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Review and Analysis of the Military Occupational Specialty (MOS) Restructuring Problem

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In 1988, the U.S. Army Signal Center requested that Army Research Institute (ARI) initiate a focused examination of Military Occupational Specialty (MOS) restructuring issues existing within the Army's Signal Branch. This research note defines a procedural baseline with respect to existing policy, current practices, past research, and identifies possible high impact opportunities for developing systematic and quantitative techniques supporting MOS restructuring studies. This research note also assesses the potential applicability of expert systems to MOS restructuring analysis activities. The findings of this first effort may be used to set the course and initiate further efforts that will ultimately ease the burdens of the Army's personnel proponents in terms of MOS restructuring.

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REVIEW AND ANALYSIS OF THE MILITARY OCCUPATIONAL SPECIALTY (MOS) RESTRUCTURING PROBLEM

EXECUTIVE SUMMARY

Research Requirements:

Army personnel proponent agencies routinely engage in MOS restructuring studies. The purpose of these studies is to determine changes in the MOS structure as result of the acquisition of new equipment or changes in doctrine or training, among other triggering mechanisms. These studies may result in recommendations to merge existing MOSs or create entirely new MOSs.

While MOS restructuring studies have been performed by personnel proponent agencies and its predecessors from the Army's earliest days and analytical requirements are documented in the Guide for Preparations of Changes to the Military Occupational Classification Structure (MOCS), 1988 (commonly referred to as the MOCS Handbook), neither systematic nor quantitative techniques have been formally developed to assist the MOS analyst in performing his job.

In 1988, the U.S. Army Signal Center requested that the Army Research Institute (ARI) initiate a focused examination of MOS restructuring issues existing within the Army's Signal Branch. The ultimate objective of this effort is to develop methods and evaluate methods to facilitate the analysis and design of MOSs and Career Management Fields (CMFs). This is part of a larger effort by ARI's System Research Laboratory to produce MANPRINT tools.

The purpose of this research note is to define a procedural baseline with respect to existing policy, current practices, and past research and to identify high impact opportunities for developing systematic and quantitative techniques supporting MOS restructuring studies.

Procedure:

The work underlying this research note involved five analytical steps. First, existing Army policy and regulations related to MOS restructuring were reviewed. Second, related research efforts were identified and assessed for their applicability. Third, current procedures were documented. Fourth, the potential applicability of expert systems to MOS restructuring analysis activities was examined. Based on this

research, opportunities for making the process more systematic and quantitative were identified and described; emphasis was placed on identifying opportunities which could be initiated within the scope of subsequent tasking under this research effort.

Findings:

MOS restructuring activities at the proponent level have been evaluated and requirements for improvements have been proposed often in recent years. The principal findings in this research note generally do not differ from what has become conventional wisdom. However, this report is a first step towards making the process more systematic and quantitative, and consolidates in a single document a procedural baseline and potential improvements.

In the chapters of this report, a procedural baseline is defined based on the following findings:

1. Existing Army regulations and policy, particulary the MOCS Handbook, provide a suitable basis for MOS restructuring activities by the personnel proponent agencies.

2. Past research does not generally lend itself in meeting requirements for making the restructuring process more systematic and quantitative.

3. Current analytical practices at the personnel proponent agencies lead to acceptable MOS restructuring proposals; procedures could, however, benefit from systematic methods and analytical tools that facilitate data handling and guide the MOS analyst with respect to how to perform MOS restructuring studies.

4. While artificial intelligence remains largely a research topic, the application of expert systems to portions of the MOS restructuring process is feasible.

There are many ways in which the current process may be made more systematic and quantitative. Based on the constraints posed by the resources available through this research effort as well as the availability of proponent computer assets, eight opportunities have been formulated. These include developing concepts and initial prototypes for the following MANPRINT tools:

1. System Architecture for Operations-Based MOS Restructuring Methodology

2. Position Data Analysis Job Aid (PDAT-JA)

3. Standards of Grade Authorization (SGA) Job Aid

4. MOS Restructure Data Manager

5. MOS Action Plan Generator

6. MOS Action Item Submittal Documenter

7. Career Management Field (CMF) Assessment Aid

8. MOS Restructuring Trade-Off Analysis Model.

Utilization of Findings:

Under this current phase of research, the possibility exists to initiate development of one or more of the eight proposed improvements. Further effort may be expended under subsequent tasking.

Ultimately, a substantial developmental effort encompassing model development as well as training support and requiring resources significantly greater than presently programmed for this research effort will be required in order to make substantial, wide-ranging improvements encompassing all eight proposals.

Nonetheless, the findings of this research note may be used to set the course and initiate efforts that will ultimately ease the burdens and enhance the results of MOS restructuring activities of the Army's personnel proponents.

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REVIEW AND ANALYSIS OF THE MILITARY OCCUPATIONAL SPECIALTY (MOS) RESTRUCTURING PROBLEM

Introduction

This research note documents the findings of an indepth review and analysis of existing methods, software, guidebooks, MOS action submittals, Army regulations, and working environments encompassing Army Military Occupational Specialties (MOS) restructuring. This is one of several reports being developed as part of a research effort focusing on the development of methodologies and techniques which can be used to restructure MOSs.

The purpose of this report is to establish a procedural baseline in terms of the existing policies, practices, and techniques used by Army personnel proponents to structure MOSs. The baseline will serve as a point of departure for identifying and developing techniques to enhance the MOS structuring process at the personnel proponent level.

Background

A recurring activity faced by the Army in the areas of systems acquisition and personnel management is MOS restructuring. An MOS represents an occupation performed by an Army enlisted soldier or warrant officer. An MOS may be characterized, in part, by the tasks that a trained, qualified soldier is expected to perform in the accomplishment of a specific objective.

The convergence of declining demographic trends, recruiting performance, and the growing sophistication of weapon systems has generated a major emphasis on more effective methods for MOS design and analysis. Within the Army's life cycle systems, equipment-related MOS restructuring has assumed a key role in support of force integration, structure, manpower, and personnel requirements planning. MOS restructuring is defined as the reassignment of tasks to be performed by an MOS within a CMF and the assignment of new tasks to an existing or new MOS or Additional Skill Identifier (ASI).

In this environment, the Army is continually faced with critical decisions regarding restructuring MOSs in order to create a strategically balanced alignment of manpower and personnel requirements in support of revisions in doctrine, training, organizations, and new equipment or technology introductions.

Restructuring an MOS involves revising its task composition either by eliminating tasks, adding tasks, merging tasks with another MOS, or creating an entirely new MOS. Further, MOS restructuring requires analysis of other areas important to the health of an MOS such as grade structure, physical demands, and impact on recruiting, among others. Selection of the "optimal" MOS structure involves a complex set of interconnected judgments involving doctrine, organization, equipment densities, training, demographics, personnel policy, and cost over a planning cycle covering up to seven years.

This research identifies opportunities for improving MOS analysis and restructuring at the personnel proponent level. This initial research is based on MOS restructuring practices at the Army Signal Branch, and complements research into a taxonomic approach describing the psychological and equipment aspects of MOS design at the Army Intelligence Center.

<u>Overview of Report</u>

This research note consists of six sections. The first section discusses the major research goals, issues, and approach of this project.

The second section presents a summary and evaluation of current Army regulations and policy related to MOS structuring. These policies are examined from both the strategic and operational aspects of the Army's Life Cycle System Management Model (LCSMM), MANPRINT program, and the Personnel Proponent System.

The third section provides an analysis of prior research into MOS restructuring and analysis. The value of past research to the present effort is also discussed.

The fourth section examines current MOS analysis and restructuring practices at both the Army and personnel proponent levels. This examination includes (1) an exploration of the essential MOS restructuring analysis areas for development of future methodologies (2) capability and constraints of hardware, software, and models currently in use by the Army Signal Center's Personnel Proponent and (3) the type, number, and complexity of ongoing MOS actions.

The fifth section presents the results of a survey of current artificial intelligence (AI) and expert systems (ES) technology with potential application to MOS restructuring. The survey includes an inventory of application types and a description of available ES technology.

The last section assesses the current baseline with respect to policy, research, practices, and technology. This assessment is used to identify potential procedural and system improvements for MOS design and restructuring methods. Areas of high impact opportunity, within the current efforts resource and time constraints, are described.

Research Issues and Goals

This section discusses the research issues and goals for this initial effort. The purpose is to identify the scope of this undertaking and to lay out the approach which will be followed in identifying opportunities for developing new methodologies supporting MOS restructuring.

The section first addresses the research objectives underlying this report. Second, the research issues are delineated; these provide rationale as well as define the operational and institutional aspects of MOS restructuring. Lastly, the study design and approach for this phase of the research are presented.

Research Objectives

Timely and accurate identification of MOS restructuring requirements are critical to the success of introducing new equipment systems into the Army's inventory. Failing to identify these requirements can seriously affect the Army's ability to field, maintain, and sustain new equipment. More serious is the very real possibility that new equipment could not be effectively operated or maintained in combat because not enough trained and experienced soldiers exist to support the equipment.

As a primary means of organizing manpower and personnel requirements in the Army, MOS restructuring is performed to insure that there are sufficient personnel assigned and trained within an MOS to meet Army mission requirements. MOS restructuring becomes necessary when changes have occurred and the MOS can no longer fulfill the role for which it was designed. MOS restructure requirements are usually triggered by changes in doctrine, organizations, or equipment, or a combination of any of the three. Regardless of the cause, when an MOS restructuring action is undertaken a complex sequence of analysis processes occurs. Completion of these analysis processes and their supporting documentation are the responsibility of the personnel proponent.

The goal of the research described in this report is to create more systematic and quantitative methodologies to support evaluation of existing MOS structures and the development of alternative MOSs due to the acquisition of new equipment.

The research objectives addressed in this report are two-fold:

1. To establish a baseline for creating more systematic and quantitative analytical

techniques by defining existing research, current policy, routine practices, and available technology;

2. To identify high impact opportunities for improving the MOS restructuring processes and practices at the personnel proponent level.

Establishing a baseline for creating better restructuring techniques. Defining a baseline for this research is a multi-faceted process that must incorporate numerous critical dimensions. One is establishing the scope of "MOS restructuring" which will be addressed by this effort. Another, having bounded MOS restructuring, is determining the current policy and procedural practices which may benefit from improved techniques. And, still a third is identifying what research has been achieved to date and what technologies may be available to improve current methodologies.

As Figure 1 illustrates, MOS restructuring actually occurs in two different scenarios. The first of these restructuring processes begins early in the development cycle of any new equipment item under consideration for Army procurement. This "requirements-based", or Type 1, MOS restructuring begins in the research and development phase of equipment procurement, and continues through the final documentation of the equipment item in the tables of organization and equipment (TOEs). Type 1 MOS restructuring reflects 100 percent go-to-war requirements that are not initially constrained by budget considerations.

Type 1 MOS restructuring originates during the development of the Operational and Organizational (O&O) Plan. The O&O Plan is produced by the combat developers of both the Training and Doctrine Command (TRADOC) and the various service schools. This plan determines personnel impacts based on an examination of the equipment system design and an assessment based upon the skills required to operate and maintain the system.

Assessment and recommendation of required changes to existing MOS structures are driven by the development of the Basis of Issue Plan (BOIP) and the Qualitative and Quantitative Personnel Requirements Information (QQPRI). The BOIP and QQPRI provides recommended personnel changes to support new equipment fielding such as the need for new or revised training, duty position requirements, and the need to develop a new or revised MOS.

Manpower and personnel integration (MANPRINT) methods are used to try to ensure that equipment design accommodate the soldier and not vice versa.

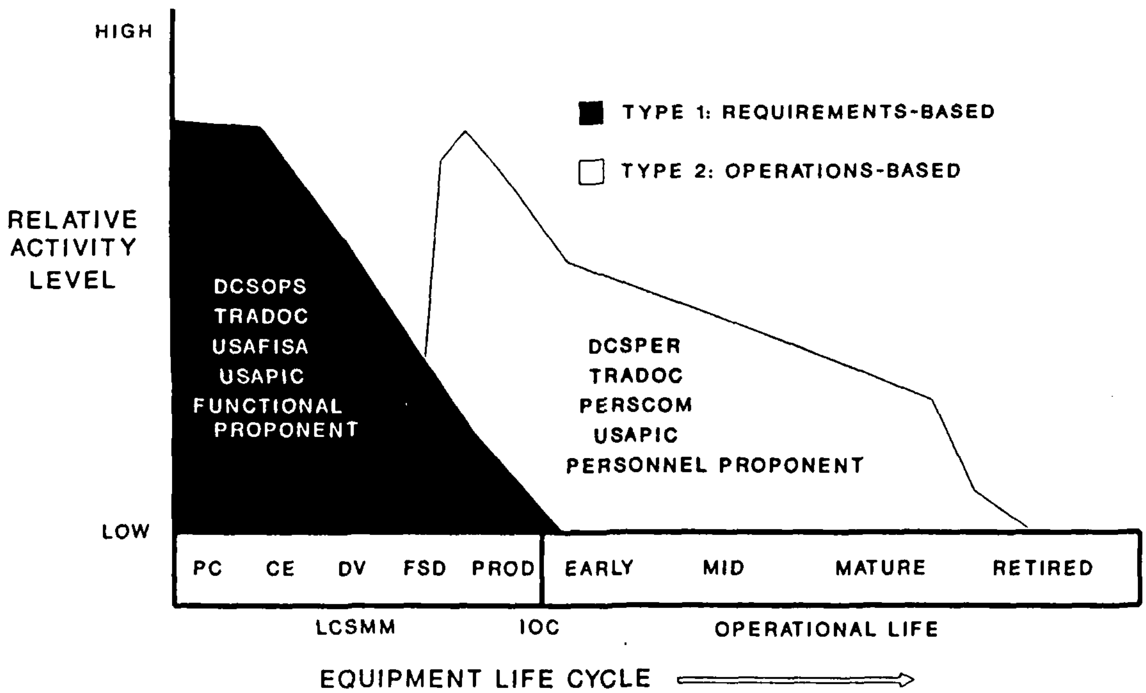


Figure 1

TYPES OF MOS RESTRUCTURING ACTIONS

"Operations-based", or Type 2, MOS restructuring is an extension of the manpower-related MOS restructuring occurring during the acquisition process. Once the requirements have been determined through the process described above, the focus changes to supporting those requirements in terms of personnel.

Type 1 and Type 2 restructuring interface and overlap at many points. The former deals with spaces while the latter deals with creating a personnel support system that provides a structure for the Army to access, train, distribute, develop and sustain the personnel force needed to meet the requirement of new or revised doctrine, organizations, or equipment.

Type 2 MOS restructuring is heavily constrained and operates in a zero-sum-gain environment. Personnel MOS restructuring only influences personnel requirements that have been approved through manpower-related restructuring and does not provide any additional manpower resources.

This effort places its initial emphasis on developing techniques supporting the analytical and procedural requirements associated with Type 2 MOS restructuring. However, as work progresses into future tasks and phases of this research effort, the focus will encompass Type 1 MOS restructuring in order to address equipment domains and the overlap between manpower-based and operations-based MOS restructuring.

This beginning work focuses on enhancing existing practices and procedures. The restructuring of MOSs has been an ongoing process since the U.S. Army was established, and the Army's personnel proponents are well-versed in performing the required analysis. The aim, and the focus, of this research is to enhance these practices through more systematic and quantitative procedures.

Improving existing practices implies that the strengths and shortcomings be established as a baseline. This can be accomplished by a review of current policies and procedures, a review of existing research products, and an assessment of the utility of current analytical techniques.

In sum, to fulfill the overall goal of this research, a baseline is required. That is one of the objectives of this research note.

Identify high impact opportunities for improving MOS restructuring. The second objective addressed in this research note is the identification of high impact opportunities for improving MOS restructuring.

The need to select specific aspects of MOS restructuring as the focal points of this research effort stem from two factors: one is the complexity and variety of analytical steps involved in restructuring and the other is the limitation of resources in relation to the potential requirements.

As discussed above, there are at least two scenarios in which MOS restructuring occurs. Concentrating this effort on Type 2 actions narrows the scope of this inquiry; however, each type of MOS restructuring involves numerous steps, volumes of data, and various analytical complexities. Analytical and procedural requirements for Type 2 structuring are specified in the MOCS Handbook. Nine steps, some more complicated than others, some more critical than others, and some dependent upon complex data manipulation, constitute Type 2 structuring.

Today, approximately 30 personnel proponents including the Signal Personnel Proponent are engaged in performing MOS actions. This number is expected to almost double when personnel proponency is extended to incorporate the Army's civilian workforce. Each proponent faces common and unique requirements.

Generally speaking, the procedures and practices for processing MOS actions have not been formalized in the personnel proponencies. Each proponent prepares its MOS action submittals following practices that have evolved locally.

There are many elements of the MOS restructuring process that can benefit from research supported by this effort. Approximately 6-9 technical person-months are allocated from the project's resources for improving analytical techniques. The resources are sufficient to develop concepts and create prototypes of particular techniques.

A key objective addressed in this research note is identifying the "high impact" opportunities. Which aspects of MOS restructuring can benefit the most from these research efforts? Answers to this question are important inasmuch as the resources are not available to address all potential areas of improvement. Furthermore, even if resources did not pose constraints, good system development practice dictates that priorities be established and that system development occur incrementally.

Summary: research objectives. In sum, the objectives underlying this present research effort and research note constitute an initial step aimed at creating analytical methodologies that are systematic and quantitative in their approach to MOS restructuring. Both a baseline and opportunities for enhancing the MOS restructuring practices as they occur at the personnel proponent level are established in this report.

Research Issues

MOS restructuring analysis is an ongoing activity of every personnel proponent agency in the Army. Although the current MOS restructuring processes do not benefit from systematic and quantitative methodologies, there are procedures in place to assist the proponents in analyzing MOS restructuring issues. The MOCS Handbook is widely used by the personnel proponents as a procedural guide in MOS analysis. This fact raises several issues that must be addressed in the course of conducting this research:

1. Are the existing methodologies as outlined in current Army regulations and procedural guides adequate to meet the requirements of MOS restructuring?

2. What benefits can be expected in the development of new methodologies?

3. To what agencies should the MOS restructuring methodologies developed in this research have applicability?

The limitation of current methodologies. Current Army regulations, policies, and guides furnish an abundance of procedural and report content guidance to support MOS restructuring. However, current methods and technology fall short in providing a systematic and quantitative framework for the actual hands-on analysis and design of healthy MOS structures. Although the current procedural guidance outlined in the MOCS Handbook is adequate as a first generation MOS analysis and restructuring tool and is a valuable resource for development of follow-on methodologies, the handbook is not adequate alone to meet the requirements of MOS restructuring.

While the handbook was developed to provide guidance for restructuring MOSs, it also represents a first effort to tell MOS analysts what analytical steps must be performed. This accomplished, the requirement for guidance passes from "what to do" to "how to do". The ARI tasking represents an initial effort to develop analytical techniques that begin to address the latter requirement.

Experience using the handbook also has made the personnel proponent community aware of some of the attributes that analytical methodologies ought to have. Particular interest focuses on techniques that are quantitative in character and can be systematically applied.

The benefits of new methodologies. The creation of new systematic and quantitative methodologies will enhance the ability of the personnel proponent to perform MOS restructuring. These analytical methods will strengthen MOS analysis procedures by standardizing the analysis process. Standardization means that analytical procedures can be replicated in terms of approach, steps in performance, and data collection.

During the MOS analysis process, difficulties arise in determining how solutions were arrived at by the proponent. This phenomena occurs more often than not because the current methodologies are subjective rather than quantitative. Currently many restructuring decisions are made based upon "gut reaction" rather than decision making parameters that are measurable and can be audited. New quantitative methodologies will reduce the number of decisions made based strictly upon expert opinion, by replacing the current decision making processes with processes that have measurable characteristics.

In order to address MOS restructuring at the personnel proponent level, new methodologies are required. None that exists today completely satisfy the proponent's requirements for MOS restructuring analysis.

MOS restructure methodology applicability. A third important issue that needs to be addressed is identifying which Army agencies are the primary users of the new methodologies stemming from this effort.

As outlined in preceding paragraphs, MOS restructuring issues occur in two different environments: (1) a manpower requirements-based environment during materiel acquisition and (2) personnel-based environment during development of a personnel support structure to operate and maintain the new equipment.

During the acquisition process, issues are addressed regarding manpower, personnel, and training (MPT) requirements that must be met in order to operate and maintain new equipment. During procurement, MOS decisions are based on analysis of the new equipment's maintenance and operational requirements, the tasks that existing personnel in existing MOSs are trained to perform, and the match between the requirements and capabilities of the current MOS. These MOS restructure issues must be addressed in order to determine the best approach for manning the new equipment.

The second environment in which MOS restructuring is addressed is that of the personnel proponent who must initiate MOS actions in response to requirements stemming from the fielding of new equipment. These actions require the personnel proponent to perform an indepth analysis of the equipment fielding requirements and develop a MOS structure capable of supporting those requirements. The methodologies developed in this initial effort are being designed for primary application in the latter environment, i.e., in support of MOS restructuring decisions that must be made by the personnel proponent in response to the fielding of new equipment.

Study Design and Approach

Figure 2 illustrates the framework which is being used to develop the analytical methodologies in this research effort. There are three related efforts, each encompassed within the scope of an individual subtask.

The work documented in this research note focuses on describing the current MOS restructuring environment and establishing a developmental baseline for the operations portion of MOS restructuring efforts. Army regulatory guidance, policy and procedures for MOS restructuring analysis are delineated. Existing research is identified. Current proponent practices and procedures are reviewed. Potential improvements in MOS restructuring analysis methodologies are identified and recommendations made. The potential use of artificial intelligence and expert systems techniques, among other decision and analytical modeling techniques, are addressed.

A second focus of this research effort, which will be reported in subsequent research notes, addresses the development of new methodologies and the establishment of prototype specifications for software in order to support MOS restructuring analysis and documentation. This will be accomplished using the baseline developed in this research note in conjunction with the findings resulting from the analysis of selected Signal MOS action items.

The third subtask within this research aims at the development of techniques to define equipment domains which may represent common requirements for skills and abilities and training, among other MOS attributes. Equipment domains can then potentially be used as a method to assess the impacts of equipment on MOS restructuring possibilities and to suggest worthwhile actions that might be undertaken.

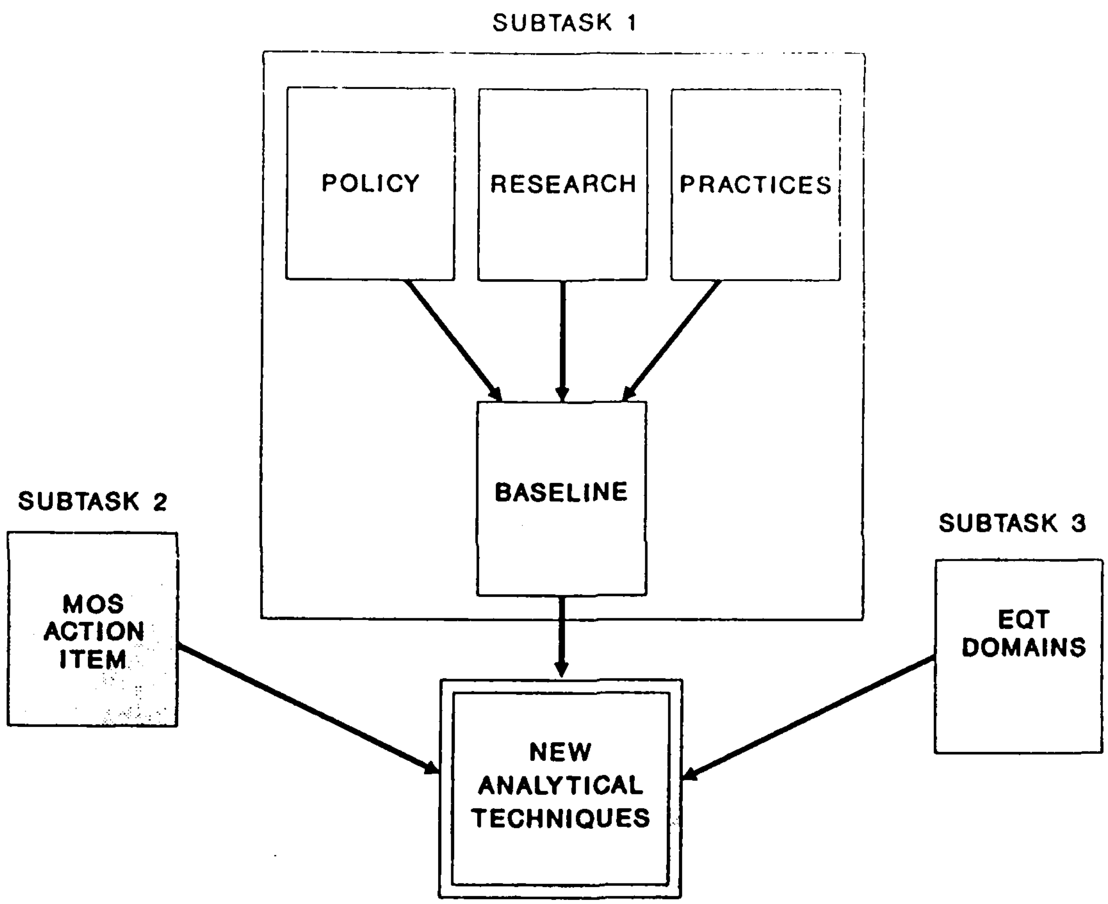


Figure 2

TECHNICAL APPROACH

Army Regulations and Policies

As the primary means for organizing, allocating, and managing military personnel within the Army, the significance of MOS and CMF structuring is reflected in the body of policy and regulations dedicated to controlling their design, analysis, and potential restructuring.

This section identifies and describes the current Army regulations, policies, and guidebooks addressing the management and change of occupational specialties and their associated career management fields. The existing set of regulations and policy for commissioned officers, warrant officers, and enlisted personnel, with detailed emphasis on the latter, are discussed.

Official Army regulations and policies in three areas are important in establishing a baseline for development of MOS restructuring techniques. The areas include:

1. The Personnel Proponent System.
2. Military Occupational Classification System (MOCS).
3. System Management and Requirements Determination.

Table 1 lists the Army regulations and related policy most relevant to the present inquiry. The review of existing policies and regulations underlying this summary has shown that shortcomings in MOS restructuring practices and procedures do not stem from a lack of policy. There is an adequate policy base for effective MOS structuring and CMF management.

The Personnel Proponent System

The personnel proponent system establishes the principal organizational entities responsible for operations-based MOS restructuring activities. AR 600-3, The Personnel Proponent System, published by the Office of the Deputy Chief of Staff for Personnel (ODCSPER), establishes overall responsibility for Army personnel management. Primary operational responsibility for the system is delegated to the Chief, Personnel Proponent Office at each Army branch and functional area.

The regulation assigns the personnel proponent office with responsibility for administration and management of the personnel life cycle management functions keyed to assuring the overall supportability of the CMFs and associated MOSs within the branch or functional area. As defined in the regulation, the personnel

Table 1

CURRENT ARMY REGULATIONS AND GUIDANCE PERTAINING TO MOS RESTRUCTURING

PERSONNEL PROPONENT SYSTEM	
AR 600-3,	The Personnel Proponent System
MILITARY OCCUPATIONAL CLASSIFICATION SYSTEM	
AR 611-1	Military Occupational Classification System
AR 611-101	Commissioned Officer Classification System
AR 611-112	Manual of Warrant Officer Occupational Specialties
AR 611-201	Enlisted Career Management Fields and Military Occupational Specialties
	Guide for Preparation of Changes to the Military Occupational Classification Structure (MOCS)
SYSTEMS MANAGEMENT AND REQUIREMENTS DETERMINATION	
DA PAM 11-25	The Life Cycle Systems Management Model for Army Systems
AR 71-2	Basis of Issue Plans and Qualitative and Quantitative Personnel Requirements Information

proponent office is responsible for evaluation and recommendation of personnel management issues in the following areas:

1. Structure
2. Accession
3. Individual Training and Education
4. Distribution
5. Unit Deployment
6. Sustainment
7. Professional Development
8. Separation.

As result of this regulation, the Army has established approximately 30 personnel proponent offices. Each has responsibility preparing MOS action submittals recommending changes to the CMFs and MOSs within their cognizance. While the focus of this initial research is on the Signal Branch, all proponent offices stand to benefit from more systematic and quantitative techniques supporting MOS restructuring.

The Military Occupational Classification System

Four Army regulations and the MOCS Handbook provide the major sources of policy governing the establishment and maintenance of MOSs and CMFs.

AR 611-1, Military Occupational Classification Structure (MOCS), prescribes the methods and command responsibilities for developing, maintaining, and changing the MOCS. The regulation provides the overall policy and directives for management of the subordinate AR 611 series regulations. Included are the sources, content and staffing requirements for proposed changes and the schedule of implementation for approved modifications. Key responsibilities assigned for management, update and staffing of proposed changes to the MOCS include: Deputy Chief of Staff, Personnel (DCSPER); Deputy Chief of Staff, Operations and Plans (DCSOPS); Deputy Chief of Staff, Logistics (DCSLOG); Army Material Command (AMC); Training and Doctrine Command (TRADOC); and the U.S. Army Personnel Integration Command (USAPIC). AR 611 series regulations that detail the Army's military occupational classifications include: (1) AR 611-101 for officer, (2) AR 611-112 for warrant officer, and (3) AR 611-201 for enlisted personnel.

AR 611-101, Commissioned Officer Classification System, details the authorized branches, functional areas, areas of concentration, grades, and language identifiers for commissioned officer positions. AR 611-112, Manual of Warrant Officer Occupational Specialties, develops Army procedures for the classification, management and designation of warrant officer positions. As a unique category of personnel with specialized skills, and technical and management expertise, warrant officers are treated as a distinct personnel category and managed separately from both the enlisted and commissioned officer personnel categories. While relevant to the proponent's overall personnel management responsibilities, officer and warrant officer regulatory guidance is not directly related to the emphasis of this research on enlisted MOS restructuring.

AR 611-201, Enlisted Career Management Fields and Military Occupational Specialties, is the principal source delineating enlisted CMF and MOS Code (MOSC) classifications. The regulation forms the basis for enlisted personnel management within the active Army, Army National Guard, and Army Reserve. This regulation also represents a central element in personnel, force structure, and organization management through definition of the MOSC structures that define Army-wide Tables of Organization and Equipment (TOE) and Tables of Distribution and Allowances (TDA) position grade requirements and authorizations.

In addition to defining Army position requirements and authorizations, the regulation also details the current approved listing of enlisted CMFs and MOSs. The listing provides a narrative description of each CMF including MOS makeup, types of duties, mental and physical qualifications, and career objectives. CMF path of progression is detailed by MOS and skill level from initial entry through Command Sergeant Major (CSM). MOS restructuring recommendations submitted by the personnel proponent and approved by Headquarters Department of the Army (HQDA), are the basis for updating AR 611-201.

In addition to these regulations, the MOCS Handbook represents the most direct, user-oriented guidelines available to the personnel proponent responsible for MOS restructuring. The handbook, published by USAPIC, develops detailed examples of analysis outputs along with general instructions to assist the personnel proponent in completing the documentation requirements for MOS action item submittals. The examples provided cover the major steps from initial MOS action to final approval and incorporation into the applicable AR 611 series publications.

In the absence of the Handbook, the personnel proponent would have difficulty in responding to MOS restructuring requirements. With the handbook, proponents are aware of the analytical and procedural steps which must be performed and are in a position to seek guidance and assistance with respect to how individual analytical and procedural steps in the handbook should be executed.

Systems Management and Requirements Determination

DA PAM 11-25, The Life Cycle Systems Management Model (LCSMM) for Army Systems, provides the framework for managing the acquisition and fielding of equipment. MOS restructuring, particularly requirements-based restructuring, has its origins in the initial MANPRINT planning processes occurring at the beginning of a materiel acquisition. Initial MOS requirements for equipment being acquired through the materiel acquisition process are ultimately reflected in the Basis of Issue Plan (BOIP) and the Qualitative and Quantitative Personnel Requirements Information (QQPRI).

AR 71-2, Basis of Issue Plans and Qualitative and Quantitative Personnel Requirements Information, defines the event sequences, content requirements, and decision review procedures for development of the BOIP and QQPRI documents that generate the update and modifications to TOE and TDA resulting from the introduction of new or improved equipment.

Requirements for revised or new MOS and CMF categories are based on input from the BOIP Feeder Document (BOIPFD) that details the equipment and proposed density. Responsibilities for developing the specific personnel requirements are shared in coordinated decision processes involving the materiel, combat, and training developers.

A QQPRI reflecting initial estimates of the operator numbers, including MOS categories, skill levels, and ASIs for operators and maintainers, is prepared by the materiel developer responsible for research and development. Identification of supervisory positions including MOS and ASI, is prepared by the combat developer.

Estimates of the required formal or on-the-job training for the MOS proposal is completed by the training developer. For new or revised MOS categories, the developer must provide estimates of the hours of training in each required subject for each MOS at each skill level.

This QQPRI is forwarded, through TRADOC, to USAPIC which develops the proposed MOS, SQI, and ASI occupational data required to operate and maintain the equipment. Requirements for new or revised MOS structures are reviewed by affected Major Army Commands (MACOM) prior to final approval.

AR 71-2 also provides details for the procedures and justifications for new or revised MOS categories. The regulation emphasizes the major impact on new systems if current MOSs, as defined in AR 611-201, cannot be utilized. Documentation requirements for new or revised MOS structures include the materiel, combat, and training developers, and closely follow the procedural requirements of AR 611-1. Although AR 71-2 charges the materiel, combat, and training developers with documenting MOS structure requirements in the QQPRI, the personnel proponent has sole responsibility for ensuring that the proposed MOS structure is (1) supportable in terms of personnel life-cycle management, (2) well defined in terms of accessions and training, and (3) documented through the AR 611-1 process and forwarded to Headquarters Department of the Army (HQDA) for approval and updating of the appropriate AR 611 series regulation.

Prior Research

While the policy basis for MOS restructuring is current and comprehensive, past research which may be used as a foundation for developing systematic and quantitative techniques is substantially lacking. There are, however, various research reports and journal articles representing conceptual models, analytical methods, theories, and empirical studies which have value both for what they present and for what they fail to address.

This section summarizes the major research products which have been identified in the course of preparing this research note. The research discussed, though not exhaustive, covers the past ten years.

Table 2 lists the research efforts discussed in this section. For discussion purposes, they have been arbitrarily divided into three groups: models and analytical concepts, MOS restructuring and related research, and empirical studies. These were identified by the ARI Field Unit-Fort Gordon, by inquiries to Navy and Air Force research laboratories, a review of abstracts from the professional literature, from presentations made at the ARI and Air Force Human Resources Laboratory (AFHRL) joint-sponsored Tri-Service Jobs Specialties Conference, and an examination of in-house literature. Each research product is summarized in terms of its objectives, study design, methodology, and results. Relevant methods, models, and system tools with potential application in this research effort are noted.

Models and Analytical Concepts

There are no existing operational models that can be readily adapted for use by the Army personnel proponents in support of MOS restructuring. There are, however, a number of research products which, in their strengths and weaknesses, provide some guidance with respect to the design and development of analytical techniques. Five such efforts are discussed here.

Air Force Specialty (AFS) Impact Model (AIM). AIM is a conceptual model developed to overcome shortcomings embedded in the Air Force's Small Unit Maintenance Manpower Analysis (SUMMA) model, which is a closed loop model that can be used to identify alternative Air Force specialty (AFS) job structures (Akman and Boyle, 1988). A major weakness in the SUMMA model is that its optimization criteria for job structuring are limited to several relatively crude measures related to training impact and task burden.

Table 2

PRIOR RESEARCH

MODELS AND ANALYTICAL CONCEPTS

Concepts for an AFS Impact Model (AIM), Akman Associates, Inc., 1988.

Small Unit Maintenance Manpower Analysis (SUMMA). Wright-Patterson Air Force Base, AFHRL-LRC, 1986.

HARDMAN III Products. Army Research Institute, 1988.

Army Manpower Cost System (AMCOS). Economic and Budget Cost Models. BDM Services Company, Monterey, California, 1985.

Specialty Structuring Systems (S^3). Brooks Air Force Base, Development Manpower and Personnel Division, AFHRL, 1988.

MOS RESTRUCTURING AND RELATED RESEARCH

MOS Restructuring: An Annotated Bibliography, Draft Research Note, Army Research Institute, Shipman and Finley, 1989.

Project A, Army Research Institute

Synthetic Validity Project, Army Research Institute, 1989

Survey of Professional Literature, Muckler, 1989.

EMPIRICAL STUDIES

HARDMAN Comparability Method (HCM), Light Helicopter Family Program (LHX), 1987.

Electronic Maintenance Structure Study (ELMS), Draft Final Report. Aberdeen Proving Grounds, Chief of Ordnance, 1987.

AIM does not take issue with SUMMA's decision model but focuses on the larger decision framework in which specialty structuring decisions must be made. In particular, AIM lays out requirements and procedures to assess and modify SUMMA solutions in terms of personnel policy, career field management, and AFS distribution.

In terms of policy, AIM presents concepts for evaluating potentially optimal task structures in terms of unit level and force policy. Career field management impact is assessed through evaluation of Armed Services Vocational Aptitude Battery (ASVAB) requirements, accession and retention rates, training requirements, overseas rotation, and paygrade distribution. Impacts on AFS distribution are evaluated in terms of the weapon systems that use the AFS.

The value of AIM to the present effort is its recognition that MOS structuring decisions, while usually driven by problems associated with a single or few equipment items, cannot be effectively made without considering the impact on other parts of the Army where the MOS may also exist. As will be elaborated in the next section, Army procedures generally do recognize the broad ramifications of MOS structuring decisions. The models and other research that have been developed to date, with the exception of AIM, have not given sufficient attention to issues external to the immediate MOS problem.

Small Unit Maintenance Manpower Analysis (SUMMA). The SUMMA program, sponsored by AFHRL, has initiated a series of research efforts for development of quantitative decision support systems to support task and job clustering analyses (Boyle, 1989). The initial research was undertaken in response to the decentralization of maintenance occupational specialties required by dispersed operating base.

The SUMMA model is a microcomputer-based decision aid intended to portray consequences of maintenance job redefinition, which typically takes the form of a job merger or job enlargement. SUMMA evaluates alternative AFS structures in terms of task content and develops optimized task and job clusters at the weapon system level. The Logistics Composite Model (LCOM) data base serves as the source for definition of the task and specialty combinations.

Optimization of the new cluster is subject to defined wartime sortie rates and a detailed tradeoff analysis of savings in manpower costs resulting from reduced specialization, incremental costs of training, and policy impact of the resulting unit level changes.

The SUMMA model, while lacking an integration of key MPT factors at the unit and force level, was based on a strong logic and analytic foundation for defining alternative job clusters and has been the subject of follow-on development in order to extend its application.

The application of SUMMA or its techniques to the operations-based MOS structuring initially addressed in this technical research is limited. Its concepts and approach, particularly when coupled with AIM extensions, have more potential relevance to the requirements-based MOS structuring that occurs at the beginning of the weapon system acquisition process.

HARDMAN III. Currently under ARI development, HARDMAN III is a set of six interrelated, microcomputer-based tools. These tools will assist Army analysts in developing systematic descriptions of system performance requirements, manpower constraints, personnel characteristics constraints, training constraints, and manpower and personnel characteristics requirements at the weapon system level (Kaplan and Hartel).

The System Performance and RAM Criteria Aid (SPARC) is being designed to develop system performance requirements based on 21 different simulation models representing major classes of Army systems. System performance may be mapped from unit performance requirements using the Blueprint of the Battlefield Taxonomy (TRADOC PAM 71-9).

The Manpower Constraints Aid (M-CON) provides crew size constraints so that equipment designers develop designs with manning requirements not exceeding the constraints. The model is based on predicting MOS availability. Requirements are projected against the expected MOS population until there is consistency between new and existing demands as well as supply.

The Personnel Constraints Aid (P-CON) provides soldier performance characteristics which can be integrated with other design dimensions. The model deals with soldier characteristics that are MOS sensitive and those that are not. The system predicts ASVAB and mental category (CAT) distributions for each MOS; these are mapped to a series of equations based on the ARI Project A data base. P-CON produces MOS dependent information on age, language, ability, and sex as well as non-MOS dependent information on size, strength, and perceptual abilities for the soldier age group.

The Training Constraints Aid (T-CON) describes probable training so that design requirements will not require unattainable skill levels that cannot be achieved by available training. The system provides training hours for operations and maintenance. For operations, T-CON provides training hours per operations function, MOS and course, the general type of training per function, and training difficulty. Maintenance training data includes training hours per subsystem, per course, and MOS, the general type of training, and training difficulty.

These four models are designed to provide the equipment designer with constraints that translate into equipment performance levels. Equipment is designed to achieve certain performance levels. The HARDMAN constraints indicate the capabilities achievable based on the projected availability of MPT resources. The final two models included in HARDMAN III are designed to be used in evaluating system designs.

The Manpower-Based System Evaluation Aid (MAN-SEVAL) is being developed to evaluate designs by determining the jobs and number of personnel per job required to operate and maintain the hardware and software. The Army will then have basis to determine manpower requirements in comparison to manpower availability.

The sixth product, the Personnel-Based System Evaluation Aid (PER-SEVAL) evaluates designs by determining human characteristics and the required level of each necessary to operate and maintain a given design to performance criteria. If the average soldier is unable to operate or maintain the system to criterion levels, ASVAB, PULHES, and Military Enlistment Physical Strength Capacity Test (MEPSCAT) scores are raised, and the model rerun until system performance is achieved.

The relevance of the HARDMAN III products to MOS restructuring like the models discussed previously bears more greatly on the requirements-based structuring. The "indirect" approach used in the HARDMAN III architecture, whereby MPT requirements are not directly estimated but result from system designs responding to SPARC, M-CON, P-CON, and T-CON constraints, may deserve consideration as an analytical approach in dealing with selected MOS restructuring actions. Since none of the HARDMAN products are operational yet, however, the efficacy of the indirect approach has not been proven.

Specialty Structuring System (S^3). As a follow-on development program to the initial task analysis and clustering methods developed in SUMMA, AFHRL has initiated the development of the specialty structuring system (S^3), which is focused on expanding the scope of the original decision model to include personnel and training tradeoff issues when optimizing task and job consolidation (Sorenson, 1988).

The model addresses macro-level MPT analysis and is intended for use by Air Force planning personnel during the pre-concept and concept development phases of the acquisition process. The design objective is maximization of work efficiency and minimization of weapon system life cycle support costs.

The project is being developed in three phases including research plan, demonstration, and software development. The completed S^3 system is intended to optimize MOS consolidations at both the unit and weapon system level. Its utility in developing analytical techniques supporting requirements-based MOS structuring is dependent upon S^3 becoming operational.

Army Manpower Cost System (AMCOS). AMCOS is based on a series of interrelated models for developing economic (real) and budgetary personnel cost estimates over the career of the enlisted soldier. Marginal and total cost projections are generated by MOS and paygrade, and can be aggregated to the unit level. The AMCOS information management system allows for extraction of cost detail at both the unit and soldier level.

The life cycle cost model provides additional cost analysis for recruiting, enlistment bonuses, equipping, training initial entry training (IET) and advanced individual training (AIT) and accession-related permanent change of station (PCS). The AMCOS research and development program has established a basis for effective cost projection algorithms and provides a source of life cycle cost data that may be useful in optimizing MOS aggregation decisions at the force level.

Cost issues have generally not been directly addressed at the proponent level during operations-based MOS restructuring studies. Costs are contained to the extent that MOS restructuring occurs in a zero-sum gain environment. Whatever additions in training or manning arise due to a restructuring generally must be offset by comparable reductions. Cost implications are addressed more explicitly during requirements-based restructuring. Consequently, AMCOS may be useful in addressing the cost implications of alternative MOS structures considered during the acquisition process.

Summary: Applicability of Models. The models identified and described here generally represent the state of the art with regard to MOS structuring. All are more suitable to requirements-based rather than operations-based structuring. The Air Force models, AIM, SUMMA, and S^3, come most closely to dealing directly with restructuring; however, these are either conceptual or under development, and, in the case of the latter two, incomplete in their decision structures. The objectives of the HARDMAN III products focus on influencing the work of the system designer; they are not intended as MOS structuring tools. Interest in AMCOS as the means for cost estimation is appropriate; however, cost is not directly considered in operations-based structuring, which, by its groundrules, is a zero-cost process.

MOS Restructuring and Related Research

Based on review of current and past research efforts, little has been found that directly bears on MOS structuring. In this subsection, the results of an ARI bibliographic search, the implications of two on-going ARI projects, and a summary of the research literature over the past ten years are discussed.

MOS Restructuring: An Annotated Bibliography. As an initial step in formulating its MOS Restructure program, the ARI Field Unit-Fort Gordon undertook a review of existing technical reports, regulations, and program descriptions concerning topics related to the question of how to restructure MOSs. The review annotated in this bibliography includes most relevant efforts either completed or currently underway. Some discussed in the bibliography have been included in this section because of their significance.

The major findings from the ARI survey are that currently available procedures generally deal with requirements-based MOS restructuring. The research efforts were all in the developmental stage and have not yet been used in MOS restructuring actions. The findings in this section are consistent with ARI conclusions in this bibliography.

Project A. Project A is a very large ARI personnel selection and classification validation project. Begun in 1983, data collection and analysis are scheduled to continue until 1992. The major research issues being addressed are a) how to define and measure job performance, b) the tradeoff between the number of jobs versus the sample size for each job, given that resources did not permit drawing a sample from each of the 275 MOSs, c) identification of predictor domains with the highest potential for adding selection validity to the existing ASVAB, d) choosing the specific variables that should be targeted for predictor development in each domain, e) aggregating performance measures into composites for validation purposes, and f) choosing predictor batteries and estimating validity for MOSs for which no empirical data could be obtained. While the goals and objectives of Project A were never intended to directly relate to MOS restructuring issues, its job performance measurement techniques and some of its data may be useful to the present work.

Synthetic Validation Project (SYNVAL). SYNVAL is an ARI project designed to expand the utility of Project A results to all Army MOSs. Project A focuses on 19 MOSs. The purpose of SYNVAL is to develop predictor batteries based on the Project A MOSs which can in turn be used to develop selection and classification procedures for new MOSs, for MOSs that have undergone significant changes, or for MOSs that have relatively few people (Wise, Arabian, Chia and Szenas, 1989).

The significance of SYNVAL to the MOS structuring project lies in the application of synthetic validity as a concept for dealing with analytical problems pertaining to relatively small subpopulations and involving potentially large amounts of data. These attributes characterize elements of the MOS structuring process; using "synthetic" projection and analytical techniques may represent feasible, economical methods.

Survey of professional literature. Considering the numerous and pervasive applications of technology to human work in this century, a substantial body of scientific and technical literature might be expected. In fact, while there is a large amount of partially relevant theory and data, there are few intensive and extensive studies on work restructuring *per se*. Only parts of the problem are addressed in the existing professional literature (Muckler, 1989).

A search of the *Psychological Abstracts* from January 1979 (Volume 61) through September 1989 (Volume 76) was made. Several keywords were used: ability, aptitude measurement, Army personnel, career changes, intelligence measures, job analysis, occupational analysis, occupational success predictions, skill learning, task analysis, and taxonomies. In addition, certain journals (e.g., *Personnel Psychology*, *Journal of Occupational Psychology*, *Journal of Applied Psychology*, and *Psychological Bulletin*) and the references within the articles themselves were particularly useful for finding applicable materials.

Based on this review, there is no direct area of literature on specific and detailed aspects of "work restructuring". There are many articles on global social and economic aspects of work change, and many more on worker's attitudes toward changing work conditions. But, there is very little that defines and deals with such direct issues as job-specific "deskilling", evolving jobs, shifts in skill and training requirements as jobs change, or, most important, precise quantitative predictions of the impact of job changes on major MPT dimensions.

Empirical Studies

The largest set of empirical studies related to MOS structuring is represented by the numerous studies that have been and continue to be routinely performed by the personnel proponents. This section, in a search for methodologies or techniques which may be transferrable to the personnel proponent, however, focuses on empirical work accomplished within a research framework. Two Army studies are addressed in this respect.

HARDMAN Comparability Methods (HCM), LHX Program. The research serves as an addendum to the initial HCM application to the Army's Light Helicopter Experimental (LHX) system. The study defines an MOS consolidation plan to support fielding of the LHX system using the six analytic steps of the HCM analysis and defines a five phase methodology for evaluating 12 Manpower, Personnel and Training (MPT) parameters supporting the MOS consolidation decision.

Within predefined constraints determined by mission analysis, functional requirement analysis, early comparability analysis, manpower requirements, training, personnel requirement analysis, Army end strength and funding levels, the five phase analysis procedure is used to evaluate four alternative MOS structures:

1. Predecessor system
2. Baseline comparison system
3. QQPRI MOS structure
4. Alternative MOS consolidation.

The candidate structures are contrasted for supportability through a detailed analysis based on the 12 MPT decision parameters which can be weighted for relative importance. The five step evaluation approach includes:

1. Develop decision parameter results for predecessor, baseline, and TQQPRI MOS structures.
2. Identify high driver MOS demands.
3. Develop alternative MOS consolidation, not exceeding high driver demands of Step 2.
4. Develop decision parameter results for alternative MOS consolidation.
5. Evaluate and select most supportable MOS consolidation structure. Infeasible or no decision solutions require repetition of Steps 3 - 5 as necessary.

Electronic Maintenance Structure Study (ELMS). The ELMS study developed a review and evaluation of the Army's electronic maintenance function and addressed MOS structuring in terms of doctrine, training, organization, and proponency. The research included a majority of functions within the electronic maintenance system, but developed its primary focus within the

European-based V Corps. The principal objective of the study was development of an improved electronic maintenance structure through improved methods for the allocation of personnel, tools, equipment, and spare parts. In developing recommendations for designing a more effective MOS structure for weapons systems support, the PROLOGUE model was utilized to simulate the battlefield buildup in Europe and generate density and dispersion data for TOE equipment and personnel.

Based on available Manpower Requirements Criteria (MARC) data, the study determined that two percent of assigned equipment (at line item number (LIN) level) accounted for 50 percent of the annual maintenance manhours (AMMH).

Group survey methods were employed in conjunction with subject matter experts (SME) to produce match rate ratios for the maintenance MOS categories in four skill areas. Combined with assessments of training requirements, equipment work load and location, equipment modification, unit organization changes, and improvements to test measurement and diagnostic equipment (TMDE), the study proposed a reduction from 104 MOS categories to 55 over a period of 14 years.

The ELMS study ultimately failed to have significant impact on the Army's electronic maintenance MOSs because too many changes to a complex environment were being promulgated at one time. There was not a sufficient foundation or data base to respond to the myriad of issues raised in an MOS restructuring of such great magnitude.

There is obviously a lesson in this experience that bears on the present efforts. While there is general acknowledgement that methodologies failing to recognize the impact of a single MOS action on related contingencies is not satisfactory, extending analytical techniques beyond the scope of the single MOS issue must be accomplished cautiously so that control for the decision makers and other parties of interest is not lost.

Conclusions

This review has not revealed the existence of models, research, or analyses that can be used directly in support of operations-based MOS structuring. Much of the research material which does exist relates more closely to requirements-based structuring and may be useful in subsequent phases of this program.

At the same time, there are lessons learned and insights associated with this body of knowledge and its successes and failures which may serve as guideposts for subsequent developmental efforts. Chief among these are the utility of well-rounded architectures and the importance of bounding the problem space for which methodologies are developed to essential building blocks.

Current MOS Restructuring Practices

The purpose of this section is to establish the procedural baseline for current Army MOS restructuring. The section describes the general procedures and then discusses features unique to the Army Signal Branch, where the analytical techniques developed in this research will be initially tested.

This section is comprised of four subsections. The first section describes basic Army procedures. This outline is general in nature since trying to capture every specific reason an MOS is created or revised would not be feasible.

The second subsection focuses on the Signal Corps Personnel Proponent as a representative proponent agency and the test bed for follow-on development of methodologies. In this subsection the MOS restructure process is explored at the Signal Proponent level. Analysis areas that are to be explored for development of future methodologies, prototype software, models, and guides are addressed in detail. Other analysis areas are discussed in less detail as they are already well defined in Army guidance and little added value would be derived from selecting them for further study.

The third subsection discusses the capability and constraints of hardware, software, and models currently in use by the Signal's Personnel Proponent.

The last subsection describes the nature of MOS actions the Signal Proponent has ongoing at this time. The type, number and nature of the action, the workload effort involved, and the implications for follow-on methodologies to support these actions are all described.

Current Army Practices

In terms of current Army practices, three significant attributes characterize the MOS restructuring process and will potentially shape the developmental methodologies:

1. MOS restructuring is an integral part of personnel life cycle management.

2. The restructuring of an MOS or the development of new MOSs is usually triggered by changes in doctrine, organizations, and equipment, or any combination of the three.

3. The Signal Personnel Proponent utilizes the MOCS Handbook as their procedural source document for MOS restructuring.

Life cycle management functions. In 1981, the Army Deputy Chief of Staff for Personnel (DADCSPER) decentralized personnel proponency from his purview to the functional proponents (Infantry, Armor, Signal, Medical, etc.). As a result, AR 600-3 was developed and published. This regulation defines responsibility and authority for personnel proponent actions. Outlined in this regulation are the functions that the personnel proponents will perform to insure the health of their respective CMFs. These functions, commonly known as the eight personnel life-cycle management functions, are shown in Table 3.

"MOS restructuring" is an integral component of personnel life cycle management. The proponent must keep his force structure healthy in order to support Army mission and personnel requirements.

Structure, the first of the management functions, concerns managing all aspects of where, when, how, and why an MOS is documented in requirements and authorizations documentation. In order to manage these concerns, the proponent reviews, analyzes and recommends changes to MOS, grade, ASIs, specialty qualification identifier (SQI) requirements in The Army Authorization Document System (TAADS), TOEs, and TDAs. Recommended changes range from simple one line changes to complete revisions of MOS classification criteria (MOS restructuring) for inclusion in AR 611-201.

Major changes to an MOS structure cannot occur in a vacuum. The reason is any major revision may have a significant impact on the other seven life cycle management functions, and vice versa. For example, a significant increase or decrease in the E-3 grade level content of an MOS may have a direct impact on accession and training requirements, distribution, and the sustainment of that MOS. Or, major changes in training could result in the need for an MOS restructure.

Triggering mechanisms. The need for MOS restructuring analysis can be triggered for almost any reason. As Figure 3 shows, however, there are three major factors:

1. Changes in Army policy and doctrine, such as war fighting scenarios or modifications in unit deployment and capabilities.

Table 3

PERSONNEL PROPONENT LIFE CYCLE MANAGEMENT FUNCTIONS

STRUCTURE

Analyze and Recommend Changes to TAADS
Recommend Changes to TOE and TDA Organizations
Recommend Classification Criteria for AR 611-201

ACQUISITION

Recommend Accession Criteria
Recommend Accession Numbers
Recommend Criteria for Selected Recall Programs

INDIVIDUAL TRAINING AND EDUCATION

Identify Training Criteria by Career Field
Identify Civilian Educational Opportunities
Identify Development or Revision Requirements
Assess the Number of Personnel Requiring Training
Ensure Training for Career Field Development

DISTRIBUTION

Evaluate Inventory and Recommend Adjustments
Assess Number of Personnel Available for Training
Recommend Changes to Army Policy
Monitor Space Imbalanced Military Occupational Specialties (SIMOS)

UNIT DEPLOYMENT

Evaluate Unit Distribution and Cohesion, Operational Readiness Training (COHORT) Battalion Rotation
Evaluate Effects of Mobilization on Proponent System

SUSTAINMENT

Communicate With the Soldiers in the Field
Represent the Professional Interest of Soldiers
Evaluate Reenlistment, Continuation, and Retention Rates
Recommend Changes to Stabilize or Improve Retention
Recommend Changes to Improve Career Fields

PROFESSIONAL DEVELOPMENT

Identify Training and Assignment Opportunities
Establish Career Progression Patterns for Career Fields
Establish Professional Development Pamphlets

SEPARATION

Recommend Exceptions to Separation Policies
Recommend Changes to Retirement Policies

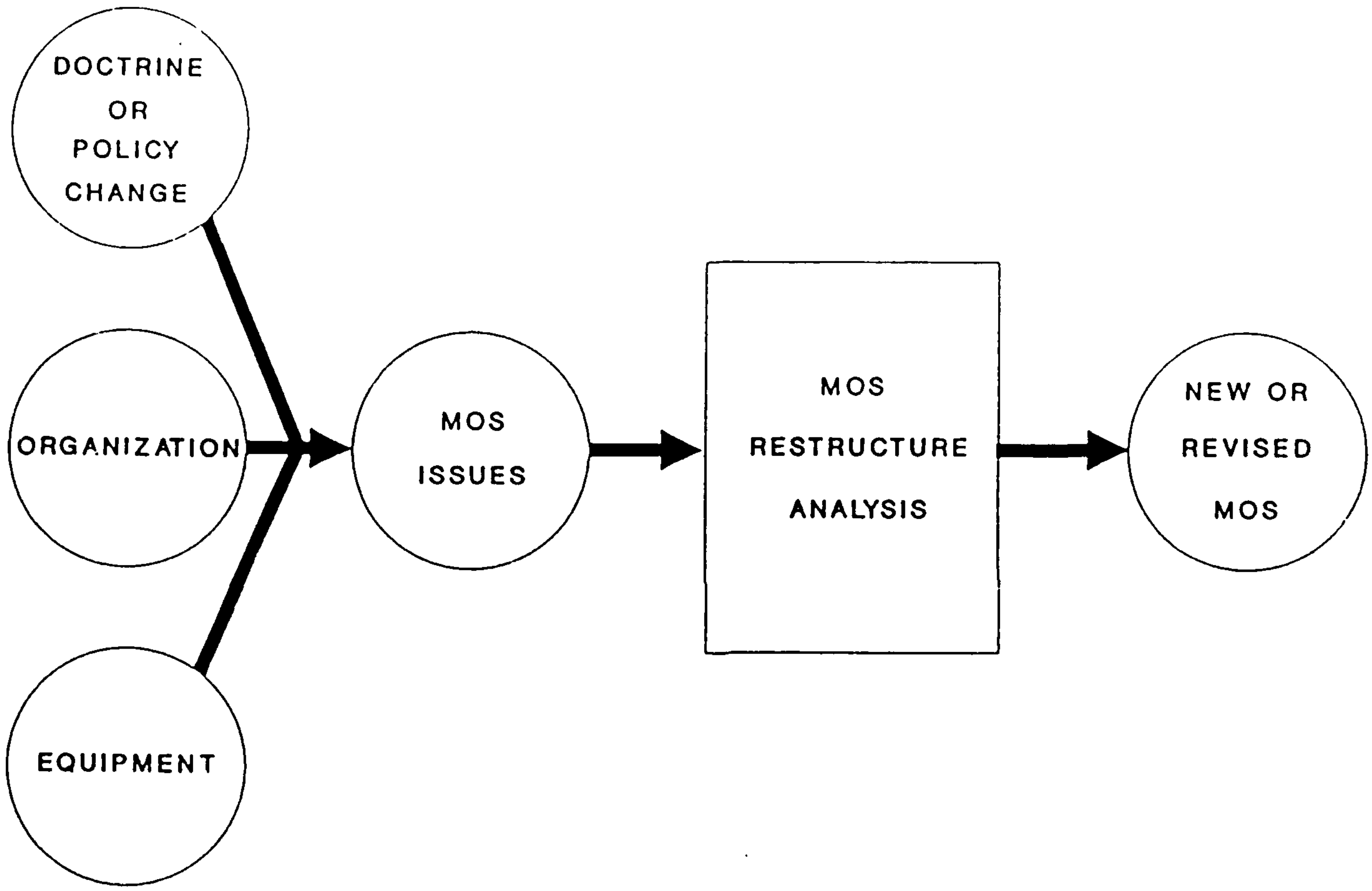


Figure 3

MOS RESTRUCTURING TRIGGERS

2. Revisions in organizational structure such as number and type TOE or TDA, introduction of new TOE or TDA, and the phase out of old organizations.

3. Introduction of new equipment or technology, changes in type or number (mix) of equipment, and phase out of existing equipment.

All or a combination of any of these triggering mechanisms may create serious MOS and personnel issues that must be addressed by the personnel proponent. Equipment issues are especially difficult to address as technology is continuously updated. Issues include but are not limited to the following:

1. Training Impacts

2. Grade Infeasibility

3. Accessions Criteria

4. Career Progression and Professional Development

5. Utilization of Female Personnel

6. MOS Imbalance

7. MOS Physical Demands

8. Space Imbalanced Military Occupational Specialties (SIMOS).

Army Procedures

The MOCS Handbook is an expanded extrapolation of AR 611-1. The handbook serves as a strawman for MOS restructuring analysis and was prepared as an aid in developing MOS actions. Procedures and guidelines for the development of MOS specifications and development of MOCS changes are described and illustrated. Documentation and procedures for coordination of recommended MOCS changes and the evaluation and review of those changes are also described.

Personnel proponents are required to complete a detailed MOS analysis prior to submission of a proposed change to an existing MOS or addition of an MOS into the force structure. The same set of analyses will be performed for ASIs as well. To ensure that a total evaluation and impact assessment is completed, a checklist of specific items to be addressed is provided in the handbook. The MOS analysis must provide documentation of all items which must be included as part of all MOS proposals.

MOS restructure analysis process. As outlined in the MOCS Handbook, the personnel proponent must gather data and perform a preliminary analysis to identify issues to be addressed during the study. Based upon this information, a study plan is devised to insure all proponent issues are addressed during the study. Following this, the proponent drafts the background and rationale for the MOS proposal.

In addition to documentation and coordination of the recommended changes, there are nine major steps as illustrated in Figure 4:

1. Position Data Analysis (PDAT)

2. Personnel Data Analysis

3. MOCS Identifier Duties and Tasks Analysis

4. Training Needs Analysis

5. Physical Demands Analysis (PDA)

6. Recruiting Impact Analysis

7. SGA Analysis and Development

8. Position Documentation and Personnel Reclassification Guidance

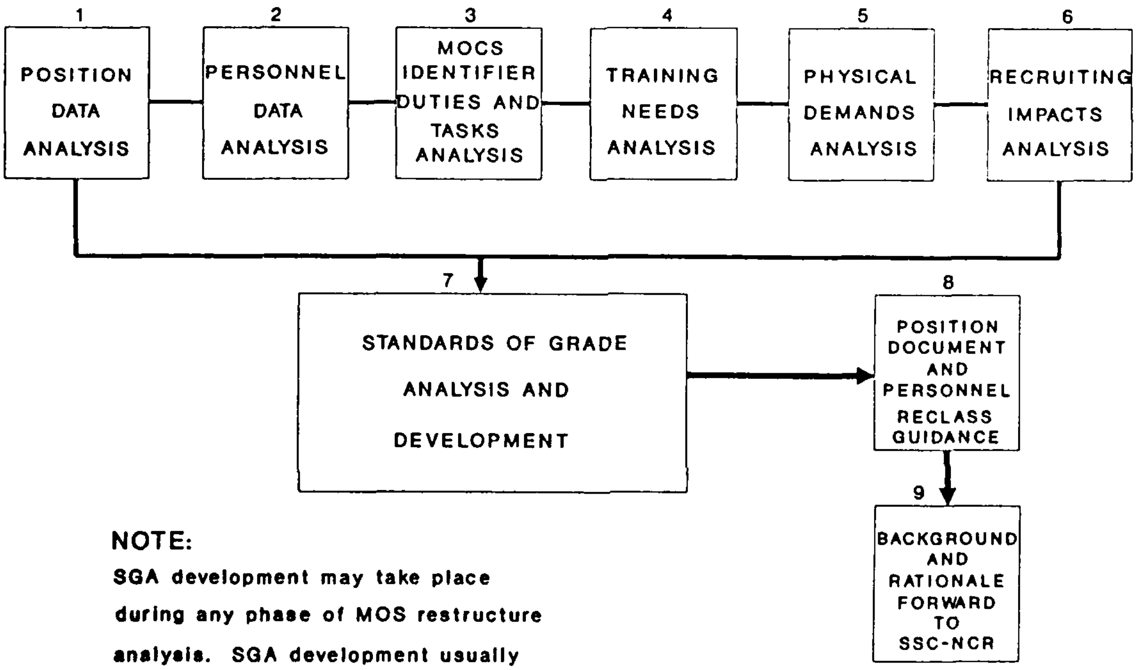
9. Background and Rationale.

In any MOS restructuring study, the emphasis and order in which these steps are executed may differ. There is uniqueness in each restructuring action. Nonetheless, all the steps are performed in some manner.

Position data analysis (PDAT). PDAT is a detailed analysis of the authorized positions affected by any of the triggering mechanisms. Table 4 summarizes its principal features in terms of data requirements, procedural steps, and resulting products.

PDAT is accomplished by "scrubbing" TAADS and identifying each position at the paragraph and line level of detail. Once accomplished, a composite picture of an MOS is drawn and is expressed in the total number of authorizations by MOS and skill level, as well as by grade cell and aggregate. If the functions are to be transferred from one MOS to another, they are reflected in this analysis also.

The results of this analysis provides the proponent with a broad overview of the relative health of the MOS, types and numbers of organizations in which the MOS is found, the



NOTE:
SGA development may take place during any phase of MOS restructure analysis. SGA development usually begins during the position data analysis phase.

Figure 4

MOS RESTRUCTURING ANALYSIS FLOWCHART

Table 4

POSITION DATA ANALYSIS

PURPOSE
Ensure a Total Evaluation of the MOS Environment
INPUTS
TAADS MOS Extract PMAD Data Operational and Organizational (O&O) Concept Plan BOIP and QQPRI Information Average Grade Distribution Matrix Current SGA TOE
STEPS OF PERFORMANCE
Research TAADS and Identify MOS Positions Review PMAD Data for Outyear Projections Analyze O&O Concept, TOE and TDA, BOIP and QQPRI Apply Average Grade Matrix Apply Current SGA
OUTPUTS
Baseline TAADS Extract Understanding of MOS Environment Impacts of New systems and Organizations on MOS Graphic Depiction of MOS Health MOS Outyear Projections Indication of MOS Grade Requirements

geographic locations and organizations (Bn, Bde, Division etc.) where the MOS is authorized, total authorized positions of the MOS, SIMOS implications, grade structure needs, combat probability of the MOS, and so on.

Personnel data analysis. In addition to the analysis of positions affected by the triggering mechanisms, the personnel proponent is also required to perform a personnel data analysis. This analysis is essential in assessing the impact of the triggering mechanisms on personnel supportability. Table 5 summarizes its principal data requirements, procedural steps, and results. The general areas of concern are:

a. How and from where personnel will be accessed.

b. The MOS career path in which the soldier can expect to progress.

c. Space Imbalanced MOS (SIMOS) implications (a SIMOS is one where more than 55 percent of the MOS authorizations are based outside the continental U.S.).

d. Utilization of female personnel and what impact will result from a revision.

MOCS identifier duties and tasks analysis. The proponent performs an analysis to determine what changes, if any, must be made in the MOS's descriptive duties and tasks. Table 6 lists the required data, procedural steps, and results. In the case of a new MOS, the descriptive duties and tasks must be developed. Army policy requires that Skill Level 1 tasks be included unless precluded by the complexity of the tasks. If it is determined that the MOS will start beyond Skill Level 1, a detailed justification must be submitted with the MOS action.

Occupational surveys are used during this analysis to the maximum extent possible. When no survey exists, the proponent may use various other methods such as the use of subject matter experts, results from job and task analysis, or convene a joint working group of doctrine and training developers, subject matter experts, and MOS analysts to develop this product.

Training needs analysis. The personnel proponent must develop a strategy for training new or revised occupational identifiers. The major features of training needs analysis are summarized in Table 7. This subsection of restructure analysis is usually shared with the training developer and the teaching branch in which the proposed training is or projected to be taught. Areas considered in this analysis are:

a. Length of current or projected training.

Table 5

PERSONNEL DATA ANALYSIS

PURPOSE
Determine Implications of MOS Revision on Personnel Management
INPUTS
Outputs from Position Data Analysis PMAD Outyear Projections
STEPS OF PERFORMANCE
Examine PMAD Data for Increases or Decreases of MOS Authorizations Review Force Structure for SIMOS Implications Review Position Data Analysis For Combat Probability Coding Requirements Review Position Data Analysis for Women in the Army Issues Analyze Accession Requirements
OUTPUTS
Resolution of Increase or Decrease in MOS Authorizations Determination of SIMOS Status Resolution of Women in the Army Issues Determination of MOS Accession Point

Table 6

MOCS IDENTIFIER DUTIES AND TASK ANALYSIS

PURPOSE
Determine Required Changes for MOS Descriptive Duties and Tasks
INPUTS
Current AR 611-201 Duties and Tasks* POI Information* Soldiers Manual* Army Occupational Survey* SME or Joint Working Group Panels Doctrinal Publications Organizations Equipment Outputs from Position and Personnel Data Analysis *If Available
STEPS OF PERFORMANCE
MOS Restructure Analyze AR 611-201, Program of Instruction (POI), Army Occupational Survey, and Outputs from Position and Personnel Data Analysis Develop List of Tasks Convene SME or Task Selection Panel Select Tasks New MOS Convene Joint Working Group of Doctrine and Training Developers, SMEs, and MOS Analyst Analyze Doctrine, Organizations, and Equipment Develop List of Tasks Select Tasks
OUTPUTS
New or Revised MOCS Identifier Duties and Tasks

Table 7

TRAINING NEEDS ANALYSIS

PURPOSE
Develop Training Strategy For New or Revised MOS
INPUTS
Outputs from MOCS Identifier Duties and Tasks Analysis Individual Training Plan (ITP) for MOS
STEPS OF PERFORMANCE
Analyze Output from MOCS Identifier Duties and Tasks Determine if New Tasks Will be Added to ITP or POI Determine Impact on Course Administrative Data (CAD) (Number of Students per class, number of classes per year, etc.) Determine Impact on TTHS Account
OUTPUTS
New or Revised Course Administrative Data for MOS New or Revised ITP for MOS Note: This analysis area is usually shared with, or performed by, the training developer.

b. Number of classes per year.

c. Number of students per class.

d. Number of students per year.

e. Training man years.

f. Increases or decreases in the trainees, transients, holdees and students (TTHS) account or instructor requirements.

g. Training start date.

Physical demands analysis (PDA). A detailed analysis is performed on the physical work requirements for every entry level task performed by the MOS. Based upon the most physically demanding task performed, the proponent classifies the MOS as light, medium, moderately heavy, heavy, or very heavy. For every task to be analyzed, a Physical Demands Analysis Worksheet is completed to insure all areas are addressed. Four steps are required for completing a physical demands analysis.

a. The proponent assembles all literature pertaining to the MOS under study (Field Manuals, Technical Manuals, Programs of Instruction, etc.). If working on a new MOS, the proponent may use the resultant tasks from job task analysis.

b. Explicit and implicit tasks are identified.

c. Where possible, soldiers are observed performing the procedures, processes, skills, tasks, and work objectives of the MOS. Other data are collected by interviewing supervisors and subject matter experts.

d. The data are then reviewed, analyzed and a physical demands rating assigned.

Table 8 summarizes the major data requirements, procedural steps, and results of the physical demands analysis step.

Recruiting impact analysis. Table 9 lists the principal features of recruiting impact analysis. Impact on the Joint Optical Information Network (JOIN) must be determined. Any change in MOS title, Skill Level 1 tasks, physical demands, or accession strategy must be identified. The results of this information is placed on optical disk for presentation to perspective Army recruits.

Table 8

PHYSICAL DEMANDS ANALYSIS

PURPOSE
Define the Physical Work Requirements of Entry Level Tasks. Develop Physical Demands Classification.
INPUTS
Outputs from MOCS Identifier Duties and Tasks Field Manuals Technical Manuals POI Soldier Observation
STEPS OF PERFORMANCE
Identify Implicit and Explicit MOS Tasks Identify Skill Level 1 Tasks Observe Soldiers Performance of Tasks Annotate Physical Demands Analysis Worksheet Rate Tasks as Light, Medium, Moderately Heavy, Heavy, or Very Heavy Assign Physical Demands Rating
OUTPUTS
Finalized Physical Demands Analysis Worksheets Physical Demands Rating For MOS

Table 9

RECRUITING IMPACT ANALYSIS

PURPOSE
Determine Impact on Recruiting
INPUTS
Outputs from Position Data Analysis Outputs from Personnel Data Analysis Outputs from MOCS Identifier Descriptive Duties and Tasks Outputs from Physical Demands Analysis
STEPS OF PERFORMANCE
Analyze all Output Areas Identify any Changes in MOS Title or Skill Level 1 Tasks Annotate any Changes in Physical Demands Requirements Annotate any Changes in Accession Strategy Determine if Bonuses are Necessary
OUTPUTS
Revised Joint Optical Network (JOIN) Information and Accession Criteria (If Required)

A determination must be made on current or new recruiting programs. If the MOS qualifications or training are to be revised, the U.S. Army Recruiting Command may have to renegotiate enlistment contracts. For new MOSs, recruiting strategies must be developed and documented.

Standards of grade (SGA) analysis and development. SGA analysis is performed in an effort to meet mission requirements and optimize the career pattern of an MOS. Table 10 lists data requirements, procedural steps, and results. This analysis may take place during any phase of restructure analysis and usually begins during the position data analysis phase. SGA analysis is perhaps the most difficult analysis performed during an MOS restructure effort. It is highly constrained by Congressional, Department of Defense, Army, and, to some extent, local policies. There are six areas of concentration for this phase of analysis:

a. Duty position titles are developed to be descriptive of the position they annotate.

b. Decisions are made as to which skill level the MOS will start and if any ASIs or SQIs will be associated with the MOS.

c. Each authorized position is reviewed and assigned an appropriate rank (E3, E4, E5 etc.) reflective of the skills or supervision requirements of the position.

d. A notional grade pattern is developed using the Average Grade Distribution Matrix, which is a grade percentage model developed by the Army and designed to help in assessing career progression and optimizing the structure of the MOS.

e. The basic grade pattern is adjusted to incorporate constraining factors such as grade ceiling constraints, mission requirements, training requirements, special skill needs, and career progression concerns.

f. The SGA analysis is repeated until the notional grade pattern represents the proper ("best") solution when evaluated against TAADS and PMAD.

Position documentation and personnel reclassification guidance. After all phases of MOS analysis are completed, the personnel proponent analyzes the products of the analysis for implications that impact on personnel supportability. Table 11 lists the data requirements, steps, and results of this step. This information may include the need for transition training, MOS reclassification, MOS conversions, general assignment or

Table 10

SGA ANALYSIS AND DEVELOPMENT

PURPOSE
Develop an SGA That Will Meet Army Mission Requirements and Optimize the MOS Career Pattern
INPUTS
Outputs from Position Data Analysis Outputs from Personnel Data Analysis Outputs from MOCS Identifier Descriptive Duties and Tasks Outputs from Training Needs Analysis Outputs from Physical Demands Analysis Outputs from Recruiting Impact Analysis
STEPS OF PERFORMANCE
Develop Duty Position Titles Define MOS Career Pattern Assign Appropriate Grade to Supervisory Positions Develop Grading Pattern for Subordinate Positions Compose Proposed SGA Table Apply Proposed SGA to TAADS and PMAD Compare Results to the Average Grade Matrix Adjust SGA as Required and Reapply to TAADS and PMAD Finalize SGA Proposal Develop Tables 1 and 2 for MOS in Accordance with AR 611-201
OUTPUTS
Revised MOS Identifier and SGA

Table 11

POSITION DOCUMENTATION AND PERSONNEL GUIDANCE

PURPOSE
Define Personnel Support Requirements for MOS Restructure
INPUTS
Outputs from Position Data Analysis Outputs from Personnel Data Analysis Outputs from Training Needs Analysis Outputs from MOCS Identifier Duties and Task Analysis Outputs from Physical Demands Analysis Outputs from Recruiting Impact Analysis Outputs from SGA Analysis and Development
STEPS OF PERFORMANCE
Analyze All Analysis Area Outputs Determine Impacts on Personnel Supportability Document Findings
OUTPUTS
Recommended Personnel Policy and Guidance to Support the MOS Restructure

utilization needs, utilization of transition ASIs, and other information vital to a smooth change in personnel policy.

Background and rationale. The personnel proponent prepares a brief statement that includes information that outlines why a revised or new MOS is needed. This statement is a narrative description of the change and reasons that precipitated the change. Table 12 summarizes the major aspects of this step.

Once the restructure analysis is completed, the proponent gathers all the outputs of analysis and assembles them in proper format. The final document is then bound and staffed with the appropriate internal agencies. After internal approval of the revision is gained, the study report and recommendations are forwarded to USAPIC for HQDA staffing.

The current procedures for performing MOS restructure analysis are outlined in the MOCS Handbook. The procedures are relevant and are presented in a logical and concise manner. The handbook defines what must be done and gives examples of what the products should look like. As a first generation procedural guide, the handbook is still valid and widely used throughout the personnel proponent system.

Current Signal Corps Practices

The Army Signal Corps' enlisted structure consists of four CMFs and a total of 48 MOSs. The active duty force consists of approximately 65,500 authorizations with an operating strength of nearly 64,000 personnel. The Signal Corps' enlisted force comprises almost 10 percent of the total Army strength, and Signal MOS positions can be found in nearly any kind of organization. The Signal Corps personnel proponent is charged with maintaining the health of Signal CMFs consistent with the procedures described above.

This subsection discusses the development of MOS specifications and MOCS changes as this process is typically performed by the Signal personnel proponent. The analysis format outlined in the MOCS Handbook is followed. Those analysis areas where significant contributions can potentially be made in terms of new methodologies are emphasized. Physical demands analysis, position documentation, and the background and rationale areas of MOS restructuring are not covered as they are addressed clearly in the MOCS Handbook.

Position data analysis. The MOS analyst gathers data from various sources. Among these are TAADS documentation, developmental TOES (DTOES), living TOES (LTOES), O&O concepts, manpower authorizations and requirements criteria (MARC), doctrinal literature, BOIPs, QQPRIs, and PMAD. This information is gathered in an effort to gain a complete picture of the MOS

Table 12

BACKGROUND, AND RATIONALE
DOCUMENTATION AND COORDINATION OF CHANGES

PURPOSE Provide Description of Change and the Reasons that Precipitate the Change
INPUTS Outputs from Position Data Analysis Outputs from Personnel Data Analysis Outputs from Training Needs Analysis Outputs from MOCS Identifier Duties and Task Analysis Outputs from Physical Demands Analysis Outputs from Recruiting Impact Analysis Outputs from SGA Analysis and Development Outputs from Position Documentation and Personnel Guidance
STEPS OF PERFORMANCE Review all Analysis Area Outputs Develop Rationale that Outlines Why a New or Revised MOS is Needed Assemble and Format all Output Areas into Final MOS Revision Proposal Staff Document With Appropriate Agencies Forward Final Document to USAPIC
OUTPUTS Background and Rationale for MOS Proposal Final MOS Revision Product

force structure. From these data sources, the analyst can learn where the MOS is on the battlefield, type of units for which the MOS is authorized, supervisor to subordinate ratios, new requirements for the MOS, projected doctrinal changes, projected equipment changes, projected authorization changes, and a host of other information critical to understanding the MOS.

TAADS analysis. The MOS analyst reviews TAADS documentation and identifies each authorized MOS position at paragraph and line level of detail as depicted in Figure 5. Once all positions are identified, the analyst manually counts each one by placing a tick mark by each grade cell on a separate worksheet (See Figure 6). After this, the results of the count and the requirements generated by the Average Grade Distribution Matrix is compared in Figures 7 and 8 to see how closely they match. The reason for this procedure is to determine if the MOS, as currently documented, is "healthy" from a career progression standpoint.

Next the analyst applies the current standards of grade (SGA) found in AR 611-201 to the TAADS document to insure that the structure issues are not a result of misgrading the MOS on TAADS. This again is a manual operation consisting of pencil changes on the TAADS printout as depicted in Figure 9. Once this task is completed, the analyst repeats the steps as outlined above. Additionally, the analyst investigates the geographic data pertaining to the MOS. This includes where the MOS is located on the battlefield for combat probability coding purposes and whether the MOS is space imbalanced. Other geographic information such as TOE versus TDA mix is also gathered to gain insight on the MOS's operating environment.

Research doctrine. The analyst researches doctrinal and other associated literature (FMs, TMs, SMs, etc.) to gain a better understanding of how the MOS is employed in the field. DTOES and LTOEs of each functional branch where the MOS is found are investigated. In this investigation, the analyst reviews all three subsections of the TOE for mission capabilities of the unit, mission support needs of the unit, where the unit is deployed on the battlefield, personnel requirements of the unit, and also the type and impact of equipment assigned to the unit. If the MOS is also found in TDA, analysis will be performed on the TDA document for corresponding information.

BOIPs and QQPRI data review. When new equipment is involved in an MOS action, the analyst reviews the BOIP and QQPRI for new structure implications. Based upon the information provided by these two documents, the analyst predicts the grade structure required to support the adopted equipment.

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SRC	UIC	UNIT DESCRIPTION	PARA	LINE	DUTY TITLE	ID	GR	MOS	ASI	LIC	BR	REQ	AUT	CCNUM	LOC	RMK	STATION
	W4LZAA	DEF MOB SYS PLANNI	470	40	COMP SYS OPR	YMD	I	E7	74F40		NC	1	1	DF0100	7VA		PENTAGON
								UIC	TOTAL			1	1				
								CMD	TOTAL			39	39				
	WBKC99	MD HSP AUG	101D	02	PROG ANAL	DMH	I	E6	74F30		NC	1	1	E80300	GE		FRANKFURT
			101D	03	PROG ANAL	DMH	I	E4	74F10			1	1	E80300	GE		FRANKFURT
								UIC	TOTAL			2	2				
	W46599	CS HHC PERS CM	133A	01	DP SUPV	DBFR	I	E7	74F40		NC	1	1	E80100	GE		SCHWETZINGEN
								UIC	TOTAL			1	1				
	WOANAA	USAREUR 7A DCINC	010	04	PROG ANAL	VBA	I	E5	74F20		NC	1	1	E10200	GE	SA	HEIDELBERG
								UIC	TOTAL			1	1				
	WOBXAA	USA INTEL CTR EUR	002C	02	SR PROG/ANAL	DBFS	I	E7	74F40		NC	1	1	E10100	GE	0255	HEIDELBERG
			002C	03	PROG/ANAL	DBFS	I	E7	74F40		NC	1	1	E10100	GE	0294	HEIDELBERG
			002C	04	PROG ANAL	DBFS	I	E6	74F30		NC	1	1	E10100	GE	0294	HEIDELBERG
			002D	02	PROG ANAL	DBFS	I	E6	74F30		NC	1	1	E10100	GE	0294	HEIDELBERG
			002E	02	SR PROG/ANAL	DBFS	I	E7	74F40		NC	1	1	E10100	GE	0255	HEIDELBERG
			002E	03	PROG/ANAL	DBFS	I	E7	74F40		NC	1	1	E10100	GE	0294	HEIDELBERG
			002E	04	PROG	DBFS	I	E6	74F30		NC	1	1	E10100	GE	0294	HEIDELBERG
			002H	02	SR PROG/ANAL	DBFS	I	E7	74F40		NC	1	1	E10100	GE	0255	HEIDELBERG
			002H	03	PROG/ANAL	DBFS	I	E7	74F40		NC	1	1	E10100	GE	0294	HEIDELBERG
			002H	04	PROG	DBFS	I	E4	74F10			1	1	E10100	GE	0255	HEIDELBERG
								UIC	TOTAL			10	10				
	WODAAA	HHC USA COMBT EQP	0016	02	PROG/ANAL	DBFS	I	E7	74F40		NC	1	1	E20200	GE		KAFERTAL
			0016	03	PROG/ANAL	DBFS	I	E6	74F30		NC	1	1	E20200	GE		KAFERTAL
			0016	04	PROG/ANAL	DBFS	I	E5	74F20		NC	2	2	E20200	GE		KAFERTAL
			0016	04A	PROG/ANAL	DBFS	I	E4	74F10			2	2	E20200	GE		KAFERTAL
								UIC	TOTAL			6	6				
	W4JSAA	USA REG PERS CENTE	006	03	QUAL COM CLK	PDQP	I	E5	74F20		NC	1	1	E50204	GE		MAINZ
								UIC	TOTAL			1	1				
11402J	WCDMAA	0022 CORPS SIG BDE	105	12	SR PROG/ANALYST		I	E7	74F40		NC	1	1	E50107	GE		HOCHST
			105	16	PROGRAMMER/ANALYST		I	E6	74F30			1	1	E50107	GE		HOCHST
			105	21	PROGRAMMER/ANALYST		I	E4	74F10			1	0	E50107	GE		HOCHST
			105	23	PROGRAMMER/ANALYST		I	E3	74F10			1	0	E50107	GE		HOCHST
								UIC	TOTAL			4	2				

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Figure 5

TAADS EXTRACT

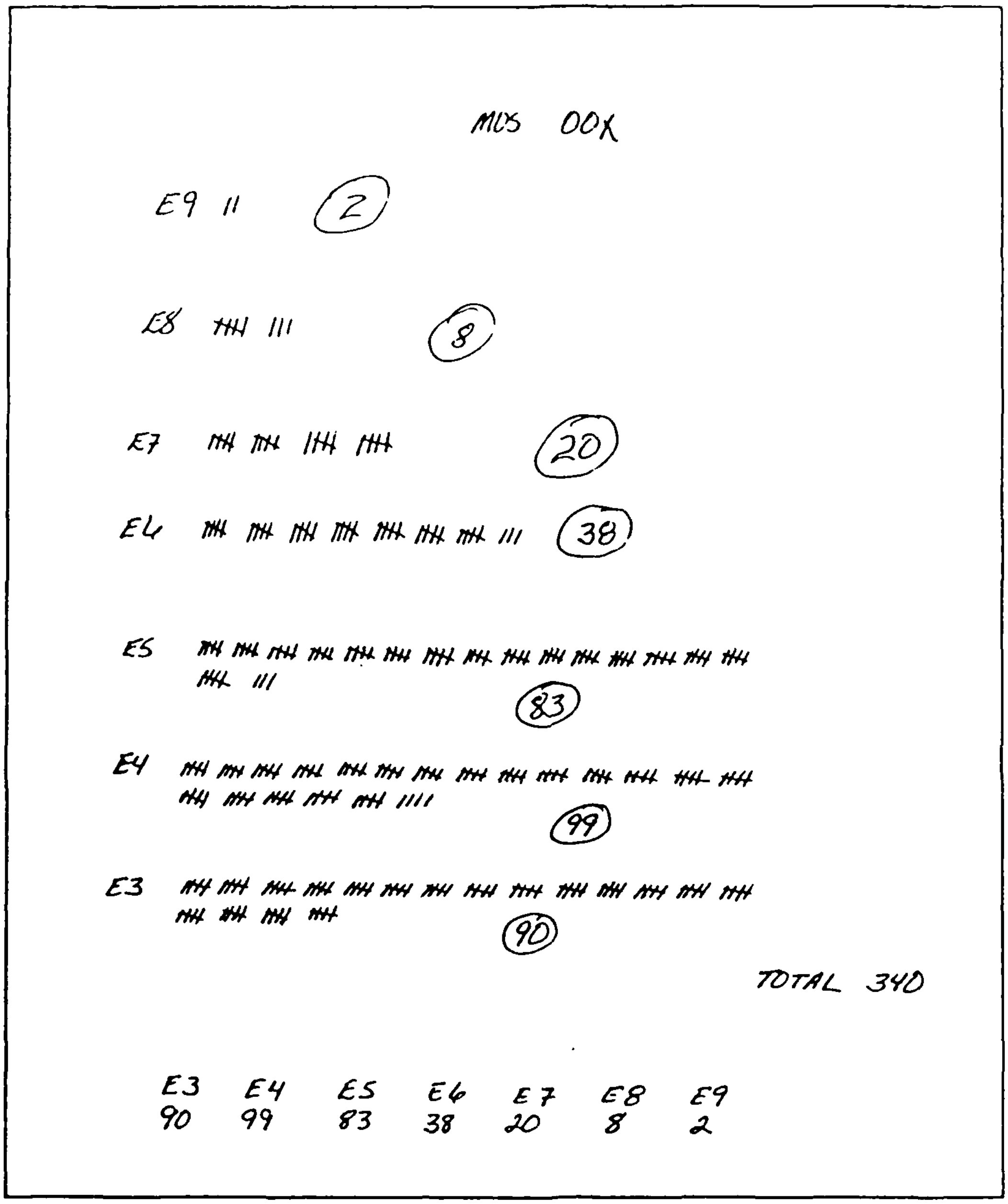

Figure 6

POSITION IDENTIFICATION WORKSHEET

FROM / TO	E3	E4	E5	E6	E7	E8	E9	TOTAL %
E3 - E9	23.208	31.892	19.869	13.624	8.501	2.457	.449	100
E3 - E8	23.512	32.035	19.959	12.686	9.539	2.469		100
E3 - E7	23.902	32.846	20.464	14.032	8.756			100
E3 - E6	26.196	35.999	22.428	15.379				100
E3 - E5	30.956	42.540	26.504					100
E3 - E4	42.119	57.881						100
E4 - E9		41.530	25.873	17.741	11.071	3.199	.585	100
E4 - E8		41.774	26.026	17.845	11.135	3.219		100
E4 - E7		43.163	26.892	18.439	11.506			100
E4 - E6		48.775	30.388	20.837				100
E4 - E5		61.614	38.386					100
E5 - E9			44.251	30.343	18.933	5.473	1.000	100
E5 - E8			44.698	30.649	19.125	5.528		100
E5 - E7			47.313	32.443	20.244			100
E5 - E6			59.322	40.678				100
E6 - E9				54.428	33.962	9.816	1.794	100
E6 - E8				55.422	34.582	9.996		100
E6 - E7				61.577	38.423			100
E7 - E9					74.524	21.539	3.937	100
E7 - E8					77.578	22.422		100
E8 - E9						84.549	15.451	100

Figure 7

AVERAGE GRADE DISTRIBUTION MATRIX

								TOTAL
GRADE	E3	E4	E5	E6	E7	E8	E9	340
TAADS	90	99	83	38	20	8	2	
MATRIX	81	108	67	46	28	8	2	340
DELTA	-9	+9	-16	+8	+8			0

Figure 8

MATRIX/MOS COMPARISON

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SRC	UIC	UNIT DESCRIPTION	PARA	LINE	DUTY TITLE	ID	GR	MOS	ASI	LIC	BR	REQ	AUT	CCNUM	LOC	RMK	STATION
	W4LZAA	DEF MOB SYS PLANNI	470	40	COMP SYS OPR	YMD I	E7	74F40			NC	1	1	DF0168	7VA		PENTAGON
								UIC	TOTAL			1	1				
								CMD	TOTAL			39	39				
	WBKC99	MD HSP AUG	101D	02	PROG ANAL	DMH I	~~E6~~ E7	74F30			NC	1	1	E00366	GE		FRANKFURT
			101D	03	PROG ANAL	DMH I	~~E5~~ E3	74F10				1	1	E00366	GE		FRANKFURT
								UIC	TOTAL			2	2				
	WH6S99	CS HHC PERS CM	133A	01	OP SUPV	DBFR I	E7	74F40			NC	1	1	EB0166	GE		SCHWETZINGEN
								UIC	TOTAL			1	1				
	W0AHAA	USAREUR 7A OCINC	010	04	PROG ANAL	VBA I	~~E5~~ E4	74F20			NC	1	1	E10266	GE	SA	HEIDELBERG
								UIC	TOTAL			1	1				
	W0BXAA	USA INTEL CTR EUR	002C	02	SR PROG/ANAL	DBFS I	E7	74F40			NC	1	1	E10166	GE	0255	HEIDELBERG
			002C	03	PROG/ANAL	DBFS I	E7	74F40			NC	1	1	E10166	GE	0294	HEIDELBERG
			002C	04	PROG ANAL	DBFS I	E6	74F30			NC	1	1	E10166	GE	0294	HEIDELBERG
			002D	02	PROG ANAL	DBFS I	E6	74F30			NC	1	1	E10166	GE	0294	HEIDELBERG
			002E	02	SR PROG/ANAL	DBFS I	~~E5~~ [handwritten]	74F40			NC	1	1	E10166	GE	0255	HEIDELBERG
			002E	03	PROG/ANAL	DBFS I	~~E5~~ [handwritten]	74F40			NC	1	1	E10166	GE	0294	HEIDELBERG
			002E	04	PROG	DBFS I	E6	74F30			NC	1	1	E10166	GE	0294	HEIDELBERG
			002H	02	SR PROG/ANAL	DBFS I	~~E5~~ [handwritten]	74F40			NC	1	1	E10166	GE	0255	HEIDELBERG
			002H	03	PROG/ANAL	DBFS I	E7	74F40			NC	1	1	E10166	GE	0294	HEIDELBERG
			002H	04	PROG	DBFS I	E4	74F10				1	1	E10166	GE	0255	HEIDELBERG
								UIC	TOTAL			10	10				
	W0DAAA	HHC USA COMBT EQP	0016	02	PROG/ANAL	DBFS I	E7	74F40			NC	1	1	E20266	GE		KAFERTAL
			0016	03	PROG/ANAL	DBFS I	E6	74F30			NC	1	1	E20266	GE		KAFERTAL
			0016	04	PROG/ANAL	DBFS I	E5	74F20			NC	~~1~~ 4	~~1~~ 4	E20266	GE		KAFERTAL
			~~0016~~	~~04A~~	~~PROG/ANAL~~	~~DBFS I~~	~~E4~~	~~74F10~~				~~2~~	~~2~~	E20266	GE		KAFERTAL
								UIC	TOTAL			6	6				
	W4JSAA	USA REG PERS CENTE	006	03	QUAL CON CLK	PBQR I	E5	74F20			NC	1	1	E50266	GE		MAINZ
								UIC	TOTAL			1	1				
11402J	WCDMAA	0022 CORPS SIG BDE	105	12	SR PROG/ANALYST	I	E7	74F40			NC	1	1	E50107	GE		HOCHST
			105	16	PROGRAMMER/ANALYST	I	E6	74F30				~~1~~	~~1~~	E50107	GE		HOCHST
			105	21	PROGRAMMER/ANALYST	I	E4	74F10				2 ~~1~~	1 ~~1~~	E50107	GE		HOCHST
			105	23	PROGRAMMER/ANALYST	I	E3	74F10				1	0	E50107	GE		HOCHST
								UIC	TOTAL			4	2				

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Figure 9

TAADS PENCIL CHANGES

Final output analysis (position data). Upon completion of analysis as described above, the analyst gathers the resulting analysis output and begins to tie all the position data information together. The emphasis on this phase of analysis is to answer four questions:

1. Has faulty SGA application (misgrading) caused serious grade structure problems?

2. Does the documented SGA meet current or projected doctrinal needs?

3. Does the documented SGA meet current or projected organizational needs in both TOE and TDA?

4. Does current grade and skill meet current or projected equipment needs?

These questions are not easily answered, and the analyst may not have expertise in the area under analysis. Therefore, the Signal Proponent may survey SMEs from the field to aid in interpretation of the analysis outputs. The surveys can either take place by phone or formal surveys mailed to the field.

Personnel data analysis. The analyst reviews outputs of position data analysis and PMAD information is analyzed to ascertain the total number of authorizations currently in the MOS force structure and to get an understanding of the projected authorizations in the outyears. If significant increases or decreases occur for the outyears, the analyst then looks further to determine the causes.

The force structure is analyzed for SIMOS implications. If the MOS is determined to be space imbalanced, the analyst develops methods to minimize the impacts and justifies the reasons for the MOS being SIMOS.

The MOS analyst conducts a study on how and from where personnel for the MOS should be accessed. If the MOS is found to be very complex, the analyst may recommend that soldiers be accessed from other MOSs in the Army. On the other hand, if the MOS is easily trained or does not appear to be to complex, the MOS will be accessed from the civilian community as new recruits. As depicted in Figure 10, decisions are then made on the recommended career path of the MOS.

Direct combat probability coding for the MOS. TAADS analysis output is reviewed and a total number of combat probability one (P1) is determined. As P1 positions are closed to female

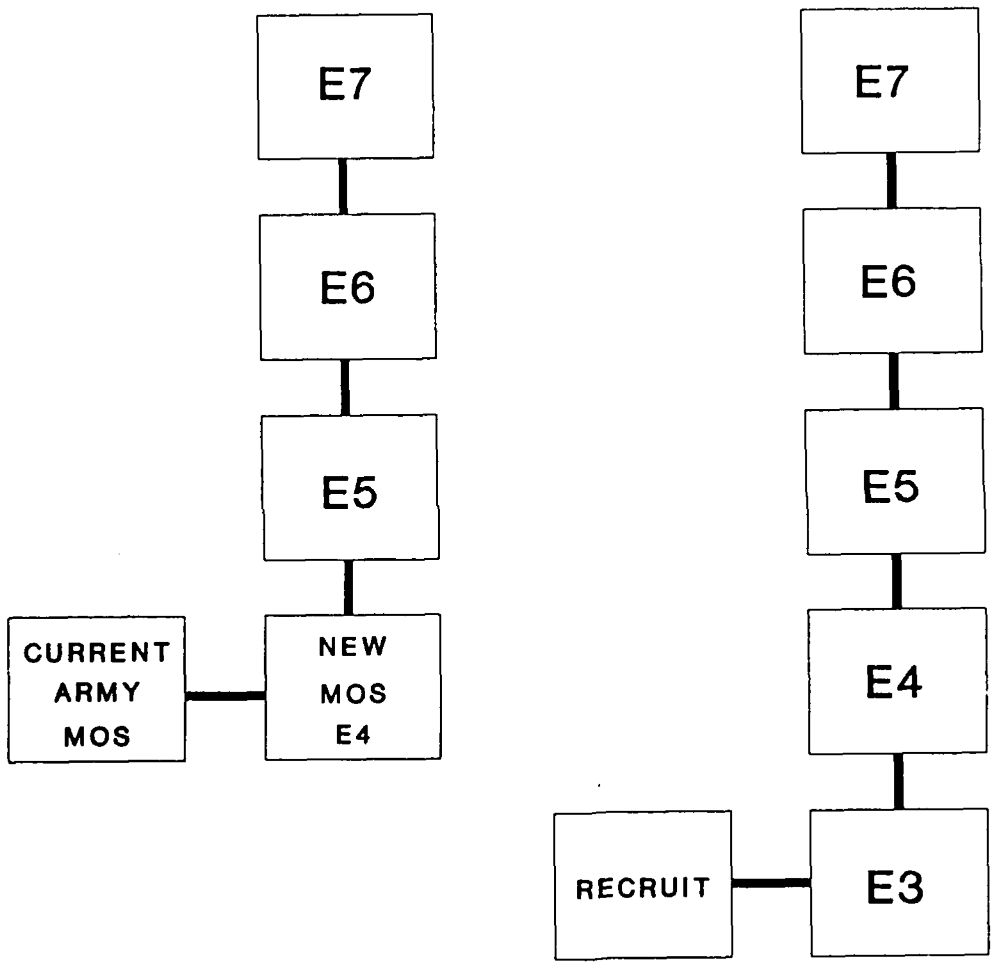

Figure 10

ACCESSION AND CAREER PATH DECISION

soldiers, this exercise assists the analyst in assessing the impact of assigning and utilizing females in the MOS.

Recruiting impact analysis. The analyst determines the impact on JOIN based upon the outputs of position and personnel data analysis. For example, if the accession point of the MOS changes from civilian recruitment to in-service recruitment, the analyst insures that the MOS is removed from JOIN. The analyst also determines if recruiting programs are impacted as discussed in the previous subsection.

MOCS identifier duties and tasks analysis. Analysis is performed to determine what changes if any are to be made to the MOS descriptive duties and tasks. This analysis is accomplished in various ways depending on the information available and whether the MOS is to be restructured or a new MOS created. For an MOS restructure, the analyst compiles a list of tasks the MOS incumbent performs from AR 611-201, soldier's manuals, and the current program of instruction (POI). Next, the analyst compares the compiled list to the latest Army occupational survey information on the MOS to determine if the tasks are actually performed in the field. Any tasks not performed are deleted from the list and new tasks identified by the survey added.

If major changes are required in the MOS's descriptive duties and tasks, the proponent convenes a tasks selection board. This board, comprised of subject matter experts, training developers, and the MOS analyst, select the tasks that are to be included in the revised MOS description.

The methodology for developing descriptive duties and tasks for a new MOS is somewhat different as soldiers manuals, occupational surveys, and POIs do not exist. In this case, the proponent convenes a joint working group of subject matter experts, training developers, doctrine developers, and the MOS analyst. This group analyzes all known information on the proposed MOS (doctrine, organizational functions, type of equipment, equipment characteristics, etc.) and generates the task list. Once compiled, the list is handed off to the tasks selection board for their use.

Training needs analysis. The Signal personnel proponent performs an oversight role only for this phase of analysis. Training needs assessments for Signal MOSs are determined by the Director of Training and Doctrine (DOTD) at the Signal Center.

Standards of grade (SGA) analysis and development. SGA analysis actually begins concurrently with position data analysis and continues through all phases of analysis discussed this far. Outputs from position data analysis are especially critical in SGA development as this information defines the mission requirements of the MOS. Data from TAADS analysis, doctrinal research, review of BOIPs and QQPRIs, training needs analysis, personnel data analysis, and the MOCS identifier duties and tasks establish the assignment and environmental characteristics of the MOS, and provide the analyst with the tools necessary to develop the SGA.

The MOS analyst begins SGA development by generating standards for supervisory personnel. This is accomplished in descending order beginning with the highest grade authorized for the MOS and working down (E8, E7, E6) as the supervisory or staff responsibilities change.

If the highest grade for the MOS is to be E7, the analyst reviews every work center in TAADS for positions that either currently are or should be graded E7 based upon mission requirements and the staff or supervisory needs of the unit in which the work center is found. This information is documented on a separate worksheet as depicted in Figure 11. As the E7 positions are documented on the worksheet, the analyst begins to see commonalities in the positions under review. For example, the analyst may find that many of the positions under consideration for grading as E7, supervise from 9-12 personnel, and that all of these type positions are in TDA. Or the analyst may see that single positions exist in the headquarters of major TOE activities such as brigade, division, or corps also requiring E7 staff skills. The analyst continues to "scrub" TAADS until all potential E7 positions have been identified and annotated on the worksheet. The analyst also makes notes on the worksheet that provides reminders of why the position was selected for this grade level, a clear understanding of the unit size, where duty is performed, and any other information that specifies the intended grade. This information is transformed into explanatory notes to incorporate the grade in the SGA table.

This same process continues for E6 positions and any E5 positions that have unique requirements such as single positions in specialized units, and MOS positions that have specialty skill identifiers (ASIs) associated with them.

When developing worker requirements, the analyst reviews TAADS and separates the TAADS paragraphs into work units. To do this, all positions that were previously identified as supervisory, requiring unique grade structure, requiring an associated, as well as civilian positions are backed out. The analyst then develops a worksheet as depicted in Figure 12, and manually counts each work unit and places a tick mark by the number of positions.

Once this process is completed, the information is then transferred to another worksheet as depicted in Figure 13 and each column is totaled. This worksheet is designed to only depict work unit counts up to ten. If there are more than ten

TOE	E7 POSITIONS	R	A
SRC 112810L	PLT SGT	2	2
SRC 112830L	PLT SGT	2	2
SRC 112820L	PLT SGT	1	1
SRC 115810L	STAFF NCO	1	1
SRC 081280H	DET NCO	1	1
SRC 082270H	DET NCO	1	1
	TOE TOTAL	8	8

TDA			
FORT GORDON	HHC GARRISON	1	1
FORT HOOD	HHC GARRISON	1	1
FORT ORD	HHC GARRISON	1	1
FORT CARSON	HHC GARRISON	1	1
	TDA TOTAL	4	4

Figure 11

SUPERVISORY POSITIONS

POSITIONS	WORK UNITS	
1	11111 11111 11111 11111 11111 11111 11111 11111	= 40
2	11111 11	= 107
3	11111 1	= 136
4	11111 1111	= 9
5	11111 11	= 7
6	11111 1111	= 9
7	11111 11111 11111	= 15
8	11111 1	= 6
9	11111 1111	= 9
10	11111 1	= 6
11	1111	= 4
12	1	= 1
13	1	= 1
14	1	= 1
15	111	= 3
16	1	= 1
17	1	= 1
18	1	= 1
20	1	= 1
26	1	= 1
43	1	= 1

Figure 12

WORKER REQUIREMENTS
WORKSHEET 1

	WORK UNITS											
POSITIONS	1	2	3	4	5	6	7	8	9	10		TOTAL
1	40										=	40
2	107	107									=	214
3	136	136	136								=	408
4	9	9	9	9							=	36
5	7	7	7	7	7						=	35
6	9	9	9	9	9	9					=	54
7	15	15	15	15	15	15	15				=	105
8	6	6	6	6	6	6	6	6			=	48
9	9	9	9	9	9	9	9	9	9		=	81
10	6	6	6	6	6	6	6	6	6	6	=	60
11	8	4	4	4	4	4	4	4	4	4	=	44
12	2	2	1	1	1	1	1	1	1	1	=	12
13	2	2	2	1	1	1	1	1	1	1	=	13
14	2	2	2	2	1	1	1	1	1	1	=	14
15	6	6	6	6	6	3	3	3	3	3	=	45
16	2	2	2	2	2	2	1	1	1	1	=	16
17	2	2	2	2	2	2	2	1	1	1	=	17
18	2	2	2	2	2	2	2	2	1	1	=	18
20	2	2	2	2	2	2	2	2	2	2	=	20
26	3	3	3	3	3	3	2	2	2	2	=	26
43	5	5	5	4	4	4	4	4	4	4	=	43
TOTAL	380	336	228	90	80	70	59	43	36	27	=	1349

Figure 13

WORKER REQUIREMENTS
WORKSHEET 2

work units, then the eleventh position in the work unit is counted as a first position and the twelfth as second and so on. The total number of first positions are graded as the firstosition in the SGA, and the total number of tenth positions are graded as the tenth position in the SGA.

Based upon this information, a grading pattern is developed which provides a distribution that approximates the grade requirements generated by the Average Grade Distribution Matrix, as depicted in Figure 14. In this procedure, any additional positions that require special grade considerations are also backed out and listed separately as requiring special grading consideration.

The MOS analyst then consolidates the data from all work sheets and composes the proposed SGA. The data for supervisory, staff, ASI unique positions, and worker requirements are transposed into SGA lines as depicted in Figure 15.

Application of the proposed SGA. After development of the proposed SGA, the analyst again applies the SGA to TAADS as outlined above and obtains counts for each grade cell. The SGA is then applied at unit identification code (UIC) level in PMAD as depicted in Figure 16 and recapped by grade. The results of this exercise will determine if the proposed SGA provides a grade structure that meets the structure requirements as defined by the average grade matrix at each grade cell. The rule of thumb in terms of fit is ± two percent at each grade cell.

The grading patterns depicted by the proposed SGA may require adjustment many times before the best SGA to mission and force structure requirements mix is found. Each time a change is made to the grading pattern in the SGA, it is reapplied to both TAADS and PMAD for resulting force structure implications and determining goodness of fit with the average grade matrix.

The preceding section has highlighted how the Signal personnel proponent performs MOS restructure analysis. In general, the proponent utilizes the MOCS Handbook as the procedural source document for conducting analysis and developing the standards of grade for Signal MOSs. Also, this section characterizes MOS restructure analysis as a very manpower and time intensive process that requires the MOS analyst to possess analytical skills that cross many occupational areas and functions. Most importantly, MOS restructure analysis is actually a series of analytical subsets that culminate in a proposed MOS restructure.

EXAMPLE

For this example, we will assume the total authorized strength to be 1799.

The Average Grade Distribution MATRIX indicates the breakout to be:

E3	E4	E5	E6	E7	E8	E9
.23208	.31892	.19869	.13624	.08501	.02457	.00449

Therefore the position grade distribution should be approximately -

E3	E4	E5
1799	1799	1799
x.23208	x.31892	x.19869
418	574	357

WORK UNITS

POSITIONS	1	2	3	4	5	6	7	8	9	10		TOTAL
	380	336	228	90	80	70	59	43	36	27	=	1349
	E4	E3	E5	E4	E5	E4	E3	E5	E3	E4		

GRADE	POSITIONS	TOTAL	
E5	3	228	
	5	80	
	8	43	
		351	vs 357-Average Grade Distribution - E5
E4	1	380	
	4	90	
	6	70	
	10	27	
		567	vs 574-Average Grade Distribution - E4
E3	2	336	
	7	59	
	9	36	
		431	vs 418-Average Grade Distribution - E3
	TOTAL	1349	vs 1349-Average Grade Distribution

Figure 14

WORKER REQUIREMENTS
WORKSHEET 3

			Number of Positions Authorized*										
Line Duty Position	**Code**	**Rank**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Explanatory Notes**
1. In Flight Missile Repairer	XXB10	PFC		1	1	2	3	4					
2. In Flight Missile Repairer	XXB10	SPC	1	1	1	1	1	1					
3. In Flight Missile Repairer	XXB20	SGT			1	1	1	1					
4. In Flight Missile Repair Supervisor	XXB30	SSG											On the Basis of one per Missile Repair Section
5. PSG	XXB40	PSG											In TOE on the Basis of One Per Platoon
6. Det NCO	XXB40	SFC											In Missile Detachment with more than 30 Personnel Authorized
7. Section NCO	XXB40	SFC											In TDA on the Basis of One Per HHC Garrison

NOTE: Actual grading pattern is developed by position number 6.

Figure 15

STANDARDS OF GRADE AUTHORIZATION

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FORCE STRUCTURE AND PERSONNEL REQUIREMENTS DIRECTORATE
U.S. ARMY SOLDIER SUPPORT CENTER - NATIONAL CAPITAL REGION
FORECAST - PERSONNEL AUTHORIZATION MODULE (PAM)
FUNCTIONAL REVIEW REPORT

PRIORIZATION OVER TIME BY SRC OR UNIT (F8804) DATABASE: PMAD

ACTION CRITERIA: MPC=E MOS=29F 29P 29S

RC	UIC	MOS	GR	SQI	ASI	FY89	FY90	FY91	FY92	FY93	FY94	DELTA	%DELTA
	WEWN99 0298 AUG 29S SIG CO--DCS OP (MACOM CZ, STACO = GE0430, KAISRLTRN, GE)												
		29F	E3	0	00	1	1	~~1~~ E5 1	1	1	1	+0	+0.0
			E4	0	00	1	1	~~1~~ E5 1	1	1	1	+0	+0.0
			E5	0	00	3	0	0	0	0	0	-3	-100.0
	MOS TOTALS.......................					5	2	2	2	2	2	-3	-60.0
	UIC TOTALS.......................					5	2	2	2	2	2	-3	-60.0
	WEGN99 0072 AUG BC HHD (MACOM CZ, STACO = GE433, KARLSRUHE, GE)												
		29F	E3	0	00	0	1	~~1~~ E5 1	1	1	1	+1	N/A
	MOS TOTALS.......................					0	1	1	1	1	1	+1	N/A
		29S	E3	0	00	0	0	0	0	0	0	+0	N/A
			E4	0	00	0	0	0	0	0	0	+0	N/A
			E5	0	00	0	0	0	0	0	0	+0	N/A
	MOS TOTALS.......................					0	0	0	0	0	0	+0	N/A
	UIC TOTALS.......................					0	1	1	1	1	1	+1	N/A
	WEH899 0169 AUG SC CO=DCSOP (MACOM CZ, STACO = K9902, TAEGU, KS)												
		29F	E5	0	00	1	1	1	1	1	1	+0	+0.0
	MOS TOTALS.......................					1	1	1	1	1	1	+0	+0.0
	UIC TOTALS.......................					1	1	1	1	1	1	+0	+0.0
	WEX99 0169 AUGS SC CO DCS OP (MACOM CZ, STACO = GE897, VAIHINGEN, GE)												
		29F	E5	0	0	1	1	1	1	1	1	+0	+0.0
	MOS TOTALS.......................					1	1	1	1	1	1	+0	+0.0
	UIC TOTALS.......................					1	1	1	1	1	1	+0	+0.0
	WGQA99 0270 AUG SC CO DCS OPS (MACOM CZ, STACO = GE67A, PIRMASENS, GE)												
		29F	E3	0	00	5	5	~~5~~ 3	5	5	5	+0	+0.0
			E4	0	00	7	7	~~7~~ 5	7	7	7	+0	+0.0

Figure 16

PMAD DATA

Constraints of Available Hardware, Software and Models

The hardware capabilities of the Signal Corps Personnel Proponent's data processing environment involve three types of computer hardware and their associated operating systems. Outlined below are the essential characteristics of each and how they interface.

There is mainframe capability which is available on a by request basis from the Director of Combat Developments (DCD) who provides limited support to the proponent. The bulk of support provided is the downloading of TAADS information into DOS files for use by the proponent. This is accomplished by downloading the information onto floppy disks. Alternatively, a person from the proponent office will physically transport a personal computer (PC) down to DCD and have the files loaded onto the 20 megabyte (MB) internal hard drive of the PC.

The proponent has minicomputer capability in the form of an INTELL 320 computer. This computer contains 120 MB on-board storage capacity and uses a XENIX operating system with multiple user capability. The computer is used mostly as a file server on a local area network serving up to twelve PCs when networked. On average, 60 MB of storage are used for software and operating system requirements with the remaining 60 MB dedicated to file storage.

There are 14 personal computers. These are contract standard Zenith 248 PCs each with a 5-1/4 inch floppy drive and a 20 MB internal hard drive.

Printers are either Alps 2000 or Smith Corona single head dot matrix. The proponent has no high speed or laser jet printer capability at this time.

Software capabilities include Army standard software packages consisting primarily of dBase III+ for data base management, LOTUS and SuperCalc for spreadsheets, Harvard Graphics and Freelance for graphics development. The Signal proponent has no locally developed models in use at this time.

With exception of the minicomputers, the Signal Corps Personnel Proponent's data processing capability is representative of the current state of technology for most personnel proponent agencies with exception of the Army Medical Department (AMEDD). The computer environment as outlined above represents the typical resources available to support the use of software developed to support MOS restructure activities. The software characteristics must be tailored to PC applications since the operating systems of the minicomputer and the PCs do not allow direct software linkage between these two types of computers.

Current MOS Restructuring Activities

According to the OCOS Status Report, dated August, 1989, the Signal Personnel Proponent has twelve MOS actions and one ASI action in-house. As depicted in Figure 17, ten of the actions are complex MOS mergers that will require substantial time and manpower efforts. One action is an MOS deletion, and the remaining action is to establish an ASI.

Six of the actions are related to maintenance MOSs and the remaining seven are operator MOSs. Of thirteen actions, four are required as a direct result of new or revised signal equipment.

The point to be made here is that every one of these actions requires a complete MOS restructure analysis. The MOS mergers with their associated additions and deletions of ASIs will require two to three times the effort of a standard MOS restructure. The reason for this is that each MOS that is merged must be analyzed as a separate entity prior to being combined with the proposed merger MOS. Once combined, the merged MOSs are again analyzed via the MOS restructure analysis process. Determining the level of effort in terms of time is difficult. However, given the current manual manipulation of data, a reasonable prediction would be seven to eight person years of effort to complete analysis on all twelve actions.

The MOS actions identified in the preceding provide an adequate sampling of MOS restructuring activities to support the development of follow-on restructuring methodologies.

MOS	ACTION
29J	Create an ASI for the Merged 39L and 39Y MOSs
29M	Merge with MOS 29V, E1 - E7
29T	Delete MOS
29V	Delete ASI R2 and train in 29Y10 Merge with MOS 29M, E1 -E7
29Y	Stovepipe MOS, E1-E7 Delete ASI R2 and train in 29Y10 Convert ASI Y1 to permanent ASI
31G	Merge with MOSs 31K and 31V
31K	Merge with MOSs 31G and 31V
31M	Subsume MOS 31Q Establish new ASI for TACSAT
31Q	Merge with MOS 31M Delete ASI 06 and train in 31M10 Delete ASI R6 and train in 31M10
31V	Merge with MOSs 31G and 31K
39L	Merge with 39Y and make ASI of 29J
39Y	Merge with 39L and make ASI of 29J

DATA SOURCE: OCOS, AR 611-1 Enlisted Action Status Report, Dated 89/08/11.

Figure 17

MOS ACTIONS

Artificial Intelligence and Expert Systems

The purpose of this section is to evaluate the potential use of artificial intelligence (AI) and expert systems (ES) techniques in MOS restructuring activities. The discussion is based on the premise that artificial intelligence is actually an academic research program much in the same sense that the study of medicine or physics are academic research programs. AI techniques embody a wide range of computer applications, from programs that play chess and recognize the human voice, to sophisticated computer enhanced robotics. AI is just now emerging from the infant stages, which means that most AI applications are very expensive and are primarily limited to scientific, academic, and industrial functions. Given this, most AI applications are not valid alternatives for use in the MOS restructuring environment.

Expert systems, however, are one area of AI that have evolved to the point where the systems have become relatively inexpensive and possess the flexibility to be adapted for use by many diverse occupational disciplines. This section, therefore, focuses on ES because of the considerable potential of expert system applications and software to be developed for use in MOS restructuring activities.

In essence, an expert system enables the computer to assist people in analyzing and solving complex problems that previously required a human expert's attention. This is accomplished by extending the use of the computer beyond the usual mathematical and statistical functions by creating knowledge programs that conduct dialogues with decision makers and use logic to suggest various courses of action.

This section first discusses the selection criteria for development of ES applications. Second, the types of ES applications and the rationale behind them are delineated. Third, the availability of ES software, relative cost, and hardware requirements are reviewed. Finally, the current and expected uses of expert system applications and software are described.

Expert System Application Criteria

When designing an expert system, the developer first must select an appropriate problem area or field to investigate. Clearly, the field must be compatible with potential ES applications, and a distinct need for an expert system should exist.

Table 13 depicts common criteria used when selecting a field for potential ES application development. First, the proposed ES application must be cost effective. The field selected must not only lend itself to ES application but should also be a high impact field requiring: (1) a significant investment of training and expertise, (2) large numbers of individuals to perform similar tasks across a wide range of topic areas, or (3) an area where loss of the human expert could credibly be replaced through the use of an ES application.

Risk absorption must be examined when considering cost effectiveness of a proposed ES application. The possibility exists that the expert system will be relied upon heavily to provide the "right" answer every time. This is an unrealistic expectation. Good decisions are not always made and all systems, whether human or automated, make errors. In terms of developing an ES application to solve problems or make decisions, the problem or decision-making criteria must be properly and narrowly defined.

Using the current human error rate as a baseline, a determination can be made if an expert system can reduce or at least match the current error rate. Even if an ES can only match the current human rate, risk is reduced because the expert system frees the human to interact with more difficult problems which should provide an overall reduction in errors and time spent in performance of specific tasks. On the other hand, if the ES application cannot match or reduce the error rate, developing an expert system application would not likely be cost effective.

The problem area or field must be decomposable. As a generalization, the problem area or field should lend itself to being subdivided into as many steps or parts as possible. The reason for this is that each different step or part may require a different knowledge or procedure in order to be accomplished successfully. Once the problem area is decomposed, a model of the expert's knowledge can be developed that in turn will suggest what particular ES technique(s) are required to capture and duplicate the expert's reasoning process.

In addition to being decomposable, the problem area or field must also be programmable. Simply put, to create an expert system, knowledge must be transferred from the human expert to the computer. In order to be programmable, the problem area must not be too loose in its methodology nor too rule bound. Further, knowledge of the problem area or field must be plentiful and redundant. Facts and rules must be reliable, accurate, and precise. Also, the expert's knowledge of the area or field must be consistent and complete. Providing all these standards are met, a step-by-step problem solution protocol is developed and the ES techniques that will best fit the problem area or field can be selected.

Table 13

EXPERT SYSTEM APPLICATION CRITERIA

1. COST EFFECTIVE
2. RISK ABSORPTION
3. DECOMPOSABLE
4. PROGRAMMABLE
5. DATA AVAILABILITY AND COMPABILITY
6. ORGANIZATIONAL ENVIRONMENT

Data availability and compatibility is another important criterion that should be pursued when selecting a problem area or field for development. In terms of ES, the scope of data availability and compatibility is very broad because: (1) frequently, data are in an unsatisfactory form for the selected ES application, (2) there are such vast amounts of data residing in multiple data bases that the data requires a major editing and merging effort to be useful, and (3) data may not be available and must be generated for the purposes of providing the necessary information for the expert system to operate.

Because of the nature of data availability and compatibility issues, care should be exercised when selecting a field for ES development. This criterion is a principal discriminator in the selection process that should not be overlooked. Cost for development of usable data for an ES application can be extremely high and must be considered when selecting a problem area or field for development as an expert system.

The final criteria to be weighed is the organization environment as every organization offers different challenges in terms of ES application. These challenges are normally characterized in the following categories:

1. Personnel considerations

2. Interfacing the expert system

3. Maintenance of the system.

Personnel considerations are among the more critical aspects of the organizational environment. Any expert system can fail simply because it is not accepted by the people for whom it was designed. Successful introduction of an expert system into the work place is dependent upon careful planning, communication about the usefulness of the system, and how it will free the users from repetitive tasks rather than replace them.

The system itself must be designed in such a way that training is supported, therefore insuring maximum efficiency is achieved quickly. Of course, this means that the expert system will be more expensive in the near term; however, if the system is for a large number of users the extra cost will pay off.

The users are not the only persons to consider when developing an expert system; the people in the decision chain must also be considered. In almost all organizational environments, the decision-making process is either not standardized or there are multiple decision makers. Because of this, the expert system should be flexible enough to accommodate multi-tasking in order to be responsive to the needs of the decision-making process.

Interfacing the expert system suggests several areas to be considered. First, the system needs to interface the user as outlined above and the system must also interface with the hardware and software currently in use by the agencies for whom the system is designed. The ES may need to be developed in such a way that it can acquire information from different types of software or other hardware that will provide input to the system. Because of this, determinations must be made on whether a computer program language will be required for system translation or if an existing commercial ES shell software can support system requirements. Still other factors may include acquiring compatible hardware and software so that the system can run efficiently. Interfacing can cause intractable problems if not considered early in the development process.

Once personnel and interfacing issues have been resolved, the final organizational issue addressed is maintenance of the expert system. If the ES application is to be relatively large with multiple users, maintenance costs can be high because the more the system is used the more that is learned. When more is learned, the system's knowledge base must be updated to incorporate the new knowledge. Decisions on how and by whom the system will be maintained are also required early in the ES development process. Additionally, continuing updates necessitated by new equipment and software releases are also key problems as they can have a significant impact on the durability and life span of the expert system. If the system design is not flexible enough to incorporate new hardware and software releases, the system will quickly become unmaintainable and outdated.

The application criteria provide a basis for selecting a problem area or field for development of an ES system. If any of these criteria are ignored, considerable effort may be wasted. Through the application of these criteria, the costs-to-benefits ratios of developing an expert system may be weighed and informed decisions made.

Types of ES Applications

Knowledge is more complex than information or data (Paul Harman, Rex Maus, and William Morrisy, 1988). Knowledge refers to a body of information about a particular subject that is organized in a useful manner. Expert systems focus on representing knowledge in sentences and pictures manipulated by logical inferences. Therefore, if the computer is to help the decision maker to face complex problems, the computer must be able to aid in analyzing and solving problems that are expressed in linguistic terms. Knowledge representation applications or techniques support linguistic expression by allowing the encoding of these expressions into the computer through various knowledge applications.

Conventional problem solving depends upon a complete analysis of all the elements and steps in a problem. In effect, this limits the domain of conventional computing to problems that can be solved through mathematical or statistical applications. AI, on the other hand, tries to deal with problems that are too big and complex to be understood completely.

Humans solve large complex problems using heuristics (rules of thumb) to reduce the large problem to a manageable size. Heuristics, by their nature, can lead to errors. Rules of thumb do not always guarantee the correct answer, but they do increase the likelihood of finding a usable answer.

For example, an MOS analyst when faced with a decision on grading a principal enlisted supervisory position in a small unit with the grade of either E7, Detachment NCO, or E8, First Sergeant, employs heuristics when making the decision. As a rule of thumb, only units authorized 75 or more subordinate personnel should be authorized a First Sergeant. Units containing less than 75 subordinate personnel should be graded as E7, Detachment NCO. Utilizing this rule of thumb, the analyst makes a preliminary decision based upon the unit's authorized number of subordinate personnel, and grades the position accordingly. This example illustrates the key elements of heuristics. Heuristics depend upon the knowledge of the specific problem area or field and are usually acquired through experience.

In terms of the expert system, heuristics represent probable knowledge, and the use of heuristic programming techniques in computer applications allows the user to make a decision with less than a complete analysis of the problem. Typically, the use of a heuristic programming based expert system will not always provide a correct answer but will suggest options and provide an estimate of the likelihood for each.

Expert system applications can be classified into five basic categories (Paul Harmon, Rex Maus, and William Morrisy, 1988). Each category focuses on the overall knowledge representation found in the application. Table 14 delineates the most common expert system applications and lists them in ascending order of their relative power and flexibility.

Inductive applications work best when a knowledge base with numerous examples of correct analysis or decision making already exist. Based upon this, an inductive application allows a rapid development of a good system to guide future decisions.

Table 14

CATEGORIES OF EXPERT SYSTEM APPLICATIONS

1.	INDUCTIVE APPLICATIONS
2.	SIMPLE RULE-BASED APPLICATIONS
3.	STRUCTURED RULE-BASED APPLICATIONS
4.	HYBRID APPLICATIONS
5.	DOMAIN SPECIFIC APPLICATIONS

Inductive applications use an algorithm that constructs a simple decision tree and in the process prioritizes the order of questions asked the user.

Certain types of problems are ideal for inductive expert system applications. For example, selecting tasks for incorporation into an MOS may be one use of an inductive system application. The MOS analyst first identifies a large number of tasks that apply to the MOS and identifies a finite range of values associated with each task. The task and their associated values may then be loaded into the inductive system, and the system will develop a basic decision pattern or matrix. Once the matrix is constructed, the system will generate all possible task combinations from which the analyst may select.

There are drawbacks, however. Inductive applications can only operate if there are a limited number of independent factors such as the values placed on the tasks in the example. If more than a limited number of independent factors are required, the inductive system will not provide reliable output.

Simple rule-based applications are more powerful than inductive applications in that they allow the use of if-then rules to represent knowledge and use backward chaining to process the rules. Simple-rule based applications do not try to capture true expertise. Instead, simple-rule based systems offer the user specific advice regarding how to deal with difficult problems. Simple-rule based systems are often referred to as intelligent job aids. These job aids help the user take into account a large number of different facts and then apply this information to determine a correct response.

A simple rule-based system potentially could be used to record the rules and requirements of MOS restructuring outlined in the MOCS Handbook into a computerized knowledge base. Then this knowledge could be provided to a large number of new analysts to help them learn the tasks associated with MOS restructuring. In the typical personnel proponent agency, knowledge of MOS restructuring is usually possessed by only a few analysts. To spread this knowledge more quickly, the new analyst can turn on the intelligent job aid rather than consulting the handbook or the seasoned analyst. The intelligent MOCS job aid would allow the new analyst to be productive while in the process of learning MOS restructuring.

Structured rule-based applications differ from simple rule-based applications by allowing the division of rules into hierarchically arranged sets. In structured rule-based applications, one set of rules can inherit information acquired from rules in another context. This type of system application is needed when a large number of rules are required or the problem area requires structured subdivision.

Structured rule-based applications also allow partitioning of the rule base and take advantage of inheritance. These applications also provide confidence factors, Bayesian probabilities or some other method to handle uncertainty. Structured rule-based applications usually require a great deal of programming in their development and should be supported by very clear documentation when fielded.

Hybrid applications are the most complex of the expert system applications. Hybrid applications use object-oriented programming techniques to represent the elements of each problem on which the application works as objects. Hybrid applications are typically much more difficult to use and generally require large mainframe computers on which to run. Hybrid applications are designed for systems that require from 500 to several thousand rules. These applications usually facilitate the development of complex, geographically oriented user interfaces and lack the narrow focus of the applications discussed above. Essentially, hybrid applications are not designed to build knowledge bases, but rather, these applications are designed to build other applications that build knowledge bases. Hybrid applications should be considered to be very powerful research applications rather than practical applications for use in PC-based expert systems.

The last ES application to be covered is the domain specific application. Domain specific applications are designed to be used only in the development of an expert system for a particular domain. Domain specific applications can incorporate any of the applications listed above and could be essentially classified in the other categories. These applications, however, provide special development and user interfaces that make possible development of an expert system in a particular domain.

Domain specific applications are comparatively new and not yet well developed. However, these applications are expected to expand rapidly in the coming years and, therefore, are given their own category in this report.

For the purposes of this report, only inductive, simple rule-based, and structured rule-based ES type software applications are considered because larger applications such as hybrid and domain specific applications have limited utility in the personal computer (PC) environment. Therefore, only applications capable of running in the PC environment found in the average proponent office are addressed.

Availability of ES Software, Average Cost, and Hardware Requirements

Many companies are involved in developing and marketing expert system application software. Just as types of applications vary, so do the cost of such application software. To gain an appreciation on the availability of expert system software, an inquiry was conducted to identify ES software currently available on the commercial market. During the course of the inquiry, over 200 ES software packages were identified.

A few vendors provide commercially designed packages that include support, training, and documentation. Other vendors, while offering commercial expert system software packages, do not really package or support their software adequately, largely because commercially available expert system software applications are very new.

A sampling of the more popular, vendor-supported ES software packages are: Crystal, by Intelligent Environments Inc.; Level 5, from Information Builders Inc.; and Arborist Decision Tree and Consultant Series Software from Texas Instruments. The range of applications represented by this group of software extend from the areas of manufacturing, sales, and marketing to personnel, production, research and development, and management information operations. Any decision to purchase a particular software package should be made only after considerable research is conducted into both the problem area chosen for ES application and the possible software packages that match the requirements of the problem area.

Hardware requirements for the applications listed in the preceding paragraph vary widely. However, software is available in each of these categories that will operate on a Army standard PC system.

The recommended minimum system configuration to run this type software is:

1. IBM PC or compatible computer.

2. PC-DOS version 2.0 or 3.0.

3. Color graphics adapter or enhanced graphics.

4. Minimum 640 Kilobytes of memory.

5. Color monitor.

6. 20 Megabyte hard disk.

7. Diskette drive.

Prices for PC based ES software range from a low of fifty dollars to several thousand dollars. The cost of the ES application is generally related to the ability of the application to represent knowledge. As a rule of thumb, inductive applications are the most limited and therefore the least expensive; while structured rule-based applications are the more sophisticated and generally the most expensive.

The availability and cost of ES software is only a small part of the total cost picture. More critical to the success of using any application is the identification of the proper problem areas or fields where an expert system would be most valuable.

In order to identify these variables, several costly activities must be undertaken. These activities fall into the general areas of front-end analysis and task analysis. For this analysis to be successful, decisions must be made on a systems development strategy. Areas associated with systems development include identifying a problem domain, determining an overall objective, identifying the problem or opportunity, and insuring the problem or opportunity is well and narrowly defined. In other words, the problem area must first be converted to a form that ES applications can use. The most important aspect of expert systems is the overall analysis and design of the problem area that ultimately lends itself to an application.

In considering a small inductive expert system, cost will usually not be a deterrent. However, if considering a larger system such as a simple rule-based or structured rule-based system that will be used by several people at once, then cost will rise proportionately to the level of effort involved. Costs will then include an expert to provide knowledge for the system, a programmer with an ES background to develop the system, and assignment of these personnel to what will likely be a 3-18 month task. Hybird expert systems by their nature require major investments in hardware and software. Therefore, Hybird systems are not considered viable options for MOS restructuring application.

Current and Expected Applications in MOS Restructuring Activities

At the present time, no expert system applications are in use by the personnel proponents. Because of the initial investment in front-end analysis, programming requirements, the expert's time, and developmental time, any one personnel proponent agency would not likely be willing or able to underwrite the cost for such an undertaking. This is not to say, however, that MOS restructuring could not benefit from expert system application. On the contrary, the possibility exists for several areas in MOS restructuring activities to become more efficient in the form of an expert system. Figure 18 is a matrix indicating MOS restructuring activities that may potentially benefit from expert system development.

Impact on recruiting may lend itself for development as an inductive expert system. A knowledge base that includes MOS title, MOS code, skill level 1 tasks, and the most physically demanding tasks could be developed for each MOS in a particular CMF. In addition to the knowledge base, a local data base that contains the current JOIN data could also be developed. Any changes to the knowledge base would trigger the inductive system to update the current information in the local JOIN data base automatically. The system would, in turn, provide a report of the new JOIN requirements to be sent to the Army Recruiting Command in order to update the Army's JOIN.

A simple rule-based expert system application could be used in assessing the training impacts and strategies of an MOS revision. For this type of expert system, a knowledge base containing rules such as required trainer-to-student ratios, number of training seats allocated to the course, required student attributes (high school algebra, biology, chemistry etc.), as well as other mandated training rules, could be developed for each MOS.

A data base containing information such as course length, number of course iterations per year, number of students per class, total MOS authorizations, MOS operating strength, and MOS retention rates could be developed for each MOS in a particular CMF. Based upon the information in both the knowledge and data bases, the simple rule expert system could prompt the user through menu driven dialogue to answer questions pertaining to training needs and strategy. Figure 19 provides an example of this dialogue. Given answers to certain questions, the system could be programmed to carry out calculations on the number of personnel required for training, perform "what-if" analysis based on changes in total authorizations or changes in MOS retention rates, and provide training strategy output reports to be included in the MOS restructure proposal.

Position data analysis, personnel data analysis, and SGA development are also identified for possible selection as structured rule-based application candidates in the matrix. Each of these analysis areas are very complex and would require a significant amount of front-end and cost benefits analysis prior to selection for expert system development. However, initial analysis of these analysis areas indicate that any of the three may well lend themselves to cost effective expert systems.

	INDUCTIVE	SIMPLE RULE-BASED	STRUCTURED RULE-BASED
MOCS HANDBOOK		■	
POSITION DATA ANALYSIS			■
PERSONNEL DATA ANALYSIS			■
MOCS IDENTIFIER DUTIES AND TASKS	■		
IMPACT ON RECRUITING	■		
TRAINING NEEDS ANALYSIS		■	
POSITION DOCUMENTATION AND PERSONNEL RECLASSIFICATION GUIDANCE			
PHYSICAL DEMANDS ANALYSIS			
BACKGROUND AND RATIONALE			
SUMMARY OF CHANGES			
SGA DEVELOPMENT			■

Figure 18

TENTATIVE ES APPLICATIONS

Has the total number of 39Y authorizations changed?

YES

Enter new number at the prompt.

720

What do you wish to do?

1. Calculate new training demand
2. Calculate training seats required
3. Calculate number of classes per year
4. Update the ATARS data base

3

Running

Figure 19

TRAINING STRATEGY SYSTEM

Conclusions

Expert system applications may well be viable approaches when developing methodologies for use in MOS restructuring activities. The state of technology (in terms of basic software applications) for ES has matured to a point conducive to successful development of expert systems software for MOS restructuring.

ES software that incorporates the essential application requirements for MOS restructuring is available on the commercial market. However, purchase of any software should be deferred until an indepth front-end analysis for high probability MOS restructuring activities is performed to ensure that the activities lend themselves to ES development. Once the indepth analysis is complete, an associated cost benefits analysis (CBA) for each selected development area will be required. The CBA based upon the application criteria outlined in this chapter will establish the framework for the decision making process and provide cost information in terms of dollars, manpower, data base development, risk absorption, interfacing issues, and organizational environment issues.

Opportunities for Improving MOS Restructuring

Research reveals that MOS restructuring analysis is a difficult, time consuming, and manpower intensive process. Although current Army regulations, policy guidance, handbooks, and existing research provide an abundance of procedural and content guidance to support MOS restructuring, current methods and technology fall short of providing a structured and systematic framework for the analysis and design of alternative MOS structures.

In practice, the art of performing an MOS restructure and the associated analysis required for restructuring remains largely an ad hoc decision process with considerable dependence on the initiative, ability, and creativity of both the proponent agency and the individual MOS analyst.

The purpose of this section is two-fold:

- To identify deficiencies and gaps in current MOS restructuring policies and practices which may benefit from research and development; and,

- To identify high impact opportunities for improving the MOS restructuring capabilities of the personnel proponent.

This section first summarizes the findings and conclusions stemming from the review of policy and research. Second, currently practiced MOS restructuring procedures are evaluated with respect to deficiencies and gaps; potential improvements in analytical procedures offering the greatest benefits to the personnel proponent are described. Finally, specific research initiatives are identified; based on resource availability and priority, some of these will be the focus of developmental efforts in subsequent research.

Existing Policy and Research Base

The review of policy, research, and current procedures reported in this research note confirms the general view of proponent MOS analysts and other parties of interest that many important opportunities for making the MOS restructuring process more systematic and quantitative in character do exist. At the same time, the foundation upon which to build is uneven.

From a policy perspective, sufficient guidance exists in the Army regulations which have been promulgated. The MOCS Handbook, in particular, identifies the key analytical and procedural requirements that must be met in order for an MOS restructuring action to be considered through the Army chain of command. The regulations which document MOS structuring decisions represent a longstanding element of Army personnel management recognized, accepted, and utilized by all soldiers.

The MOCS Handbook establishes what procedural steps must be undertaken. To this extent, the handbook is a valuable asset in any endeavor undertaken to improve the MOS restructuring process. While there may be steps or procedures in addition to those laid out, the procedural steps already included pose a challenging analytical requirement upon the personnel proponent. One major research need is to enhance the existing procedural steps through the introduction of quantitative and systematic methods. This need becomes more evident in the subsequent subsections of this section in which potential improvements are discussed.

For the moment, assuming that improvements are justifiable and desireable, the body of research that exists does not offer specific contributions to any such undertaking. Instead, there is a wealth of general principles and lessons learned which may bear on future undertakings aimed at improving MOS restructuring.

One lesson is that the wide range of activities encompassed in MOS restructuring should not necessarily be allowed to define the solution set. Some research efforts, such as the ELMS study, have simply fallen short because too much was attempted too quickly creating technical risks too great for existing organizational or political entities to respond. Small, but sure, technical advances are more achievable, can establish a pattern for subsequent successes, and provide the foundation for continued technical enhancements.

A second lesson, reflected in some of the shortcomings of SUMMA and the strengths of AIM and HARDMAN III, among others, is the importance and value of the appropriate system architecture in which research and development occurs. If, on the one hand, there are unacceptable risks associated with doing too much too soon, the formulation of an architecture or comprehensive strategy reduces the risk of creating piecemeal technical solutions that prove ineffective or misdirected. The value of past research lies in these and similar, less global, lessons that have been previously discussed.

One focus of this effort is on operations-based MOS structuring. In this respect, Army policy sets the agenda; past research offers limited, specific results upon which to build. The agenda is based on identifying opportunities for improving existing procedures.

Opportunities for Improving Existing Procedures

MOS restructuring analysis methodologies and procedures required by the MOCS Handbook are relevant, valid, and widely used throughout the personnel proponent community. As a first generation procedural guide, the handbook is designed to be applicable to all personnel proponent agencies regardless of agency size, complexity of the CMF represented by the agency, the ADP capability of the agency, or the analytical abilities of individual MOS analysts.

Notwithstanding the many significant differences from one agency to the next, the handbook provides a procedure that works as currently configured. The way the procedure works, however, leads to considerations of enhancements and improvements. The handbook does not prescribe how analysis should be performed. There are no systematic or quantitative procedures. Tracking the rationale, data sources, and analyses once an MOS action is being staffed is very difficult since no standard procedure exists. The ability to replicate an analysis once completed is limited.

Beyond these general conclusions, opportunities for improvements also are apparent in viewing the specific analytical steps, the available hardware and software resources, as well as other critical aspects not necessarily involving methodology.

Opportunities for improvement: MOS restructuring procedures. There are significant opportunities to improve the restructuring process because of the absence of a structured systematic framework at the agency level for the actual analysis and design of alternative MOS structures. These opportunities can be attributed to:

a. The lack of a standardized MOS study plan that describes the purpose of the proposed restructure and outlines the analysis requirements and data sources for each component analysis area.

b. The need for a study checklist that prompts the MOS analyst to consider each analysis area, report findings of preliminary analysis, and insure that MOS action areas in the study plan are addressed.

c. The "stubby pencil" nature of data manipulation and application of Army Average Grade Models requiring the MOS analyst to manually manipulate data and perform MOS authorization counts by physically searching for data in a printed report and transferring information to a separate worksheet.

d. Manual procedures requiring repeated data searches that are both time consuming and difficult to manage.

e. The manual development of SGAs and resulting applications to TAADS, requiring weeks of analysis involving constant and repeated counting and recounting of MOS position data information found in the TAADS report document.

f. The repetitious analysis of position data information that are collected and analyzed against many different variables both prior to and after SGA development.

Most persons involved in MOS restructuring activities point to position data analysis and SGA analysis and development as the two areas deserving primary consideration. The preceding list suggests there are other steps in the process deserving attention as well.

Opportunities for improvement: computer resources. Computer resources, including hardware and software, exist at the personnel proponent agencies in a haphazard manner. The resources, where they do exist, are the result of the Army's computer acquisition program rather than in response to specific needs of the personnel proponent shop. As a result, in most instances, there is a smattering of personal computers, off-the-shelf software, and some, although limited, data handling capability. None of these resources generally has been assembled to meet any specific MOS restructuring analysis objectives. Often, these resources are underutilized because of its lack of purpose as well as the absence of user training.

At some point, the current mix of computer resources will pose constraints on the enhancements that can be achieved through the development of systematic and quantitative analytical techniques. This seems very likely in regards to position data analysis and SGA analysis due to the amounts of data involved. However, given the current underutilization of these resources, existing capabilities can be used to meet some of the procedural needs. Other procedural enhancements will require additional computer resources.

Opportunities for improvement: other considerations. The focus of this research effort is on improving methodology. This singular focus, however, should not obscure other serious deficiencies and gaps that may have equal importance in improving MOS restructuring at the personnel proponent level. First, among these other issues, is the need for analyst training. To the extent that the processes are improved through computer-based techniques, embedded training may be an integral part of enhanced methodologies.

Enhancing the MOS Restructuring Process

There are many proposals and ideas for improving the MOS restructuring process. The opportunities exceed the resources currently available although there are potentially many payoffs to the Army that may result from investing in a range of improvements. Table 15 lists eight potential initiatives, any of which may be initiated within the framework of this research effort.

These initiatives are described here in general terms; conceptual development has not occurred nor has feasibility been addressed. The ascending order reflects a priority which may be altered as a function of resources and other considerations. Each is discussed with regards to its purposes, uses in MOS restructuring, and rough order of magnitude estimates of initial development efforts. The focus is on using typical proponent agency ADP resources. In terms of data handling, the standard equipment is constraining; however, in an environment in which these resources are underutilized, initial capabilities will lead to improvements as well as create the foundation for more far-reaching development.

System architecture for operations-based MOS restructuring methodology. There are seven research initiatives representing improvements to individual steps in the MOS restructuring process. These along with the elements of the existing process which already are satisfactory can lead to improved, more effective procedures. However, this opportunity can be lost if each of these initiatives is addressed independently. Piecemeal efforts are effective only by happenstance. To make significant improvements to the MOS restructuring process, there is a need for an overall system architecture and strategy as a framework for setting priorities and undertaking development.

The purpose of this first initiative is to create a system architecture that identifies all the critical analytical, data processing, and data management components of a systematic, quantitative, analytical support system for the personnel proponent agency.

There would be at least five subarchitectures defined and interrelated in such a plan. These would include architectures for analysis, data management, data flow, management control, and computer environment. The architecture would identify the relationships between the existing analytical assets as well as the individual initiatives identified in this section. Other components, neither existing nor identified here as priorities, may also be defined.

Table 15

ENHANCING THE MOS RESTRUCTURING PROCESS

1. System Architecture for Operations-Based MOS Restructuring Methodology
2. Position Data Analysis Job Aid
3. Standards of Grade Authorization (SGA) Job Aid
4. MOS Restructure Data Manager
5. MOS Action Plan Generator
6. MOS Action Item Submittal Documenter
7. CMF Assessment Aid
8. MOS Restructuring Trade-Off Analysis Model

The architecture may be used to identify priorities as well as formulate development strategies. This effort would produce a master plan to guide future efforts. The plan could also be used to monitor progress and periodically review system concepts in order to insure their currency and effectiveness in a situation in which the analytical requirements change over time. Estimated effort to develop a system architecture would be 8-12 technical person-months (TPM).

Position data analysis job aid (PDAT-JA). The purpose of the PDA Job Aid is to provide PC-based analytical aids which can be used to support position data analysis. The focus here is on a job aid as opposed to a complete analytical system. A more modest purpose seems appropriate at this stage in the absence of existing computer-based capabilities upon which to build.

Position data analysis is one of the more critical steps in the MOS restructuring process. Performance of this analysis generally precedes SGA analysis. Substantial amounts of data must be analyzed. The analysis itself is not particularly difficult; the volumes of data involved and the absence of computer-based support, however, make the process tedious, time consuming, and slow. This, in turn, makes consideration of alternatives difficult because there are no ready means for assessing marginal changes without repeating much of the analysis.

There are two primary design objectives tied to the PDA Job Aid. One is to employ ES techniques to provide structure to the analytical process. The other is to introduce data handling protocols and techniques, e.g., synthetic data constructs, and proxy data, among others, to reduce the burdens of analyzing the large volumes of data involved in position data analysis.

Development of the PDA Job Aid involves conceptual design, prototype development, detailed design, development, and testing. The first two steps may be accomplished within a 6-12 TPM effort; the results would provide the basis for more precisely defining the scope and level of effort required for full-scale development.

Standards of Grade Authorization (SGA) Job Aid. The approach to the SGA Job Aid mirrors that of the PDA Job Aid. The purpose of the SGA Job Aid is to provide PC-based analytical and data handling support to facilitate the performance of SGA analysis.

A major portion of SGA analysis occurs in the context of position data analysis. Development of job aids for SGA must be integrated with similar tools created for PDA and other essential analysis areas such as personnel data and recruiting impact analysis. Because the procedural burdens posed by SGA analysis are similar to those found in PDA, (e.g., large amounts of data and difficulty analyzing alternatives), ES techniques would also be used in an effort to reduce the procedural difficulties and data handling techniques would be applied to reduce the data burdens.

Development of the SGA Job Aid would entail similar steps as those identified for the PDA Job Aid. Conceptual design and initial prototype development may be accomplished within a 6-12 TPM effort.

MOS Restructure Data Manager. One of the most prevalent features of the MOS restructuring process is the volumes, sources, and amounts of data required to process an MOS action item. Each one of the nine analytical steps has data requirements which, to some significant degree, differ. Data are required by the personnel proponent from USIPIC as well as from in-house sources.

The purpose of the data manager is to provide computer-based support for the acquisition, storage, maintenance, and utilization of data supporting specific MOS action items. Systematic, computer-based procedures may result in more efficient data acquisition as well as provide a tracking facility which the analysts may use to identify specific data elements supporting restructure analysis. Such data recall capabilities may facilitate the development of alternative data sets which can be used to assess the consequences of various restructure options.

Development of design concepts and initial prototypes may require an effort of 12-18 TPM.

MOS Action Plan Generator. The development of a study plan is not presently a routine procedure in an MOS restructuring analysis. A study plan would be designed to organize the analyst's work by identifying the types and sources of data required, defining the specific issues to be addressed, making explicit key assumptions about the study, and identifying the essential elements of analysis.

Developing a study plan at the front-end of an MOS action item analysis, while important in setting an agenda, is neither labor intensive, or time consuming. ES and word processing applications readily lend themselves to supporting the development of a study plan.

The purpose of the MOS Study Plan Generator is to provide the PC-based tools to quickly support the proponent analyst in developing a study plan. The ES elements of the model would insure that all study requirements are addressed and word processing boilerplate would facilitate the production of the plan.

The study plan generator would also provide capabilities to generate an MOS study plan timeline indicating major milestones. This work schedule and associated critical paths may be used to monitor and control the performance of the MOS restructure study.

Development of concepts and initial prototype capabilities would require approximately 6-9 TPM.

MOS Action Item Submittal Documenter. The MOS Action Item Submittal Documenter is a job aid designed to assist the analyst in preparing his action item submittal. Like the study plan generator, the documenter represents a PC-based capability combining ES techniques and word processing that would make the production of the MOS package more efficient as well as increase the likelihood of conformance with Army reporting standards. This product provides a document production capability promoting standardization and control; analytical support would result from development of the models and job aids described here as well as others not yet defined.

The documenter would incorporate modules tailored to generate each portion of an MOS submission. While the analytical process is not likely to ever allow a simple, fill-in-the-blank system, this proposed job aid would permit analysts to insert their analytical data into boilerplate narratives which he could further tailor to meet specific requirements. Furthermore, the documenter may be designed to incorporate data initially entered into a study data base as part of the study plan.

Development of concepts and initial prototype capabilities would require approximately 12-18 TPM.

CMF Assessment Aid. The purpose of the CMF Assessment Aid is to provide the analyst with a capability to evaluate the impact of an MOS restructuring on its CMF. MOS actions often are developed in the absence of considerations about the impact of changes on related MOSs. There is danger in restructuring an MOS within a narrow framework. MOSs within a CMF have relationships in terms of career progression and changes to a single MOS may create problems elsewhere within the CMF. The CMF Assessment Aid would employ ES, data base, and analytical techniques to identify and help assess potential impacts of an MOS restructuring action.

There is no existing capability upon which to build the CMF Assessment Aid. Research is required to identify potential impacts and MOS relationships and to develop an analytical model. An estimated 12-18 TPM is required to develop concepts and initial prototype capabilities.

MOS Restructuring Trade-Off Analysis Model. The purpose of the MOS Restructuring Trade-Off Analysis Model is to provide a PC-based capability that can assist the personnel analyst in identifying and assessing trade-offs related to an MOS restructuring. A trade-off model would have utility in both the requirements-based and operations-based setting.

In the requirements-based setting, the model may be used to identify and evaluate trade-offs between MPT and weapon system features. Particular attention often focuses on relationships between MPT requirements and reliability and maintainability. Strategic MPT and design decisions must be made during the acquisition process leading to choices about which MOSs are likely to be required for the operations and maintenance of the new weapon system.

In the operations-based setting in which the personnel proponent agency considers MOS changes, the ground rules dictate a zero-sum process, e.g., additions to an MOS must match deletions elsewhere, changes in grade structure are constrained by the Average Grade Matrix, among others. These circumstances have reduced the extent to which trade-offs are considered explicitly by the personnel proponent. The process inherently forces trade-offs.

While such inherent trade-offs occur, there are other potential impacts of MOS restructuring decisions which are not captured by the process. For instance, the impacts on training as result of MOS restructuring involve many trade-offs; these include training length, course content, and training difficulty. Other areas requiring consideration include retention, accessions, and selection.

The trade-off model would be designed to identify potential trade-off areas and provide analytical aids to determine their magnitude and significance. The introduction of this type model into the MOS restructuring process would result in trade-offs being considered in a more systematic fashion. In particular, the likelihood that a single criterion might be addressed independent of other key decision variables would be significantly reduced as result of a comprehensive trade-off analysis model.

Given the current focus of this research to support the needs of the personnel proponent agency, this proposal focuses on an initial trade-off capability designed for application in the operations-based setting; however, a fully-developed capability would support trade-off analysis occurring during requirements-based MOS structuring as well. To develop concepts and initial prototypes for an MOS Restructuring Trade-Off Analysis Model would require a 12-18 TPM effort.

Summary and Conclusions

This section has identified many ways in which the MOS restructuring process may be made more systematic and quantitative. The research products noted here are by no means an exhaustive list. With the exception of the MOS Restructure Data Manager, each product could function in the typical personnel proponent hardware and software environment.

The scope and resources supporting this research effort are sufficient to make improvements in the MOS restructuring process. Priorities, however, are necessary to identify specific research initiatives. The important benchmarks at this stage are to establish the parameters of a comprehensive analytical approach and to demonstrate, through at least one of the initiatives, that the MOS restructuring process at the personnel proponent level can be made more systematic and quantitative.

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ACRONYMS

AFHRL . . . . Air Force Human Resources Laboratory

AFS . . . . . Air Force Specialty

AI . . . . . . Artificial Intelligence

AIM . . . . . Air Force Specialty Impact Model

AIT . . . . . Advanced Individual Training

AMC . . . . . Army Material Command

AMCOS . . . . Economic and Budget Cost Models

AMEDD . . . . Army Medical Department

AMMH . . . . . Annual Maintenance Manhours

ARI . . . . . Army Research Institute

ASI . . . . . Additional Skill Identifier

ASVAB . . . . Armed Services Vocational Aptitude Battery

BOIP . . . . . Basis of Issue Plan

BOIPFD . . . . BOIP Feeder Document

CAD . . . . . Course Administrative Data

CAT . . . . . Mental Category

CBA . . . . . Cost Benefits Analysis

CMF . . . . . Career Management Field

CSM . . . . . Command Sergeant Major

DCD . . . . . Director of Combat Developments

DCSLOG . . . . Deputy Chief of Staff for Logistics

DCSOPS . . . . Deputy Chief of Staff for Operations

DCSPER . . . . Deputy Chief of Staff for Personnel

DOS . . . . . Disk Operating System

DOTD . . . . . Director of Training and Doctrine

DTOE . . . . . Developmental Tables of Organization and Equipment

ELMS . . . . . Electronic Maintenance Study

ES . . . . . . Expert System

HARDMAN . . . Hardware/Manpower Integration

HARDMAN III . Hardware/Manpower Integration III

HCM . . . . . HARDMAN Comparability Study

HQDA . . . . . Headquarters Department of the Army

IBM . . . . . International Business Machines

IET . . . . . Initial Entry Training

ITP . . . . . Individual Training Plan

JOIN . . . . . Joint Optical Information Network

LCOM . . . . . The Logistics Composite Model

LCSMM . . . . Life Cycle System Management Model

LHX . . . . . Light Helicopter Experimental

LIN . . . . . Line Item Number

LTOE . . . . . Living Tables of Organization and Equipment

M-CON . . . . The Manpower Constraints Aid

MACOM . . . . Major Army Command

MAN-SEVAL . . Manpower-Based System Evaluation Aid

MANPRINT . . . Manpower and Personnel Integration

MARC . . . . . Manpower Requirements Criteria

MB . . . . . . Megabyte

MEPSCAT . . . Military Enlistment Physical Strength Capacity Test

MOCS . . . . . Military Occupational Classification Structure

MOS . . . . . Military Occupational Specialty

MPT . . . . . Manpower, Personnel, and Training

MTOE . . . . . Modified Tables of Organization and Equipment

O&O Plan . . . Operational and Organizational Plan

OCOS . . . . . Office of the Chief of Signal

ODCSPER . . . Office of the Deputy Chief of Staff for Personnel

P-CON . . . . The Personnel Constraints Aid

P1 . . . . . . Probability One

PC . . . . . . Personal Computer

PCS . . . . . Permanent Change of Station

PDA . . . . . Physical Demands Analysis

PDAT-JA . . . Position Data Analysis Job Aid

PDAT . . . . . Position Data Analysis

PER-SEVAL . . Personnel-Based System Evaluation Aid

PMAD . . . . . Personnel Management Authorization Document

POI . . . . . Program of Instruction

QQPRI . . . . Qualitative and Quantitative Personnel Requirements Information

RAM . . . . . Reliability and Maintainability

S^3 . . . . . . Specialty Structuring System

SGA . . . . . Standards of Grade Authorization

SIMOS . . . . Space Imbalanced Military Occupational Specialty

SME . . . . . Subject Matter Expert

SPARC . . . . The System Performance and RAM Criteria Aid

SQI . . . . . Specialty Qualification Identifier

SUMMA . . . . Small Unit Maintenance Manpower Analysis

SYNVAL . . . . Synthetic Validation Project

T-CON . . . . The Training Constraints Aid

TDA . . . . . Tables of Distribution and Allowances

TAADS . . . . The Army Authorization Documents System

TMDE . . . . . Test Measurement and Diagnostic Equipment

TOE . . . . . Tables of Organization and Equipment

TQQPRI . . . . Tentative Qualitative and Quantitative Personnel Requirements Information

TPM . . . . . Technical Person Months

TRADOC . . . . U.S. Army Training and Doctrine Command

UIC . . . . . Unit Identification Code

USAPIC . . . . U.S. Army Personnel Integration Command