This chapter provides an overview of ELIM and MOSLS, two of a family of models used by Army strength managers. It describes the models' general analytic approach, the processing steps involved, and the outputs generated by each. It also discusses the advantages and disadvantages of ELIM and MOSLS for managing the Army's various personnel activities. For a more detailed description of what ELIM and MOSLS do and how they work, see Appendices A and B, respectively.

ELIM OVERVIEW

The Enlisted Loss Inventory Model/Computation of Manpower Program using Linear Programming model, commonly referred to as ELIM, is the primary model used by the Army to manage its enlisted personnel strength at the aggregate level. ELIM was developed during the early 1970s with the principal objective of supporting improved planning and budgeting of the active force and specifying the required monthly draft calls during the drawdown at the end of the Vietnam conflict. It has been extensively modified over the last two decades to capture the evolving objectives, policies, and concerns of the Army strength management community. It has also been modified to take advantage of emerging mathematical programming algo-

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1The General Research Corporation (GRC) originally developed the model and remains the prime contractor for model upgrades and enhancements, in addition to providing overall support to the Army strength management community. It conducts periodic training classes for Army officers new to strength management organizations and maintains documentation on the technical aspects of ELIM.
Rithms and technology. Because of the problems that typically sur-
round older models that have been extensively modified, the Army is
beginning a multiyear development effort to replace ELIM and to
provide an integrating framework to streamline ELIM’s interactions
with other models and databases.

Figure 4.1 shows how ELIM interacts with other models and data sys-
tems. The shaded symbols in the figure reflect data files or calcula-
tions that feed ELIM and its primary hard-copy output, the Active
Army Military Manpower Program (AAMMP). The unshaded boxes
are the other models that interface with ELIM.

ELIM primarily addresses enlisted personnel strength in operating
units. However, it tracks and produces output for the total Army end
strength, including officers and personnel in the individuals account.
Officer strengths are provided by the Officer Projection Aggregate
Level System (OPALS). The individuals account includes personnel
in various training categories, on medical leave, hospitalized, in
criminal detention, or in-transit between duty locations. Individuals
account personnel levels are input from the Trainees, Transients,
Holdees, and Students (TTHS) model.
The FELIM model is a female-only version of ELIM. It was developed in the late 1970s in response to the increased interest in the accession and management of female enlisted personnel. FELIM is a mirror image of ELIM that produces the female portion of the AAMMP and provides female strength and accession data to ELIM.

**ELIM GENERAL ANALYTIC APPROACH AND ARCHITECTURE**

The model takes a two-step analytical approach. First, a simulation forecasts future enlisted personnel levels, starting with the current enlisted inventory and estimating, based on historical data, monthly losses for seven years into the future. In the second step, a mathematical programming optimization routine determines the monthly accession levels needed to minimize the operating strength deviation (the difference between “faces” and “spaces”) given various constraints that exist in the personnel management system. The overall model architecture is shown in Figure 4.2.

In simplest terms, ELIM determines the number of annual accessions needed during each of the seven inventory projection years. It determines these accessions after applying losses and comparing the remaining enlisted force with required end strength. Three things complicate this process. First, ELIM projects on a monthly basis. Second, accessions are broken down into eight characteristic groups (see Table A.1 for the makeup of these groups) and constraints are imposed on the composition of the accessions in these groups (e.g., number in a given mental category). Finally, within a year, seasonal constraints can be imposed on the monthly availability of a given characteristic group’s accessions. For example, a composition constraint used during a recent analysis required that 67 percent of each year’s accessions come from male high school graduates in mental category I-IIIA. A seasonal constraint might require a percentage of those accessions to come in July.

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2FELIM was developed because ELIM, constrained by its original design and processing capabilities, could not accommodate the increased number of variables resulting from distinguishing males and females. One of the objectives of the current model development and enhancement is to combine males and females into a single model.
The objective of the inventory projection is to determine the number of accessions needed to minimize the monthly operating strength deviation while conforming to all composition and seasonal constraints. No month carries more weight than any other month, and the optimal number of accessions over the 84-month period may lead to positive or negative deviations in specific months. Constraints can be imposed to ensure that these deviations remain within acceptable bounds.

On a more detailed level, here's how ELIM works. The modeling process involves the following four steps:

1. Prepare model inputs.
2. Project enlisted inventory.
3. Determine optimal accession levels.
4. Produce model output.
In the short term, the simulation projects the expected outcomes of events that have occurred in previous time periods. For example, the simulation “knows” how many soldiers will reach the end of their current enlistment contract (ETS) in each future month (and the expected number who will reenlist or extend at that point and for every month prior to that point). The simulation also has access to the future output of training pipelines. Therefore, the short-term inventory predictions are largely “fixed” by past decisions and are difficult for the Army to adjust by changing policies or increasing resource levels.

In the next step in the ELIM process, a linear programming model determines the optimal set of enlisted accessions required to meet the operating strength objectives over the seven-year horizon. These accessions are constrained by recruiting objectives for various types of enlisted people (e.g., gender, education or test scores, or seasonal recruiting constraints). The model also balances the population of different groups by tracking the movement of people through the system (e.g., moving first-term enlistees into career status).³

Model outputs are used in three general areas. The main hard-copy output of ELIM—the AAMMP—is used by various personnel management organizations to understand the current and future status of enlisted inventory. In this role, the AAMMP is a primary document in the determination of the Program Objective Memorandum (POM) and the budget. ELIM output also provides the monthly accession goals, both by quantity and type of recruit, to the Recruiting Command. Finally, ELIM outputs are input to MOSLS, where they act as aggregate constraints on MOSLS training pipeline projections.

**MOSLS OVERVIEW**

The Military Occupational Specialty Level System, or MOSLS, is the model used by ODCSPER and PERSCOM to balance the MOS and grade-level requirements of the Army with the available population.

³The model can also use entry-level training base capacity and budget constraints for the total force. These capabilities are not currently used.
It complements ELIM in that it provides grade and MOS detail, which ELIM does not consider.\(^4\)

MOSLS supports enlisted personnel policy at two levels. At the most aggregate level, MOSLS enables Army analysts to explore the implications of policies and behaviors that affect the Service's need for total numbers of individuals of certain skills and grades. MOSLS also supports the analysis of voluntary loss behavior and of involuntary loss policies upon the entire enlisted force. At the more detailed MOS and grade level, MOSLS results can be used to assess the effects of promotion, reenlistment, and accession policies. MOSLS also forecasts the Service's need for newly trained individuals by skill and helps determine the training programs necessary to produce such individuals.

MOSLS is one system within the Army's strength management family of models, resources, and products. Figure 4.3 shows how MOSLS interacts with ELIM, other models, and data systems.

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\(^4\)The modification to ELIM will include the grade dimension.
MOSLS GENERAL ANALYTIC APPROACH AND ARCHITECTURE

Like ELIM, MOSLS uses both optimization and simulation to consider the ways the personnel community can control the enlisted force, the constraints upon various management options, and events beyond the control of the Service. The optimization function prescribes the best set of personnel management actions for what the Army can control—promotion, reclassification, training load, and forced losses. The optimization models consider legal, resource, and budget constraints when determining the best sets of policies.

The simulation models predict the behavior of the force beyond the Army’s control. Simulation provides a more accurate representation of the future force by replicating probable loss, aging patterns, and training graduation rates, which management policies cannot directly alter.

MOSLS has three primary elements: the pre-processor module and its inputs, the trained strength model, and the post-processor module. Figure 4.4 provides a schematic of the architecture and how its components relate to each other. In general, the pre-processor determines the targets to which the model should optimize and the constraints that limit the optimization. It also includes the training simulation model, which projects how many individuals will be graduating from each skill training course.

The trained strength model is a large network model that uses the trained output of the training simulation model and the targets and
constraints of the pre-processor to model the most optimal force achievable.

The post-processor includes the training requirements model, which considers the optimal force output from the trained strength model and reconsiders how the training simulation model should have allocated individuals across skill training course. The post-processor also compiles various output reports from MOSLS. The key outputs of MOSLS are the Enlisted Force Distribution and the Program Objective Force.

As Figure 4.4 indicates, MOSLS contains three models: the training simulation model (in the pre-processor module), the trained strength model, and the training requirements model (in the post-processor module). The training simulation model makes an initial estimate of the output of the MOS training pipeline over the 84 months of inventory projection. The second model, the trained strength model, then takes the forecast of the training simulation model and combines it with promotions, reclassifications, and losses to produce a detailed inventory projection, which it then manipulates to minimize differences between MOS inventory and requirements by adjusting promotions, reclassifications, and forced losses. This process iterates until the MOS differences show no improvement between iterations. The training requirements model then picks up, taking the results of the trained strength model and determining what input is necessary to the training pipeline to meet the detailed force structure requirements.

SUMMARY

ELIM and MOSLS are key tools for Army active enlisted strength management. The main advantage of ELIM and MOSLS is that they integrate several personnel functional activities. By relating recruiting, training, and retention at the aggregate level, ELIM provides an organized process for addressing strength management issues. By integrating training, promotion, retention, and reclassification at a disaggregated level, MOSLS provides an organized process for trained strength management, with detailed monthly updates to refine prior forecasts and observe the consequences of enlisted trained strength management policies.
ELIM and MOSLS both use analytical techniques that are valid and properly employed, given the original and current uses of the models. The models’ short-term predictions are typically very accurate. The long-term predictions are also accurate during periods of little change in the Army’s structure and policies, and in the external variables that affect personal behaviors (e.g., civilian wage and employment rates). Monthly updates and discussions that accompany the updates help adjust the models’ predictions and refine prior forecasts by incorporating changes in the Army environment or in other assumptions.

However, it is important to remember that ELIM’s optimization module and MOSLS’ simulation and optimization modules specify the policies necessary to achieve the specified future force structure goals. Predictions of future values hinge on the assumption that planned policy changes will be implemented, and that unforeseen events or policy changes will not affect the enlisted force. If unexpected policy changes occur or if the policy decisions prescribed by prior ELIM and MOSLS runs are not implemented, then the models’ future predictions will vary from actual events.

ELIM and MOSLS also have a number of limitations. Neither model can be considered “user-friendly” because of the complexity of the models and long run times required. Because ELIM was built over two decades ago and has been substantially modified over time, it is fairly opaque, making it difficult to understand. The Army’s multi-year effort to develop a replacement for ELIM should correct this limitation.

ELIM is also fairly complex as a result of the numerous data groupings and rates that are used to transition these groups into, through, and out of the personnel system. It was built and is used primarily for programming purposes. It can be, and has been, used for planning studies, but its complexity and lack of transparency hinder an analyst’s ability to do “what-if” types of analyses. Although it provides a quicker turnaround than other models such as MOSLS, it still takes two hours or longer for an ELIM run. Again, the use of more modern software and algorithmic procedures should help to shorten the run times.
MOSLS also has a long run time and requires familiarity with the model operations to conduct the monthly runs. What-if excursions are not a practical use of MOSLS, and it is unlikely that the Army will ever be able to conduct the monthly MOSLS runs independent of the civilian contractor. The MOSLS results are well documented and available in numerous data reports. However, the reports themselves are not always easily understandable, and the model processes that contribute to the results are opaque and require considerable expertise to explain. Again, the Army will probably not be able to sustain an internal expertise. The extraordinary number of calculations that complicate MOSLS, however, provide the level of detail that is so helpful to Army strength management.

An additional limitation of ELIM is the sensitivity of its predictions and the impact this has on budgets. Strength management addresses large-magnitude policies and programs. The active end strength includes approximately half a million soldiers with a military personnel budget of approximately $20 billion. Although ELIM is fairly accurate in its predictions, especially in the short term, a small percentage over or under estimate can result in a several hundred million dollar difference between the estimated and actual military personnel budget.

Finally, ELIM and MOSLS are but two parts of an overall process. These models can help understand how best to achieve future goals, but the whole process depends on when and how policies are changed or implemented and on how the propensities of people to enter or stay in the Army change.