B, Topographic Instrument Repair Specialist.

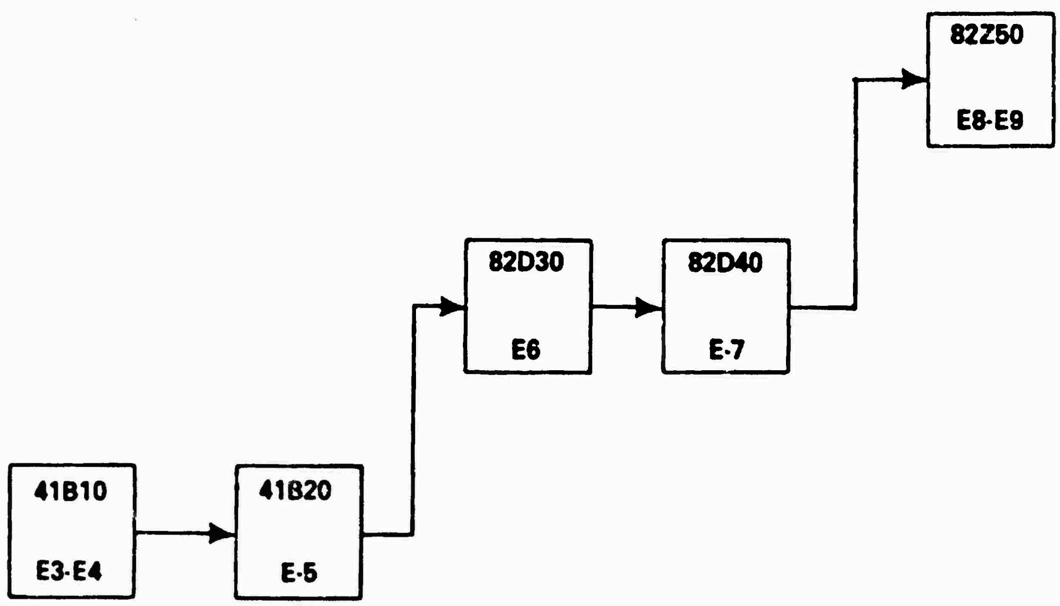

Figure 4.1-2. MOS 41B career path.

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Analyze Flow Rates

Overview

Several variables affect the personnel flow rates which account for different attrition, promotion, and TTHS rates among MOSs and paygrades. For example, as systems are presently being deployed or retired, manpower requirements are changing for particular MOSs. If the demand for an MOS decreased as a result of a system retirement, promotion rates should decrease and attrition rates should increase.

Most individuals either exit the Army or migrate to another MOS due to the lack of promotion opportunity in the field. The opposite may occur when a system is deployed. If a higher demand for a single MOS is encountered, promotion rates may increase while attrition rates decrease. Demand for an MOS which is assigned additional tasks may increase, particularly if an additional skill identifier (ASI) is required. Low promotion rates and high attrition rates may also arise with feeder MOSs.

Just as MOS demand affects promotion and attrition rates, it also may affect TTHS rates. Increased demand within an MOS and increased formal training requirements will increase TTHS rates. Likewise, the opposite will occur when demand and formal training requirements are reduced.

Objective

The objective of this substep is to establish the normalized (average) personnel flow rate for each MOS/grade career path identified in Substep 4.1 to account for individuals having different patterns of schooling and career histories.

Input

In addition to each MOS/grade career path identified in Substep 4.1, two other sources provide the data required to establish the personnel flow rates. Promotion rates and attrition rates for all MOSs and paygrades are obtainable from the Defense Manpower Data Center (DMDC). TTHS rates are determined using data from the Chief of Personnel Operations (COPO) 45 Report published quarterly by the U.S. Army Military Personnel Center (MILPERCEN).

Logic

Figure 4.2-1 depicts the logic used to establish the personnel flow rates for each MOS and paygrade.

Action Step

Requirements

The analyst calculates the attrition and promotion percentages using quarterly extracts from the Army's enlisted master file (EMF), which is supplied by the Defense Manpower Data Center. These data cover a two-year period, give the rates for each quarter, and are available in either tape or hard copy.

Objective

Attrition and promotion percentages are calculated for each MOS and paygrade.

Procedures

1. The analyst first requests quarterly personnel flow characteristics (attrition and promotion) from the Army's enlisted master file. This information is obtained from DMDC in tape format. Table 4.2-1 is an example of the record format for requesting data.

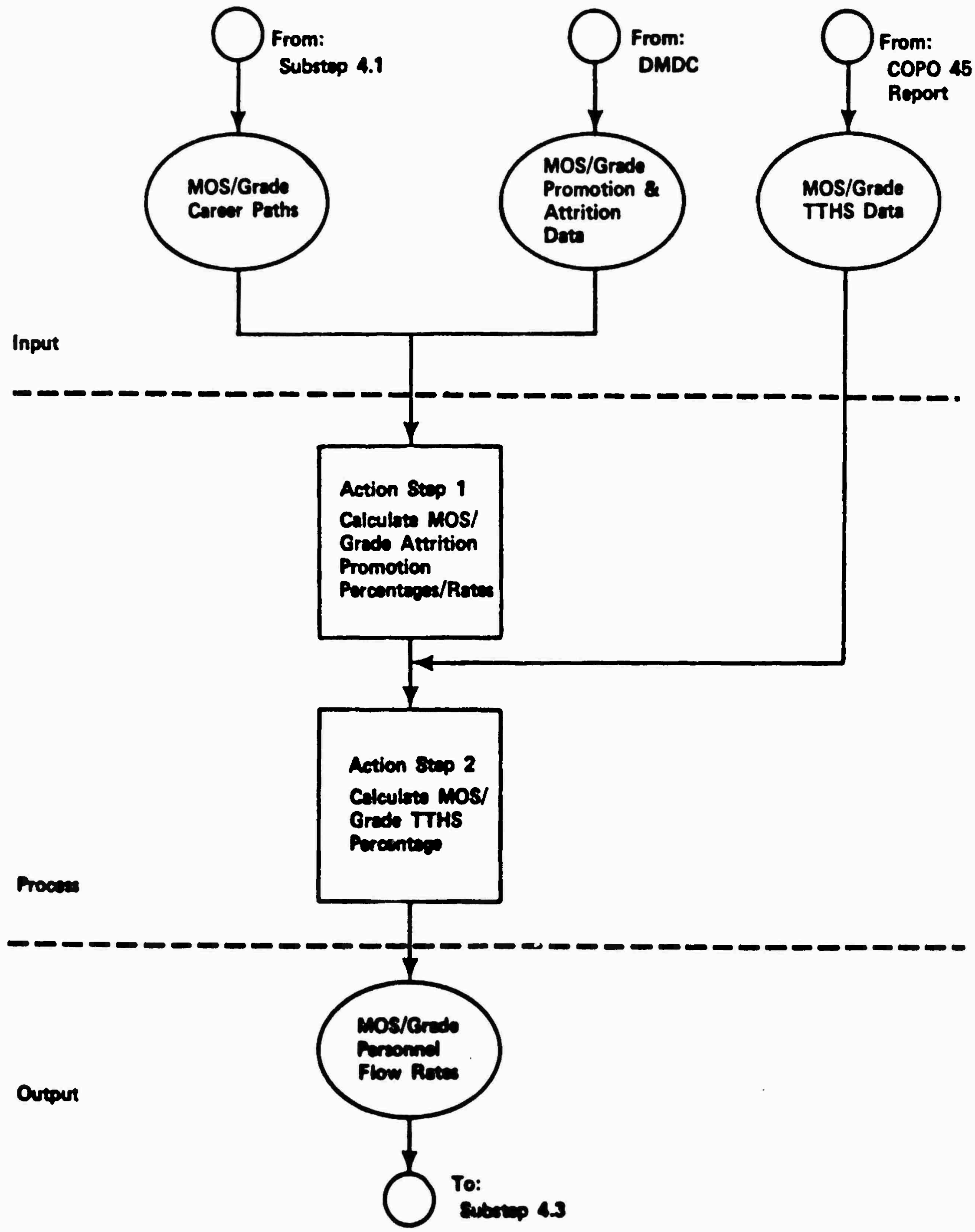

Figure 4.2-1. Logic flow for Analyze Flow Rates.

Table 4.2-1. Sample Record Format

Field	Record Position	Value
MOS	1-3	MOS specified in your request
Paygrade	4-5	0 - 10 0 = Unknown 1 = E1 2 = E2 . . . 9 = E9 10 = Total
Base Population	7-13	Number of people in that MOS paygrade.
Attrition Rate	14-19	In the form of 9.999 (including decimal)
Promotion Rate	26-31	In the form of 9.999 (including decimal)

Table 4.2-2 is an example of personnel rate data in hardcopy. The report contains eight quarters (two years) of data. Attrition and promotion percentages are reported for each MOS by paygrade as well as by MOS base population.

2. Next, the analyst must add all eight data periods (quarters) together by paygrade. This summation is also carried out by attrition rate and by promotion rate.

3. After this step is completed, an average is taken for each paygrade.

Table 4.2-2. Sample Personnel Rate Data

PQTR REPORT 3-Dec-1984
Page 55

Data Period	MOS	Pay-grade	Base Population	Attrition Rate	Promotion Rate
1	31V	1	571	0.163	0.231
1	31V	2	256	0.102	0.473
1	31V	3	914	0.058	0.253
1	31V	4	860	0.080	0.040
1	31V	5	564	0.039	0.032
1	31V	6	2205	0.020	0.003
1	31V	7	877	0.043	0.007
1	31V	8	226	0.049	0.009
1	31V	9	1	1.000	0.000
2	31V	1	513	0.133	0.452
2	31V	2	224	0.107	0.446
2	31V	3	784	0.046	0.154
2	31V	4	992	0.074	0.007
2	31V	5	585	0.063	0.010
2	31V	6	2228	0.021	0.003
2	31V	7	849	0.046	0.013
2	31V	8	220	0.064	0.009
2	31V	9	0	0.000	0.000
3	31V	1	386	0.158	0.347
3	31V	2	315	0.079	0.387
3	31V	3	756	0.056	0.142
3	31V	4	1056	0.096	0.040
3	31V	5	564	0.067	0.004
3	31V	6	2231	0.026	0.000
3	31V	7	820	0.043	0.009
3	31V	8	214	0.042	0.005
3	31V	9	2	0.500	0.000
4	31V	1	256	0.109	0.461
4	31V	2	295	0.078	0.488
4	31V	3	743	0.059	0.203
4	31V	4	1031	0.096	0.122
4	31V	5	586	0.053	0.015
4	31V	6	2202	0.025	0.088
4	31V	7	788	0.061	0.034
4	31V	8	214	0.047	0.014
4	31V	9	2	0.000	0.000

Table 4.2-2. Sample Personnel Rate Data [con't.]

Data Period	MOS	Pay-grade	Base Population	Attrition Rate	Upgrade Rate
5	31V	1	357	0.092	0.165
5	31V	2	250	0.088	0.472
5	31V	3	726	0.055	0.230
5	31V	4	956	0.089	0.037
5	31V	5	704	0.041	0.000
5	31V	6	1992	0.023	0.013
5	31V	7	928	0.041	0.008
5	31V	8	235	0.051	0.009
5	31V	9	5	0.400	0.000
6	31V	1	433	0.125	0.388
6	31V	2	176	0.091	0.489
6	31V	3	659	0.064	0.326
6	31V	4	1033	0.127	0.001
6	31V	5	719	0.038	0.003
6	31V	6	1950	0.020	0.001
6	31V	7	921	0.038	0.002
6	31V	8	230	0.065	0.004
6	31V	9	7	0.714	0.000
7	31V	1	381	0.095	0.357
7	31V	2	254	0.106	0.366
7	31V	3	515	0.082	0.208
7	31V	4	1163	0.137	0.009
7	31V	5	709	0.042	0.010
7	31V	6	1915	0.029	0.009
7	31V	7	889	0.024	0.012
7	31V	8	222	0.072	0.014
7	31V	9	2	0.500	0.000
8	31V	1	402	0.075	0.401
8	31V	2	282	0.046	0.582
8	31V	3	492	0.049	0.272
8	31V	4	1126	0.112	0.020
8	31V	5	696	0.065	0.056
8	31V	6	1843	0.053	0.079
8	31V	7	879	0.096	0.011
8	31V	8	218	0.147	0.009
8	31V	9	2	0.500	0.000

Example

Extract the attrition rates from the hardcopy for all eight data periods (Procedure 1):

MOS 31V

Pay-Grade	Period 1	2	3	4	5	6	7	8
E1	0.163	0.133	0.158	0.109	0.092	0.125	0.095	0.075
E2	0.102	0.107	0.079	0.078	0.088	0.091	0.106	0.046
E3	0.058	0.046	0.056	0.059	0.055	0.064	0.082	0.049
E4	0.080	0.074	0.096	0.096	0.089	0.127	0.137	0.112
E5	0.039	0.063	0.067	0.053	0.041	0.038	0.042	0.065
E6	0.020	0.021	0.026	0.025	0.023	0.020	0.029	0.053
E7	0.043	0.046	0.043	0.061	0.041	0.038	0.024	0.096
E8	0.049	0.064	0.042	0.047	0.051	0.065	0.072	0.147

Next, extract the promotion rates:

MOS 31V

Pay-grade	Period 1	2	3	4	5	6	7	8
E1	0.231	0.452	0.347	0.461	0.165	0.388	0.357	0.401
E2	0.473	0.446	0.387	0.488	0.472	0.489	0.366	0.582
E3	0.253	0.154	0.142	0.203	0.230	0.326	0.208	0.272
E4	0.040	0.007	0.040	0.122	0.037	0.001	0.009	0.020
E5	0.032	0.010	0.004	0.015	-	0.003	0.010	0.056
E6	0.003	0.003	-	0.088	0.013	0.001	0.009	0.079
E7	0.007	0.013	0.009	0.034	0.008	0.002	0.012	0.011
E8	0.009	0.009	0.005	0.014	0.009	0.004	0.014	0.009

Once the rates have been extracted, add all eight data periods together by paygrade (Procedure 2):

MOS 31V

Paygrade	Attrition	Pro-motion
E1	0.950	2.802
E2	0.697	3.703
E3	0.469	1.788
E4	0.811	0.276
E5	0.408	0.130
E6	0.217	0.196
E7	0.392	0.096
E8	0.537	0.073

Divide each paygrade by eight to calculate the average attrition and promotion percentage results (Procedure 3):

MOS 31V

Paygrade	Attrition	Pro-motion
E1	0.118	0.350
E2	0.087	0.462
E3	0.058	0.223
E4	0.101	0.034
E5	0.051	0.016
E6	0.027	0.024
E7	0.049	0.012
E8	0.067	0.009

Action Step 2: Calculate Transient, Trainee, Holdee, or Student (TTHS) Percentage

Requirements

The analyst calculates the TTHS percentage using data from the Chief of Personnel Operations (COPO) 45 Report (in microfiche form).

Objective

In this step, the TTHS percentage is determined for each MOS/paygrade.

Procedures

The TTHS percentage is based on eight quarters (two years) of the U.S. Army COPO 45 Report. The analyst extracts the TTHS and operating strength numbers by MOS and paygrade. Table 4.2-3 shows a standard COPO 45 Report for one quarter.

1. With this data, the analyst performs the first step in computing the TTHS percentage for eight quarters by means of the following equation:

$$TTHS\% = \frac{TTHS}{TTHS + Oper}$$

Where: TTHS% = Transient, Trainee, Holdee, or Student Percentage

TTHS = Transient, Trainee, Holdee, or Student

Oper = Operating Strength (Army-wide)

Table 4.2-3. Sample Part 6 COPO 45 Sept. '83

Army-Wide
Enlisted Authorization/Strength Comparison

PMOS	E1/ E3	E4	E5	E6	E7	E8	E9	Total
31V								
Oper	931	914	672	1916	894	220	5	5552
TTHS	402	42	32	77	34	15	0	602

2. Each paygrade is then averaged over eight quarters. For example:

Table 4.2-4. TTHS Percentage for 31V

Quarter 1			Quarters 2-8
31V	TTHS	OPER	
E1-3	402	931	"
4	42	914	"
5	32	672	"
6	77	1916	"
7	34	894	"
8	15	220	"

The above data are formatted for each paygrade and all eight quarters:

31V

E1 $$\frac{402}{402 + 93} = \frac{402}{495}$$

E8 $$\frac{15}{15 + 220} = \frac{15}{235}$$

The analyst then aggregates all eight quarters. An average is taken at each paygrade to arrive at the TTHS percentage.

$$\frac{15}{235} = 0.063$$

(The above percentage reflects only one quarter.)

Compute Personnel Requirements

Overview

This substep is preceded by determining the career path for each of the MOSs associated with the system (Substep 4.1) and gathering and analyzing the flow rates of each (Substep 4.2). The only remaining task is to adjust the manpower requirements by the personnel flow characteristics of the MOS. This adjustment is performed by computing the number of additional people which must be carried in previous paygrades to support the required level at a higher paygrade.

Having analyzed and formatted the flow rates in the previous substep, it becomes a fairly straightforward mathematical computation to apply those rates to the manpower requirements in this substep. The final products are manpower numbers for each paygrade in the MOS adjusted by attrition rates, promotion rates, and TTHS rates to yield a personnel rate which includes all these flow rates and reflects the actual number of soldiers which must be carried in the personnel pipeline to satisfy the Proposed System's manpower requirements.

Objective

The objective of this substep is simply to perform the mathematical computation required to adjust the stated manpower requirement by historical flow rates of the MOS under study.

Input

Attrition, promotion, and TTHS rates computed in Substep 4.2 are input. Manpower requirements for the MOSs determined in Step 3 (Manpower Analysis) are also input.

Products

This substep yields the number of soldiers needed in each paygrade of an MOS required to support (that is, to offset losses) system manpower requirements at a higher paygrade. The process also yields, when regarded as a whole, an accurate depiction of the personnel flow and personnel pyramid of a particular

MOS required to support the manpower requirements of the system under study.

Logic

Figure 4.3-1 depicts the logic used to compute the personnel requirements for each MOS and paygrade.

Action Step Requirements

The analyst calculates personnel requirements using manpower requirements, attrition, promotion, and TTHS percentages.

Objective

For this step, personnel requirements are calculated for each MOS by paygrade.

Procedures

1. For each MOS and paygrade, the given manpower requirements from Step 2 must be inflated by the calculated TTHS percentage.

$$M_n = MR_n (1 + T_n)$$

Where:

- M = Adjusted manpower requirements
- MR = Manpower requirements
- T = Transient, Trainee, Holdee, or Student (TTHS)
- n = Paygrade

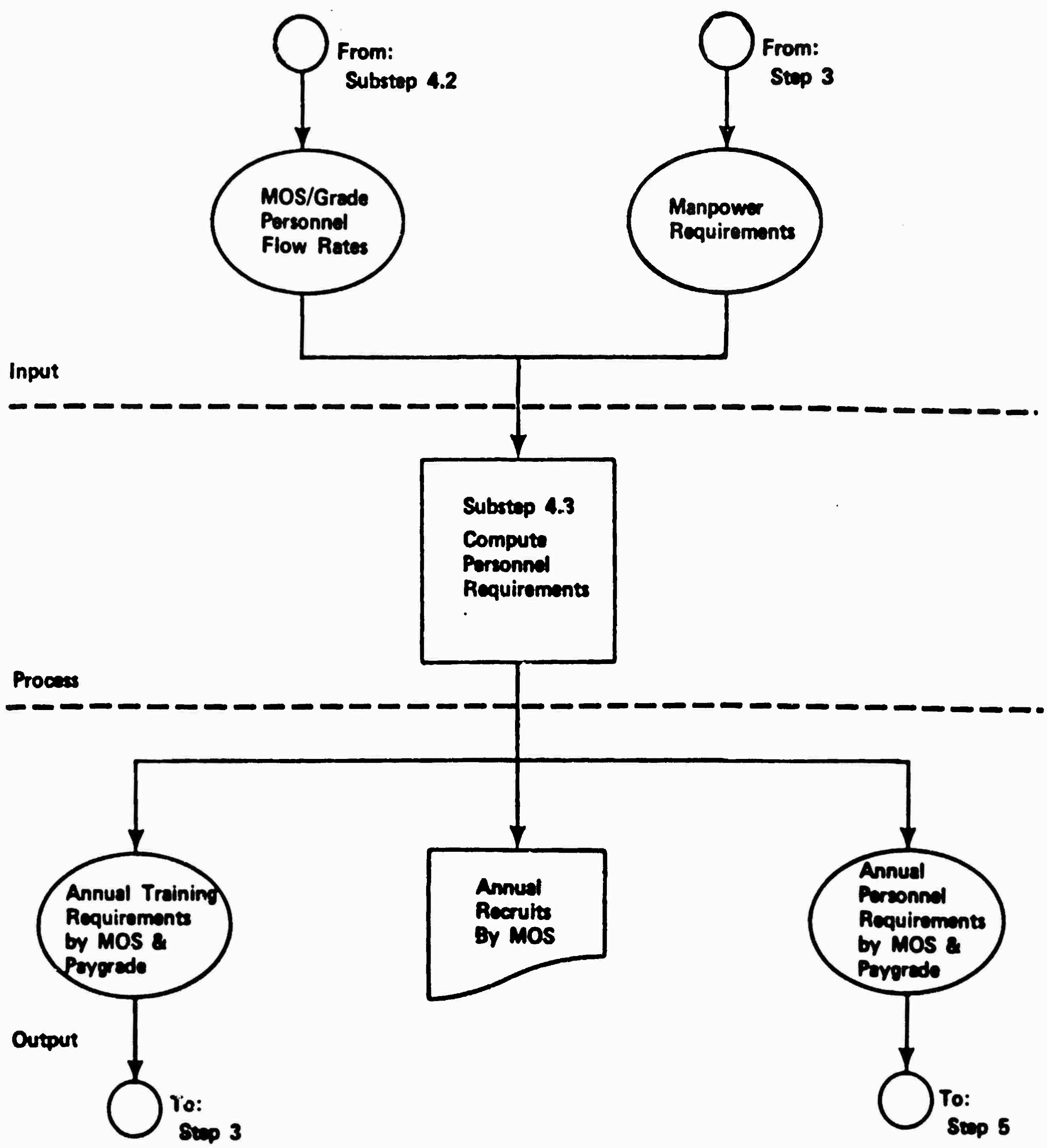

Figure 4.3-1. Logic flow for Computer Personnel Requirements.

The analyst calculates the levels of personnel requirements by paygrade which satisfy all manpower requirements by paygrade using this formula:

$$X_n (A_n + U_n) = X_{n-1} (U_{n-1})$$

and

$$X_n = M_n + O_n$$

Where:

X = Personnel requirements
A = Yearly attrition rates
U = Yearly promotion rates
M = Manpower requirements
O = Overhead rates
n = Paygrade

The analyst applies the following formula to calculate the number of personnel to be trained per year.

$$TR_n = X_n (A_n + U_n)$$

Where:

TR = Personnel to be trained per year
X = Personnel requirements
A = Yearly attrition rates
U = Yearly promotion rates
n = Paygrade

Example

Manpower Requirements from Step 2:

MOS 31V

Paygrade	Manpower Requirements
E1	0
E2	0
E3	18
E4	14
E5	9
E6	4
E7	0
E8	0
E9	0

The analyst inflates the above manpower requirements by the TTHS percentage to obtain the adjusted manpower for the 31V. The numbers reflect TTHS percentages for all eight quarters:

MOS 31V

Paygrade	TTHS Percentages	Manpower Requirements
E1	0.000	0
E2	0.000	0
E3	0.323	18
E4	0.064	14
E5	0.055	9
E6	0.044	4

(NOTE: No manpower requirements exist beyond Paygrade 6.)

$$M_n = 18\ (1 + 0.323)$$

$$M_n = 23.8$$

$$M_n = 14\ (1 + 0.064)$$

$$M_n = 14.9$$

$$M_n = 9\ (1 + 0.055)$$

$$M_n = 9.6$$

$$M_n = 4\ (1 + 0.044)$$

$$M_n = 4.2$$

MOS 31V Adjusted Manpower:

E1	E2	E3	E4	E5	E6
0	0	23.8	14.9	9.6	4.2

2. Applying the personnel requirements algorithm, the analyst calculates personnel requirements for the 31V. Attrition and promotion rates determined in Procedure 1 are input. The process will iterate itself several times until the highest manpower (adjusted) requirement is satisfied. This process can be performed with a hand calculator (see Table 4.3-1).

Table 4.3-1. Sample Iteration Process

MOS 31V

E1	E2	E3	E4	E5	E6	E7	E8
1	0.6	0.9	1.4	0.7	0.2	0.07	0.01
2	1.2	1.9	3.1	1.5	0.4	0.1	0.01
3	1.9	3.1	5.1	2.5	0.7	0.2	0.03
4	2.5	4.1	6.7	3.4	1.0	0.3	0.04
5	3.1	5.0	8.2	4.1	1.2	0.4	0.09
6	3.8	6.2	10.2	5.1	1.6	0.6	0.09
7	4.4	7.2	11.8	5.9	1.8	0.7	0.1
8	5.1	8.3	13.7	6.9	2.1	0.8	0.1
9	5.7	9.3	15.3	7.7	2.4	0.9	0.1
10	6.3	10.3	17.0	8.6	2.6	1.0	0.1
11	7.0	11.5	18.9	9.5	2.9	1.1	0.1
12	7.6	12.4	20.4	10.3	3.2	1.2	0.1
13	8.2	13.4	22.1	11.2	3.5	1.3	0.2
14	8.9	14.6	24.1	12.2	3.8	1.4	0.2
15	9.5	15.6	25.7	13.0	4.0	1.5	0.2
16	10.2	16.7	27.5	13.9	4.3	1.6	0.2
17	10.8	17.7	29.2	14.8	4.6	1.8	0.2
18	11.4	18.7	30.8	15.6	4.8	1.8	0.2
19	12.1	19.8	32.7	16.5	5.1	2.0	0.3
20	12.7	20.8	34.3	17.4	5.4	2.1	0.3
21	13.3	21.8	36.0	18.2	5.7	2.2	0.3
22	14.0	23.0	37.9	19.2	6.0	2.3	0.3
23	14.6	24.0	39.6	20.0	6.2	2.4	0.3

The algorithm is stated as:

$$X_n (A_n + U_n) = X_{n-1} (Un-1)$$

$$X_n = (M_n + O_n)$$

For this example, the iteration process was started at one and incremented by one each time until the highest manpower requirement was satisfied.

The last line of Table 4.3-1 shows the personnel requirements needed to satisfy the manpower requirements.

Using the personnel requirements results as well as attrition and promotion rates, the analyst can now determine the number of personnel to be trained for the 31V:

MOS 31V

$$T_3 = 24.0\ (0.058 + 0.223)$$

$$T_3 = 6.7$$

$$T_4 = 39.6\ (0.101 + 0.034)$$

$$T_4 = 5.3$$

$$T_5 = 20.0\ (0.051 + 0.016)$$

$$T_5 = 1.3$$

$$T_6 = 6.2\ (0.027 + 0.024)$$

$$T_6 = 0.3$$

Glossary

Action Rate The preventive maintenance action rate measured as the number of occurrences (i.e., demand) per life unit (calendar/clock time, miles/kilometers traveled, rounds fired or number of activations); (paraphrased from AR 570-2).

Additional Skill Identifier (ASI) A code added to the specialty/MOS to designate greater specialization (AR 351-1). For example, soldiers with either 11B, 12B, 19D MOS who receive Dragon Gunnery Training are assigned the ASI C2.

Administrative Time POI time allotted for administrative functions as opposed to course/training related functions.

Advanced Individual Training (AIT) Skill training given enlisted personnel after completion of basic training, so as to qualify them for the award of an MOS and to perform the basics of their job upon initial assignment to a unit (AR 351-1).

Noncommissioned Officer Course (ANCOC) A course that stresses MOS-related tasks with emphasis on technical and advanced leadership skills, and knowledge of military subjects required to train and teach other soldiers at the platoon and comparable level (AR 351-1).

Annex Logical divisions in a program of instruction (POI) that cluster tasks into blocks of instruction. Within each annex are lessons (identified by file numbers) which are designed to instruct the tasks.

Annual Accessions The number of individuals who must be recruited in a year.

Annual Costs Total cost of training computed on an annual basis.

Annual Course Costs Total course cost and individual course cost elements computed on an annual basis.

Annual Course Resources Products of Training Cost and Resources. Include number of instructors required, training cost, and training man-days.

Annual Instructor Requirements The number of instructors required to deliver all convenings of a course in a year.

Annual Training Man-Day Requirements Number of man-days per year that soldiers will be receiving a course of instruction and be unavailable for assignment to other duties.

Attrition Rate The rate at which individuals leave the Army at each paygrade within each MOS.

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

Availability Ratio An estimate of availability of an MOS to support a Proposed System.

Base Operations Cost Cost to the base operations functional account adjusted by the total number of training man-weeks.

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

Basic Combat Training (BCT) Fundamentals of basic infantry combat given to enlisted Active Army and Reserve personnel without prior military service (AR 310-25).

Basic Noncommissioned Officer Course (BNCOC) A course that prepares career soldiers in Grade E5 (Skill Level 2) for duties at grade E6. Performance-oriented training is stressed (AR 351-1).

Basic Technical Course (BTC) A course that focuses on training critical tasks listed in the Skill Level 3 Soldier's Manual for a given MOS (AR 351-1).

Basis of Issue Plan (BOIP) A plan which indicates the quantity of new or modified equipment planned for each type organization and the planned changes to personnel and supporting equipment (AR 70-27).

Bill Payer An older system that is currently consuming MPT resources and that will be phased out of the inventory upon introduction of the new system.

Career Management Field (CMF) A list of operator or maintainer Military Occupational Specialties for one functional branch area.

Class Frequency Average number of times a Program of Instruction is offered each year (averaging across locations).

Class Length Length of a course of study, usually stated in weeks.

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

Comparable Task The task closest to a new task in terms of task criticality and similarity to type or class of task.

Corrective Maintenance (CM) All actions performed as a result of failure to restore an item to a specific condition (MIL-STD-1388-1A).

Cost and Training Effectiveness Analysis (CTEA) The sole Army process used to assess the training cost and effectiveness of developing weapon systems.

Course Attrition The number of students failing to graduate from a course of instruction.

Course Number An alphanumeric code used to designate a Program of Instruction.

Course Module A component instruction which teaches a specific task; can exist at course, annex, or file level.

Course, System-Specific (1) The Advanced Individual Training (AIT) and Additional Skill Identifier (ASI) courses for all MOSs assigned to equipment in the Predecessor, Baseline Comparison, and Proposed Systems; and (2) the Noncommissioned Officer Education System (NCOES), warrant and commissioned officer courses providing direct instruction on system-specific equipment.

Crew Maintenance Maintenance actions that are performed by the personnel whose principal duty is operation of a system.

Critical Resources The implementation or management risk associated with the introduction of a new system. This risk involves manpower, personnel, and training demands created by the new system compared to the present or projected supply.

Data Management Structure A systematic, consistent method of organizing information.

Delta The Greek letter; symbolizes an expected change in the manpower, personnel, and training requirements cited in output reports.

Dependency The relationship (dependency) between a specific maintenance action and a specific metric. For example, maintenance actions associated with automotives usually depend on the number of miles driven, maintenance associated with an artillery tube depends on rounds fired, and electronic equipment depends on hours operated.

Depot Maintenance Maintenance involving the overhaul of economically repairable materiel to augment the procurement program in satisfying the overall Army requirements and when required to provide for repair of materiel beyond the capability of general support maintenance organizations (AR 310-25).

Design Differences Differences in design between projected equipment and comparable existing equipment used in the Baseline Comparison System.

Design Freedom The absence of a detailed design at the beginning of a weapon system's development.

Direct Cost Operational and Maintenance, Army (OMA), Military Personnel, Army (MPA) and Procurement Account (PA) cost elements that are directly contributable to the cost per graduate for a specific course or group of courses. The following direct costs are listed in TRADOC Cost Analysis Program Reports (MOS Training Costs), ATRM-159 (R1): direct mission, troop support, ammunition, equipment item depreciation, student pay and allowances, travel pay to course, per diem at course.

Direct Maintenance Effort expended by maintenance personnel in the actual performance of maintenance on the hardware in accordance with the prescribed procedures contained in the applicable technical manuals (DA PAM 700-127).

Direct Mission Cost Operational and Maintenance, Army (OMA) and Military Personnel Army (MPA) cost of the instructional department's costs, plus the flying hours costs plus any other costs all computed on a per graduate basis. Algorithms for computing these costs are contained in Cost Analysis Program Reports (MOS Training Costs) ATRM-159 (R1) documents.

Direct Support Maintenance (DS) Normally authorized and performed by designated maintenance activities in direct support of using organizations. This category of maintenance is limited to the repair of end items or unserviceable assemblies in support of using organizations on a return to user basis (AR 310-25).

Duty Position A group of closely related tasks and responsibilities which are normally assumed by one individual (AR 310-25).

End-Item Equipment A final combination of end item products, components, parts and/or materials that is ready for its intended use, e.g., ship, tank, mobile machine shop, aircraft (MIL-STD-1388-1A).

Engineering Comparability Analysis A structured analytic process utilizing principles of reliability/maintainability (R/M) engineering, logistics engineering, industrial engineering, and statistical extrapolation to predict the reliability and maintainability of new systems based upon the R/M characteristics of existing systems.

Environmental Variables Environmental factors such as heat, cold, snow, mud, desert conditions, etc., which may impact the operating scenario of the proposed weapon system.

Equipment Depreciation Cost Cost of equipment dedicated to a course, non-dedicated departmental equipment, and school overhead equipment amortized over a ten-year period and applied to Course Cost.

Equipment Identification Code (EIC) An alphanumeric coding scheme used to identify specific pieces of equipment. May equate to Functional Group Codes, Work Unit Codes, or Logistic Support Analysis Record numbers.

File The lessons within an annex of a program of instruction (POI) in which tasks are taught.

First Unit Equipped (FUE) The first troop unit to be equipped with the first production items/systems (DA PAM 700-127).

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

Frequency The number of times the task is performed per period of time.

Front-End Analysis The process of assessing what impacts the manpower, personnel, and training requirements of an emerging system will have on present and projected resources.

Function A broad category of activity performed by a man-machine system (Draft MIL-STD on Task Analysis, Feb. 1980). For example, upper level functions of a self-propelled howitzer would be to shoot, move, and communicate. The requirement to shoot would have lower level functions such as direct and indirect fire.

Functional Allocation The categorization of the activities (functions) performed by a man-machine system into who or what will perform them. The performance categories include hardware, software, human (operator, maintainer, or support), or a combination of these.

Functional Group Code (FGC) A standard indexing system which parcels the weapon system into its functional systems, subsystems, components/assemblies, and parts.

Functional Hierarchy Functional structure which first identifies the major functions and subsequently each of the lower level functions a system is expected to perform. These functions are arranged in a hierarchical structure to aid in the identification of components from which lower level functions and their sequence are determined and described.

Functional Requirements Functions or activities required of a proposed weapon system. These required functions are developed and stated in DoD and Army threat studies, mission area analyses, how-to-fight manuals, use studies, and system concept papers.

General Support Maintenance (GS) The maintenance authorized and performed by designated Table of Organization and Equipment (TOE) and Table of Distribution and Allowance (TDA) organizations in support of the Army Supply System. Normally, these organizations will repair or overhaul materiel to required maintenance standards in a ready-to-issue condition based upon applicable supported Army area supply requirements (AR 310-25).

Generic System A description of the general configuration of equipment, software, and duty positions required to fulfill all system functional requirements stated in Army Mission Area Analyses and System Concept Papers.

Hardware Function An activity (function) accomplished principally by the equipment.

High Driver A system element which consumes a large proportion of MPT resources.

Indirect Cost A cost which, because of its incurrence for common or joint objectives, is not readily subject to treatment as a direct cost (AR 310-25).

Indirect Maintenance Also stated as Indirect Productive Time (IPT); the time required for normal performance of the maintenance tasks but that does not in and by itself result in the total time required to accomplish the tasks. Indirect maintenance will not exceed a ratio of 1 to 0.4 (direct to indirect) for organizational and direct support maintenance. For general support, indirect maintenance will not exceed a ratio of 1 to 0.22 (direct to indirect).

Individual and Collective Training Plan (ICTP) The primary resource and planning document for developing training subsystems for new Army systems. The ICTP describes the integration of training subsystems into the development of the total system as well as integration of the developing system into ongoing training programs.

Individual Work Capacity The available productive man-hours (available for MOS duties). Excludes all non-available time factors such as security, kitchen patrol, work details, messing, casualties, personal needs, and unit movement (AR 570-2).

Induced Maintenance See Unscheduled Maintenance, Induced.

Inherent Maintenance See Unscheduled Maintenance, Inherent.

Instructional Department Cost Includes Operations and Maintenance, Army (OMA) and Military Personnel, Army (MPA) costs of the academic department's cost per graduate. It also includes pay and allowances of instructors and academic department staff, consumable supplies and equipment, and contractual services. The method used to compute Instructional Department Cost can be found in the Cost Analysis Program (MOS Training Costs) documents [ATRM-159 (R1)].

Instructional Systems Development A systems engineering approach to developing a training program based on task analysis. ISD includes five phases: analyze, design, develop, implement, and control.

Instructor Contact Hours (ICH) Instructor manhours required to present course material and to provide assistance to students during the actual presentation of course of instruction (DA PAM 570-558).

Intake to Paygrade The number of individuals who must be assessed or promoted into a paygrade.

Line Item Number A number identifying the position which end-line equipment or a component thereof holds in the equipment hierarchy.

Logistic Support Analysis An analysis supplied during the acquisition process in order to insure supportability and other Integrated Logistic Support (ILS) objectives. The analysis consists of iterative definition, synthesis, tradeoff, and test/evaluation (MIL-STD-1388-1A).

Maintainability A system's or its component's requirement for maintenance, both planned and corrective determines its maintainability. Maintainability is a product of the frequency of planned maintenance actions and corrective maintenance actions multiplied by the time these actions take to complete.

Maintenance, Corrective See Corrective Maintenance.

Maintenance Level The four basic levels of maintenance into which maintenance activity is divided. They include organizational, direct support, general support, and depot (DA PAM 700-127).

Maintenance Manhours Per Maintenance Action A measure of the maintainability parameter related to item demand for maintenance manpower: the sum of maintenance man-hours divided by the total number of maintenance actions (preventive and corrective) during a stated period of time (MIL-STD-721C).

Maintenance, Preventive See Preventive Maintenance.

Maintenance Ratio A measure of the total maintenance manpower burden required to maintain a system. It is expressed as the cumulative number of manhours of maintenance expended in direct labor during a given period of time divided by the cumulative number of end items' operating hours during the same time (DA PAM 700-127).

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

Manpower Losses Per Year Losses in productive manpower at each paygrade in an MOS due to promotion, attrition, and application of the Transients, Trainees, Holdees, and Students (TTHS) percentage to the manpower requirements over the course of a year.

Manpower Requirements An emerging weapon system's qualitative and quantitative manning needs.

Manpower Requirements Criteria (MARC) The manpower requirements of positions for Army units as defined in AR 570-2.

Mean Time to Repair (MTTR) A basic measure of maintainability. MTTR is calculated by summing corrective maintenence actions times for a particular item and dividing this sum by the total number of failures of that item at a specified maintenance level.

Military Occupational Specialty (MOS) A group of duty positions that require closely related skills such that a person qualified in one duty position in an MOS can, with adequate on-the-job training (OJT), perform in any of the other positions that are at the same level of difficulty.

Military Occupational Specialty Code (MOSC) A specific occupational identification identifying type and level of skill, level of proficiency, and/or scope of responsibility (AR 611-201); stated in terms of MOS and skill level.

Military Personnel, Army (MPA) An appropriation that provides for pay, allowances, individual clothing, subsistence, interest on deposits, gratuities, permanent change of station travel, per diem portion of temporary duty travel between permanent duty stations for members of the

Army on active duty and military academy cadets. Also includes expenses of apprehension and delivery of deserters, prisoners, and members absent without leave (AR 37-100-80).

Mission A clear, concise statement of a task or tasks to be accomplished.

Mission Area A broad subdivsion of the Army's overall mission, which is to prepare for, engage in, and win land wars.

Mission Area Analysis Process by which a threat is analyzed and a counter to this threat (i.e., the mission) is postulated. The mission is stated in the Mission Area Analysis's Studies and System Concept Papers.

Characteristics Threat and environment impacts define specific mission characteristics. Frequently, mission characteristics require specific performance requirements of a system.

Mission Name Name assigned to a specific mission that a system is expected to accomplish. For example, Defeat Enemy Armor is a mission that could be assigned to armored units, aviation units, and infantry equipped with anti-armor systems.

Mode/Concept Details the maintenance concept, organizational concept, and the operational mode/concept proposed for a system. Firing 40 rounds per hour, moving three times a day, fixing forward, and performing all organizational maintenance actions within 30 minutes are examples of modes and concepts.

New Technologies The additional technologies (in addition to technologies incorporated in current systems) that a system needs to meet stated performance requirements.

Normalized Graduates The number of students who satisfactorily completed the course (graduate), as adjusted for carryovers. Norm grads equal the number of actual grads minus one-half the number of students in training in the beginning of the fiscal year plus one-half the number of students in training at the end of the fiscal year.

Number of Acquisitions The total number of systems to be purchased. Includes TOE as well as systems purchased for Reserve Forces and operational floats. Also includes systems purchased to be pre-positioned but not manned.

One-Station Unit Training (OSUT) Training conducted at one location; includes both basic and advanced individual training for combat arms MOS and selected combat support MOS. Training is conducted in one unit with the same cadre and one program of instruction (POI) (AR 351-1 and PM 25-1).

Operating Strength The present and absent strength of an organization classified under the item "personnel status" of the morning report heading as "permanent party". Does not include "intransit" strength (AR 310-25).

Operational Environment Characteristics Environmental and operational factors that will impact the operating scenario of the proposed weapon system. Includes environmental variables as well as operational and scenario dependent variables such as smoke, NBC, and night operations.

Operational Manning (OM) The number of personnel required to operate a system in an operational environment.

Operations and Maintenance, Army (OMA) An appropriation that provides for the operation and maintenance of all organizational equipment and facilities of the Army; procurement or requisite equipment and supplies; production of audiovisual instructional materiel and training devices; operation of service-wide and establishment-wide activities; operation of depots, schools, training, and programs related to the operation and maintenance of the Army (AR 37-100-80).

Optimum Class Size The number of students designated for a class which, due to instructional considerations, is considered optimum.

Organizational Maintenance (ORG) Maintenance authorized for and performed by a using organization on its own equipment (AR 310-25).

Paygrade (PGD) The statutory paygrade established in the Career Compensation Act of 1949, as amended (AR 310-25).

Per Diem at Course The students' daily expenses which are costed for courses that are less than twenty weeks in length [ATRM-159 (R1)].

Performance Measure The qualitative description of how the function's performance will be assessed.

Performance Standard An established number of man-hours needed to accomplish a unit of work (AR 310-25).

Period Reported The period of time, in days, that the system is to maintain continuous operation and for which workload and manpower requirements are to be determined.

Personnel Flow Rates The rates of progression of individuals through the military personnel system. Includes promotion, attrition, and TTHS rates.

Personnel Pipeline The personnel structure that must be maintained to insure that required manpower requirements are met.

Personnel Requirements The number of people who must be carried in a personnel pipeline to satisfy stated manpower requirements. This number must also offset manpower losses that result from attrition, advancement, and non-availability.

Perturbation Value A quantitative representation of the impact of the design differences between the Baseline Comparison System and the Proposed System.

Phased Schedule A schedule that lists the number of new systems to be placed in service per year.

Planned or Estimated Schedule The planned or estimated schedule for a new system progressing through the acquisition process.

Predecessor System An Army system that is performing mission(s) that will eventually be performed by the new system.

Prepositioned Materiel Configured to Unit Sets (POMCUS) Equipment that has been procured but is held, unmanned, in readiness for future use.

Preventive Maintenance (PM) All actions performed in order to retain an item in specified condition. Involves systematic inspection, detection, and prevention of incipient failures (MIL-STD-1388-1A).

Primary Leadership Course (PLC) A leadership, supervisory, and management course built around the environment in which combat support/combat service support leaders perform their duties (AR 351-1).

Primary Noncommissioned Officer Course (PNCOC) A non-MOS specific, field-oriented course built around basic soldier skills and tasks that prepares E4 soldiers for duties at the E5 level (AR 351-1).

Primary Technical Course (PTC) A course that focuses on training critical tasks listed in the Skill Level 2 Soldier's Manual for a given MOS. Training is provided in resident and extension modes.

Procurement Appropriation (PA) Five continuing (multi-year) appropriations that provide funds for procurement, manufacture, and conversion of major items of combat and support equipment, including ammunition, aircraft, missile systems, weapons, combat and support vehicles.

Program of Instruction (POI) The training management document that specifies the purpose, prerequisites, content, duration, and sequence of instruction for normal resident and non-resident courses (AR 310-25).

Promotion Rate The rate at which individuals advance from one paygrade to another.

Proposed System An analytic construct used to determine the functional requirements of a new system. It incorporates the technological advances likely to exist before the system's projected initial operational capability date.

Quasi-Program of Instruction A partial program of instruction designed to evaluate the impact of emerging system designs on existing courses of instruction. It also helps determine requirements for new courses of instruction.

Reliability Can be defined as (1) the duration or probability of failure-free performance under stated conditions, or (2) the probability that an item can perform its intended function for a specified interval under stated conditions (MIL-STD-1388-1A).

Reliability, Availability, Maintainability (RAM) A measure of reliability or maintainability that includes the combined effects of item design, quality, installation, environment, operation, maintenance, and repair (AR 702-3).

Replacement Year Year when the predecessor system is scheduled to be totally replaced by the new system.

Scope See Scope, System.

Scenario A brief description of the theater, environment and threat factors that are likely to be associated with the system missions.

Scenario Usage Rate The utilization rate that is the planned or actual number of life units expended or missions attempted during a stated interval of time (MIL-STD-721C). Life unit is the duration of applicable use, i.e., operating hours, cycles, distance, rounds fired.

Scheduled Maintenance Preventive maintenance performed at prescribed points in the item's life (MIL-STD-1388-1A).

Scheduled Unit Training Training of an entire unit that occurs at regularly scheduled times. Unit training provides reinforcement of previous training as well as new training in group and unit tasks.

Self-Study Individual study by which the soldier learns new skills or reinforces skills already learned (AR 350-1).

Senior Noncommissioned Officer Course (SNCOC) Senior level training that prepares soldiers in grades E8 and E9. It consists of resident and extension training as well as on-the-job experience (AR 351-1).

Sergeants Major Academy (SGMA) The capstone of enlisted training. Master and first sergeants (E-8) are prepared for high-level responsibilities in both troop and senior staff assignments (AR 351-1).

Service School Institutional training, either individual or collective, conducted in Army schools or Army training centers; uses instructional systems development materials.

Skill Level (1) Level of proficiency required for performance of a specific military job, (2) the level of proficiency at which an individual qualifies in that military occupational specialty (AR 351-1).

Student Pay and Allowance Cost Weekly rate of pay for the model grade of a student based upon the Composite Standard Rates for Existing Military Personnel Services (AR 37-108). This weekly rate multiplied by the course length in weeks is used to compute cost per graduate [ATRM-159 (R1)].

Supervised On-the-Job Training Structured training accomplished while a person is working in a particular skill level and MOS (AR 351-1).

Support Cost That portion of total indirect cost not included in base operations cost per graduate. These are installation costs that include training aids, base communications, medical, and family housing on a pro-rate share of school's military man-years (MMY) supported as a percent of the total benefiting tenant MMY [ATRM-159 (R1)].

System The combination of people, hardware, and information which, when interacting as a whole, is capable of performing a required mission on the battlefield.

System Functional Requirement The attributes or capabilities required to be present in the system elements so that each element and the system as a whole can accomplished assigned actions.

System Scope A precise definition of the range and depth of a weapon system, including (1) number of missions assigned, (2) number of materiel commodities incorporated, and (3) number of distinct platforms and/or components comprising the system.

System Density The quantity of systems requiring maintenance and supply support in a unit, group of units, or at a maintenance level. Stated in terms of the Basis of Issue for units.

System Performance Goals A description of the goals that must be achieved for each system performance measure.

System Performance Measures Measures that describe the performance capabilities that must be achieved for each system function. System performance measures usually consist of speed, rate of fire, etc.

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.

Table of Organization and Equipment (TOE) A table that prescribes the normal mission, organizational structure, personnel, and equipment requirements for a military unit. If forms the basis for an authorization document (AR 310-25).

Task A unit of work activity that constitutes a logical and necessary step in the performance of a job/duty. It is the smallest unit of behavior in a job that describes the performance of a meaningful function in the job under consideration.

Task Description Concise wording, usually verb-object form, that describes a task.

Task Number A numerical code used to designate a task.

Threat Characteristics The specifics of an enemy threat as determined in a Threat Analysis and stated in a Threat Study (see also Mission Analysis and Mission Characteristics).

Threat Variables The range and complexity an enemy threat can take. Includes the consideration given in a Threat Analysis to the compounding of threat that a new enemy capability can have in concert with other new or existing threats. Also includes consideration of current weakness in countering the new and combined enemy threat.

Training Aids Cost Cost of installation-support training aids adjusted by the total number of training man-weeks.

Training Man-Days The length of class time needed to train an individual student in a course.

Training Resource Requirements Analysis (TRRA) A process used to estimate systematically the training requirements for Army weapon systems during the earliest phases of their development. These requirement estimates include specification of the system's task, course, and resource requirements.

Transients, Trainees, Holdees, and Students Rates (TTHS) The percentage of personnel in a paygrade who are unassignable and are therefore unable to contribute to the work associated with the weapon system.

Travel Pay to Course The travel cost per graduate computed on a standard cost per mile. The cost per mile is multiplied by a class average one-way mileage, which is obtained from a sample of student records.

Type of Instruction Type of instruction used for a training course. Typical categories are conference, demonstration, practical exercise, etc. (TRADOC CIR 351-12).

Unscheduled Maintenance, Inherent Those maintenance actions (or events) necessary for restoring an item to a specified condition when the failure has been caused by a condition resulting from an inherent fault in design or strength of material specified.

Unscheduled Maintenance, Induced Those maintenance actions (or events) necessary for restoring an item to a specified condition when the failure has been induced by a condition (including environmental) not resulting from an inherent fault of an item.

Unscheduled Maintenance, Other Those maintenance actions (or events) necessary for restoring an item to a specified condition that was not caused directly by induced or inherent failures. Causes include removal to gain entry, cannot duplicate reported descrepancy, cannibalization, unscheduled inspections, etc.

Workload The amount of work, stated in predetermined work units, that organizations or individuals perform or are responsible for performing (AR 310-25).

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References

Andrews, Walter (1983, March 16). Weapons maintenance seems costly. Washington Times.

Army Science Board (1980). Ad Hoc study group on human issues. Department of the Army, Assistant Secretary of the Army Research, Development and Acquisition. Washington, DC.

Baker, James D., and Shields, J. (1981, May). Personnel affordability: The Army's odessey into the year 2000. Paper presented at ORSA/TIMS Meeting, Toronto, Canada.

Chief of Naval Materiel (series). Ship's maintenance and materiel management program (OPNAVIST 4790.4). Washington, DC.

Chief of Naval Materiel, Ship's Parts Control Center (series). Consolidated shipboard allowance list preparation. Washington, DC

Chief of Naval Operations (1979). Application of the HARDMAN comparability methodology to VTXTS flight vehicle maintenance manpower requirements. Office of CNO, HARDMAN Project Office (OP-112C) Contractor: Dynamics Research Corporation, Contract No. N61339-80-D005.

Chief of Naval Operations (1980). HARDMAN methodology handbook, Vol. II: User's manual preliminary draft. Office of CNO HARDMAN Project Office (OP-112C). Contractor: Dynamics Research Corporation, Contract No. N61339-80-D005. Washington, DC.

Chief of Naval Operations (1983). HARDMAN methodology handbook (draft). Office of CNO HARDMAN Project Office (OP-112C). Contractor: Dynamics Research Corporation, Contract No. N61339-80-D005. Washington, DC.

Coleman, Herbert J. (1981, February 16). Weapons maintainability guidance sought by GAO. Aviation Week & Space Technology.

Cushman, Jack (1981, July 27). Troublesome tank: TAO still unhappy with M-1 results. Defense Week.

Department of the Air Force (1975). Air Force audiovisual directory (AFR 95-2). Washington, DC

Department of the Air Force (1982). Airman specialty vehicle mechanic (AFR 39-1). Washington, DC.

Department of the Air Force (1979). Maintenance management policy (AFM 66-1). Washington, DC.

Department of the Air Force (1984). USAF formal schools (AFR 50-5). Washington, DC.

Department of the Army (1984). Army personnel selection and classification: Enlisted career management fields and military occupational specialties (AR 611-201). Washington, DC.

Department of the Army (1981). Basic policies for systems acquisition. Washington, DC.

Department of the Army (quarterly). Chief of Personnel Operations 45 Report (COPO 45 Report). Washington, DC.

Department of the Army (1968). Combat, tactical, and support vehicles and special-purpose equipment (TB 750-93-1). Washington, DC.

Department of the Army (1984). Consolidated index of Army publications and blank forms (DA Pam 310-1). Washington, DC.

Department of the Army (1982). Consolidated MOS catalog (DA Pam 350-100). Washington, DC.

Department of the Army (1979). Dictionary of United States Army terms (AD)(AR 310-25). Washington, DC.

Department of the Army (1981). EPMS master training plan (DA Pam 351-9). Washington, DC.

Department of the Army. Extension training material catalogs (series) (DA Pam 350-XXX-X). Washington, DC.

Department of the Army (1981). Field artillery battalion, lance (DA Pam 350-106-3). Washington, DC.

Department of the Army (1981). Field artillery units, 155mm self-propelled (DA Pam 350-106-4). Washington, DC.

Department of the Army (1983). Fire support in combined arms operation (FM 6-20). Washington, DC.

Department of the Army (1973). Guide for using existing programmed structural materials (DA Pam 690-22). Washington, DC.

Department of the Army (1980). Index and description of Army training devices (DA Pam 310-12). Washington, DC.

Department of the Army (1979). Index of Army motion pictures and related audio-visual aids (DA Pam 108-1). Washington, DC.

Department of the Army (1980). Index of doctrinal, training, and organizational publications (DA Pam 310-3). Washington, DC.

Department of the Army (1979). Integrated logistic support management model and glossary (DA Pam 700-127). Washington, DC.

Department of the Army (1975). Life cycle system management model for Army systems (DA Pam 11-25). Washington, DC.

Department of the Army (1983). Manpower and equipment control: Organization and equipment requirements tables (AR 570-2). Washington, DC.

Department of the Army (1969). Organization and equipment authorization tables: Personnel (AR 570-2DA). Washington, DC.

Department of the Army (1980). Reliability and maintainability (AR 702-3). Washington, DC.

Department of the Army (1982). Sample data collection: The Army maintenance management system (AR 750-37). Washington, DC.

Department of the Army (1979). Staffing guide for US Army service schools (DA Pam 570-558). Washington, DC.

Department of the Army (1983). US Army correspondence course program catalog (DA Pam 351-20). Washington, DC.

Department of the Army (1984). US Army formal schools catalog (DA Pam 351-4). Washington, DC.

Department of Defense (1983). Acquisition and management of integrated logistic support for systems and equipment (DoD Directive 5000.39). Washington, DC.

Department of Defense (1983). Major system acquisition procedures (DoD Directive 5000.2). Proposed revision, October 30, 1982; March 8, 1983. Washington, DC.

Department of Defense (1982). Major system acquisition (DoD Directive 5000.1). Washington, DC.

Department of Defense (1983). Logistic support analysis (MIL-STD-1388-1A). Washington, DC.

Department of Defense (1983). Logistic support analysis record data elements and requirements (MIL-STD-1388-2A). Washington, DC.

Department of Defense (1975). Work breakdown structure for defense materiel items (MIL-STD-881A). Washington, DC.

DePuy, William, E. and Bonder, Seth (1982). Integration of MPT supply and demand and system acquisition process. US Army Research Institute, Research Note 82-1. Washington, DC.

Eckstrand, Gordon A. (1980, October). Product support -- A changing challenge. Manpower Factors in System Acquisition Aerospace Industries Symposium. Seattle, WA.

Eckstrand, G. (1980, August) Technology projection: Manpower and logistics factors in weapon system development. NTIS.

Kerwin, Gen. Walter T. and Blanchard, George S. (1980, August). Man/machine interface -- A growing crisis. U.S. Army Materiel Systems Analysis Activity.

Kuhn, George W.S., (1983). Ending defense stagnation. In Richard N. Holwill (Ed.), A mandate for leadership report -- Agenda '83. The Heritage Foundation.

Office of Management and Budget (1976). Major systems acquisition (OMB Cir A-109). Washington, DC.

Quade, E.S. (1975). Analysis for public decisions. Elsevier Science Publishers. New York.

Ritchie, M. (1974, February). Manpower implications in the design of Air Force equipment. NTIS.

Smith, CPT John (1984, March/April). HARDMAN: New asset for TRADOC systems managers. Soldier Support Journal.

US Air Force Audio-Visual Services (1980). USAF audio-visual resources and functions (AFR 95-1). Norton AFB, CA.

US Air Force Human Resources Laboratory (1982). ASSET user's guide (application). Contractor, Westinghouse Electric Corporation, Contract No. F33615-79-C-0330.

US Air Force Logistics Command (1980). USAF Maintenance Management (AFM 66-1). Andrews AFB, MD.

US Air Force Manpower Personnel Center (1982). Airman Classification Regulation (AFR 39-1). Randolph AFB, TX.

US Air Force Manpower Personnel Training Section (1981). USAF Formal Schools Catalog (AFR 50-5). Randolph AFB, TX.

US Army Materiel Command/Training and Doctrine Command (1982). Reliability, availability, and maintainability rationale report handbook (AMC/TRADOC Pam 70-11). Fort Monroe, VA.

US Army Soldier Support Center (1984). "What to do" booklet: A road map for addressing MPT in the acquisition process. Alexandria, VA.

US Army Training and Doctrine Command (1983). Armywide training and doctrinal literature (TRADOC Pam 310-3). Fort Monroe, VA.

US Army Training and Doctrine Command (1981). Combat developments studies (TRADOC Reg 11-8). Fort Monroe, VA.

US Army Training and Doctrine Command (1980). Common job and task management (TRADOC Cir 351-1). Fort Monroe, VA.

US Army Training and Doctrine Command (1984). Cost analysis program (MOS/FMS) training costs (TRADOC Reg 11-5). Fort Monroe, VA.

US Army Training and Doctrine Command (1976). Educational video tape catalog (TRADOC 350-33). Fort Monroe, VA.

US Army Training and Doctrine Command (1983). ICH computation worksheet (TRADOC Form 377-R). Fort Monroe, VA.

US Army Training and Doctrine Command (1979). Job and task analysis handbook (TRADOC 351-4). Fort Monroe, VA.

US Army Materiel Command/Training and Doctrine Command (1984). Materiel acquisition handbook (AMC/TRADOC Pam 70-2). Fort Monroe, VA.

US Army Training and Doctrine Command (1982). Training devices for Armywide use (TRADOC 71-9). Fort Monroe, VA.

US Army Training and Doctrine Command (1984). Training requirements analysis system (TRAS) (TRADOC Reg 351-1). Fort Monroe, VA.

US Army Training Support Center (1981). US Army comprehensive plan for training devices. Fort Eustis, VA.

US Marine Corps (1981). Marine Corps formal schools catalog (MCO P1500.12L). Washington, DC.

US Marine Corps (1982). MOS manual (MCO P11200.70). Washington, DC.

US Naval Education and Training Command (1984). Catalog of Navy training courses (CANTRAC) (NAVEDTRA 10500).

US Naval Military Personnel Command (1976). Manual of Navy enlisted manpower and personnel classifications and occupational standards, Sections I (updated semiannually) and II (updated quarterly).

Zimmerman, W., Butler, R., Grey, V., Rosenberg, L., and Risser, D. (1984, July). Evaluation of the HARDMAN comparability methodology. ARI Technical Report (Draft). Washington, DC.

References by Number

AMC/TRADOC Pam 70-2	Materiel Acquisition Handbook
AFM 50-5	USAF Formal Schools Catalog
AR 570-2	Manpower and Equipment Control: Organization and Equipment Requirements Tables
AR 611-201	Army Personnel Selection and Classification -- Enlisted Career Management Fields and Military Occupational Specialties
AR 702-3	Reliability and Maintainability
AR 750-37	Sample Data Collection: The Army Maintenan Management System
Ar 1000-1	Basic Policies for Systems Acquisition
ATRM 159	MOS Course Cost Report
COPO 45 Report	Chief of Personnel Operations 45 Report (published quarterly by MILPERCEN)
DA Pam 11-25	Life Cycle System Management Methods for Army Systems
DA Pam 108-1	Index of Army Motion Pictures and Related Audio-Visual Aids
DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms
DA Pam 310-12	Index and Description of Army Training Devices
DA Pam 350-100	Consolidated MOS Catalog
DA Pam 350-XXX-X	Extension Training Material Catalogs (series)
DA Pam 351-4	U.S. Army Formal Schools Catalog

DA Pam 351-9	EPMS Master Training Plan
DA Pam 351-20	Army Correspondence Course Program Catalog
DA Pam 570-558	Staffing Guide for U.S. Army Service Schools
DA Pam 690-22	Guide for Using Existing Programmed Instructional Materials
DA Pam 700-127	Integrated Logistic Support Management Model and Glossary
FM 6-20	Fire Support in Combined Arms Operation
MCO P11200.7D	MOS Manual
MCO P1500.12K	Marine Corps Formal Schools Catalog
MIL-STD 881	Work Breakdown Structure for Defense Materiel Items
MIL-STD 1388-1A	Logistics Support Analysis
MIL-STD 1388-2A	LSAR Data Elements and Requirements
NAVEDTRA 10500	Catalog of Navy Training Courses (CANTRAC)
NAVPERS 18068D	Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards, Sections I (updated semiannually) and II (updated quarterly)
NMSOINST 4790.2	Integrated Logistic Support Instruction
OMB Cir A-109	Major Systems Acquisition
OPNAVIST 4790.4	Ship's Maintenance and Materiel Management Program
SPCCINST 4790.4	Consolidated Shipboard Allowance List Preparation
TB 750-93-1	Functional Grouping Codes: Combat, Tactical, and Support Vehicles and Special-Purpose Equipment

TRADOC Cir 351-1	Common Job and Task Management
TRADOC Form 377-R	ICH Computation Worksheet
TRADOC Form 812-R	Cost Analysis Program MOS/FMS Training Costs
TRADOC Pam 71-9	Catalog of TASO Training Devices
TRADOC Pam 310-3	TRADOC Armywide Training and Doctrinal Literature
TRADOC Pam 350-33	Educational Video Tape Catalog
TRADOC Pam 351-4	Job and Task Analysis Handbook
TRADOC Reg 11-5	Cost Analysis Program (MOS/FMS) Training Costs
TRADOC Reg 11-8	Combat Development Studies
TRADOC Reg 351-1	Training Requirements Analysis System (TRAS)
TRADOC/AMC Pam 70-11	Reliability, Availability, Maintainability Rationale Report Handbook

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Acronyms and Abbreviations

A

AETIS	Army Extension Training Information System
AFB	Air Force Base
AFHRL	Air Force Human Resources Laboratory
AFLC	Air Force Logistic Command
AFM	Air Force Manual
AFMPC	Air Force Military Personnel Center
AFR	AIr Force Regulation
AFSC	Air Force Specialty Code
AIT	Advanced Individual Training
AMC	Army Materiel Command
ANCOC	Advanced Noncommissioned Officer Course
AOSP	Army Occupational Survey Program
AR	Army Regulation
AR	Availability Ratio
ARI	Army Research Institute
ARTEP	Army Training and Evaluation Program
ASARC	Army System Acquisition Review Council
ASI	Additional Skill Identifier
ASSET	Acquisition of Supportable Systems Evaluation Technology
ASVAB	Armed Services Vocational Aptitude Battery

ATRM	Army TRADOC Resource Management
ATRRS	Army Training Requirements and Resources System
ATSC	Army Training Support Center

B

BCS	Baseline Comparison System
BITE/PITE	Built-In/Plug-In Test Equipment
BNCOC	Basic Noncommissioned Officer Course
BOI	Basis of Issue
BOIP	Basis of Issue Plan
BTC	Basic Technical Course

C

CANTRAC	Catalog of Navy Training Courses
CD	Combat Developer
CDB	Consolidated Data Base
CDRL	Contract Deliverable Line Item
C-E	Concept Evaluation
CFE	Contractor-Furnished Equipment
CHRT	Coordinated Human Resource Technology
CMF	Career Management Field
CM	Corrective Maintenance
CNET	Chief of Naval Education and Training

CNATRA	Chief of Naval Air Training
CNM	Chief of Navy Materiel
CNMPC	Chief of Naval Military Personnel Command
CNO	Chief of Naval Operations
CNTECHTRA	Chief of Naval Technical Training
CODAP	Comprehensive Occupational Data Analysis Program
COEA	Cost and Operational Effectiveness Analysis
COI	Course of Instruction
COMTRALANT	Commander, Training Command, Atlantic
COMTRAPAC	Commander, Training Command, Pacific
COPO	Chief of Personnel Operations
COR	Contracting Officer's Representative
COTR	Contracting Officer's Technical Representative
CPU	Central Processing Unit
CSWS	Corps Support Weapon System
CTEA	Cost and Training Effectiveness Analysis

D

D&V	Demonstration and Validation
DA	Department of the Army
DCD	Directorate of Combat Developments
DCS	Deputy Chief of Staff
DDI	Design Difference Index

DEP	Draft Equipment Publication
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DOTD	Directorate of Training and Doctrine
DPAMMH	Direct Productive Annual Maintenance Man-Hours
DS	Direct Support Maintenance
DSARC	Defense System Acquisition Review Council
DSWS	Division Support Weapon System
DT/OT	Developmental Testing/Operational Testing
DTIC	Defense Technical Information Center

E

EIC	Equipment Identification Code
E-O	Electro-optical
EPMS	Enlisted Personnel Management System
ETM	Extension Trainig Materials
EW	Electronic Warfare

F

FEA	Front-End Analysis
FGC	Functional Group Code
FLIR	Forward-Looking Infrared Radar
FM	Field Manual
FRE	Frequency

FSD	Federal Supply Document
FSED	Full-Scale Engineering Development

G

GFE	Government-Furnished Equipment
GP	Group-Paced

H

HARDMAN	Hardware vs. Manpower
HCM	HARDMAN Comparability Methodology
HIP	Howitzer Improvement Program
HIPO	Hierarchical and Input/Process/Output Techniques
HMPT	Human Factors, Manpower, Personnel, and Training

I

I/S	Intructor-to-Student Ratio
ICH	Instructor Contact Hours
ICTP	Individual and Collective Training Plan
IEP	Independent Evaluation Plan
IET	Initial Entry Training
IFF	Identification, Friend or Foe
IKP	Instructor and Key Personnel
ILS	Integrated Logistic Support
IOC	Initial Operational Capability
IPR	In-Progress Review

IPT	Indirect Productive Time
ISD	Instructional Systems Development

J

JPL	Jet Propulsion Laboratory
JMSNS	Justification for Major System New Start

L

LCC	Life Cycle Costs
LCN	LSA Control Number
LIN	Line Item Number
LCSMM	Life Cycle System Management Model
LOA	Letter of Agreement
LOGCEN	Logistics Center
LOGSACS	Logistics Structure and Composition System
LRU	Lowest Replaceable Unit
LSA	Logistic Support Analysis
LSAR	Logistic Support Analysis Record
LSI/VLSI	Large or Very Large Scale Integrated Circuits

M

MAA	Mission Area Analysis
MAC	Maintenance Action/Allocation Chart
MAP	Materiel Acquisition Process
MARC	Manpower Requirements Criteria

MCO	Marine Corps Order
MEEI	Minimum Essential Elements of Information
MFP	Materiel Fielding Plan
MIL-STD	Military Standard
MILPERCEN	Military Personnel Center
MMH	Maintenance Man-hours
MMH/MA	Maintenance Man-hours Per Maintenance Action
MOS	Military Occupational Specialty
MOSB	MOS Training Cost Handbook
MOSC	Military Occupational Specialty Code
MP/OMS	Mission Profile/Operational Mode Summary
MPA	Military Personnel, Army
MPT	Manpower, Personnel, and Training
MR	Maintenance Ratio
MRC	Maintenance Requirement Cards
MRSA	Materiel Readiness Support Activity
MTBF/MTBMA	Mean Time Between Failure/Mean Time Between Maintenance Action
MTTR	Mean Time to Repair
MTTR/MA	Mean Time to Repair Per Maintenance Action

N

NASA	National Aeronautics and Space Administration

NATO	North Atlantic Treaty Organization
NAVMMACLANT	Navy Manpower and Materiel Analysis Center, Atlantic
NAVEDTRA	Naval Education and Training
NAVPERS	Naval Personnel
Navy 3M	Materiel Maintenance Management
NBC	Nuclear, Bacteriological, Chemical
NCOES	Noncommissioned Officer Educational System
NEC	Naval Enlisted Classification
NEPDIS	Navy Enlisted Professional Development Information System
NET	New Equipment Training
NETP	New Equipment Training Plan
NITRAS	Navy Integrated Training Resources and Administration System
NMSO	Navy Maintenance Support Office
NODAC	Navy Occupational Development and Analysis Center
NOTAP	Navy Occupational Task Analysis Program
NTEC	Naval Training Equipment Center
NTP	Navy Training Plans

O

O&O	Organizational and Operational Plan
OCS	Optimal Class Size
OM	Operational Manning

OMA	Operations and Maintenance, Army
ORSA	Operations Research/Systems Analyst
OSUT	One Station Unit Training
OT	Operational Test

P

Pam	Pamphlet
PERT	Program Evaluation Review Technique
PGD	Paygrade
PIB	Program Information Brief
PLDC	Primary Leadership Development Course
POE	Projected Operational Environment
POMCUS	Prepositioned Materiel Configured to Unit Sets
PM	Preventive Maintenance
PM	AMC Program/Project/Product Manager
PM TRADE	Project Manager for Training Devices
PNCOC	Primary Noncommissioned Officer Course
POE	Projected Operational Environment
POI	Program of Instruction
PQS	Position Qualification Standards
PTC	Primary Technical Course
PV	Perturbation Value

Q

QQPRI	Quantitative and Qualitative Personnel Requirements Information
Quasi-POI	Quasi-Program of Instruction

R

R&M	Reliability and Maintainability
RAM	Reliability, Availability, and Maintainability
Reg	Regulation
ROC	Required Operational Capability
RPV	Remotely Piloted Vehicle

S

SAT	Systems Approach to Training
SDC	Sample Data Collection
SEAD	Suppression of Enemy Air Defense
SGMA	Sergeants Major Academy
SINCGARS	Single Channel Ground/Airborne Radio System
SME	Subject-Matter Expert
SOJT	Supervised On-the-Job Training
SP	Self Paced
SPH	Self-Propelled Howitzer
SPT	Support
SQT	Skill Qualification Test
SSC	Soldier Support Center

SSG	Special Study Group
SSI	Specialty Skill Identifier
SSPO	Strategic Systems Project Office
STP	Soldier Training Publication
SUBLANT	Submarines Atlantic
SUBPAC	Submarines Pacific

T

TAMMS	The Army Maintenance Management System
TASC	Training and Audiovisual Support Center
TASO	Training Aids Support Office
TB	Technical Bulletin
TCA	Task Comparability Analysis
TD	Training Developer
TDIS	Training Development Information System
TDLR	Training Device Letter Requirement
TDR	Training Device Requirement
TEA	Training Effectiveness Analysis
TFR	Trouble Failure Reports
TLR	Top Level Requirements
TM	Technical Manual
TOE	Table of Organization and Equipment
TQQPRI	Tentative Qualitative and Quantitative Personnel Requirements Information

TRADOC	Training and Doctrine Command
TRAMEA	TRADOC Management Engineering Activity
TRAS	Training Requirements Analysis System
TTHS	Transients, Trainees, Holdees, and Students
TRRA	Training Resource Requirements Analysis
TSM	TRADOC Systems Manager

U

UHF	Ultra-High Frequency
USAMARDA	US Army Manpower Requirements and Documentation Agency

V

VHF-FM	Very High Frequency/Frequency Modulated

W

WBS	Work Breakdown Structure
WQEC	Weapons Quality Engineering Center
WUC	Work Unit Code
WSAP	Weapons System Acquisition Process

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