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MANAGEMENT OF PERSONNEL POLICIES TO INCREASE THE STABILITY OF PATRIOT CREW MEMBERS AND THEIR FAMILIES: A SIMULATION APPROACH

Michael J. Kwinn Jr.
Robert G. Phelan Jr.

Operations Research Center
United States Military Academy
West Point, New York 10996, USA

ABSTRACT

The overwhelming success of the Patriot Air Defense weapon system during Operation Desert Storm has become a double edge sword for the system's enlisted crew members and their families. During the war, the Patriot system became the first proven means of defending against Tactical Ballistic Missile (TBM) attacks. The people and the governments of Israel, Saudi Arabia and the United States praised the Patriot crew members as true heroes. Unfortunately for the Patriot crew members, their success also meant that every country wanted the protection that the system offered. A battalion is now permanently stationed in Korea. Another battalion rotates every six months to Saudi Arabia. The increased number of deployments of the system and the crew members has had a dramatically negative impact on morale, retention and recruitment of Patriot crew members. In this paper, we present a simulation model which allows a personnel manager to vary personnel policies effecting Patriot crew members to determine the impact on the number and frequency of deployments and on unit readiness.

1 INTRODUCTION

In the early stages of Operation Desert Shield military planners determined one of the major threats to US and allied forces in Saudi Arabia prior to any offensive action was from Iraqi Scud missile attacks. The solution was to send Patriot battalions as soon as possible to attack and destroy the in-bound Scuds. This anti-ballistic missile defense capability had never before been proven in combat conditions. When the first Patriot system engaged, fired and destroyed the first Scud missile over Riyadh, the effectiveness of the system became legendary - and its crew members became nomads. Suddenly every country allied with the United States wanted Patriot coverage to protect against TBM threats.

The Patriot weapon system and the soldiers that man it were moving all over the globe. Soldiers who were stationed at Fort Bliss deployed to South Korea with their Patriot Battalion. They would return from that deployment only to be sent to Germany. Shortly after arrival to Germany, they would deploy for six months to Southwest Asia (SWA) with a different battalion. It was not unheard of for solders to be away from their families for 24-30 months out of the last 36. Retention rates were dropping dramatically and morale was at an all time low. The large number of deployments did not decrease with time. When the Army decided to make the battalion in Korea a permanent stationing, it did reduce the deployment time and the uncertainty of which battalion would deploy next [Costello, 1996]. It also increased the deployment time for the soldiers from 6 to 12 months.

Prior to the conflict in Southwest Asia (SWA), the Army personnel system was undergoing dramatic reductions in all areas. With the end of the Cold War, there was an almost universal cry for a "peace dividend". In the early 1990's, this "peace dividend" took the form of a massive reduction in the Army's personnel end-strength and a realignment of installations. At the end of fiscal year 1989, the Army's enlisted end-strength was 658,000 soldiers stationed throughout the world. By the end of fiscal year 1995, the enlisted end-strength was only 422,000 soldiers [Hersh, 1995]. According to the Army Chief of Staff, General Dennis Reimer, the Army may have to reduce even further to pay for modernization programs [Reimer Interview, 1995]. Army planners are currently analyzing options on how to reduce the Army end-strength by an additional 20,000-40,000 soldiers.

Senior leaders in the US Army Personnel Command (PERSCOM) demand from their branch managers immediate analysis of the almost daily changes to the personnel system. General Reimer, recently stated, "The models that we've had that have worked well during the Cold War don't adjust well to a changing situation...." [Adelsberger, 1995]. Currently, personnel managers base many of their decisions on the *output* of the current models. Personnel managers use most models as decision *support* tools as opposed to decision *analysis* tools.

In this paper, we present a simulation model developed for the Plans and Analysis Branch, Enlisted Personnel Management Division, US Army Personnel Services Command (EPMD, PERSCOM). We designed the model to assist personnel managers in analyzing the impact changes to the personnel system. This model allows managers and analysts to modify policies and determine the impact on personnel stability and unit readiness.

2 BACKGROUND

2.1 Types of Moves

When a soldier moves from one location to another, it is a Permanent Change of Station, (PCS) move which generally falls into one of five categories: Unit, Operational, Training, Rotational, and Accessions and Separations. The movement of a soldier as a result of a unit's activation or deactivation is considered a "Unit move". When a soldier moves between one unit between units both within the Continental United States (CONUS), this is an "Operational move". An exception to this is when the move is to or from a professional development school. This is considered a "Training move". Whenever a soldier is moved "over water" (ie. From Germany to the United States), it is counted as a "Rotational move". Moves which result from a soldier either entering or exiting the Army are considered "Accession and Separation moves".

The costs associated with all of these moves total over $1 Billion annually. Rotational moves and Accession and Separation moves account for over 90% of the PCS costs [Hix, 1995]. The number of moves, and therefore the cost, increased dramatically in recent years due to the draw down. The Army closely managed the voluntary separations by soldiers by MOS and grade but not by unit or geographical region. The result was a large increase in operational moves.

2.2 Needs Analysis

Another significant impact on personnel policy was the changing force structure; especially the reduction in the number of soldiers required in Europe. For years, soldiers knew that roughly every other assignment would be overseas, usually to Europe. This was due to the fact that in the 1980's, approximately 30% of the enlisted soldier authorizations in the Army were in Europe. By the end of FY95, the ratio was down to 13%!

This realignment of forces changed the Army's "comfortable" rotational scheme for soldiers moving from overseas to stateside assignments. Base closures and threats of even further force reductions created uncertainty for the Army's leaders, too. Each base-closure recommendation from the Base Realignment Commission (BRAC) further disrupted the personnel system.

We met with LTC James Thomas, Section Chief, Plans and Analysis section, Distribution Division, Enlisted Personnel Management Directorate, PERSCOM in September of 1995. One of the needs that he explained to us was that his superiors often asked his staff to conduct analysis on the effects of changing personnel policies. For example, they would ask about the effects on unit readiness if the Army extended the tour lengths in Germany. They were also very interested in the effects of reducing the number of Operational moves allowed in a given fiscal year. He stated that his office did not have an analytical tool to directly assist his staff in analyzing these types of problems. They best they could do is long-handed work with a calculator and a pencil. As the Army continues to operate under increasing tight budgets and to realign units, he anticipated that questions such as these would be asked more frequently.

We determined that he needed an analytical tool with which his staff could quickly and easily modify PCS policies and could determine the effects of these policies on the number of moves and the readiness of the units. The model would have to provide accurate results in a short amount of time.

3 MODEL DEVELOPMENT

3.1 Use of Simulation

The personnel system is very stochastic in nature. The number of soldiers promoted in a given month varies greatly. The number of soldiers who leave the service in a given month also varies greatly. For this reason, we wanted any analytical tool which we developed to account for this variability. We were trying to predict an outcome based on a given set of parameters (the current personnel picture) and rates which varied. We could not just provide our decision maker with one pat answer and not address that variability. This was one of the major reasons we chose to develop a simulation of the personnel system. By using simulation, we could replicate the stochastic nature of the personnel system while begin able to analyze each policy by running the simulation a number of times.

We decided to use the ProModel® software package for this simulation. This is a discrete-time simulation package. Each minute of simulation time represents one month of real time. ProModel® is an object-oriented simulation package which makes programming the simulation quite easily. Additionally, it provides an outstanding use of animation and a user can easily transform the statistical output into graphical format. Displayed in the figure below is the graphics of the simulation. The numbers within the boxes near the locations are the number of soldiers at that location.

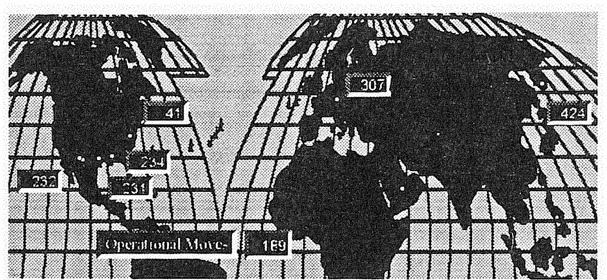

Figure 1: ProModel display for PCS Simulation Model

The animation and the statistical analysis features of the software are extremely valuable when attempting to convince a decision maker on a proposal. The problem is that it can potentially limit the overall size of the model. We will address this later.

3.2 Proof of Principle

Simulating every MOS in the Army is a very large undertaking. The overall modeling effort would take a great deal of work. It would also require a large amount of memory unless we trade-off resolution for aggregation. Prior to launching a large modeling effort, we decided to ensure our efforts would meet the needs of our client. For this reason, the simulation model we develop in this report is a proof of principle using only one MOS. We chose to model 16T, Patriot Crewmember. We decided on this MOS for a number of reasons. First, it was a representative MOS in that a 16T could be stationed in a number of locations both stateside and overseas and could also be assigned to duties away from a Patriot unit, like Drill Sergeant. Second, all of the analysts were Air Defense officers so there was a level of familiarity with the 16T career patterns. Finally, we conducted an interim brief on the project to MG Costello, Chief, Air Defense Branch. He asked that we focus on this MOS due to the lack of assignment stability for these soldiers in light of the requirement for a rotating battalion to deploy to Southwest Asia (SWA).

3.3 Concept for Modularity

Since we were only working on one MOS, we wanted to make the model as modular as possible to allow for easy expansion to encompass all MOSs. This would also allow for adaptability to different policies or realignment of forces. This modular concept also made the initial model development a great deal easier and quicker.

3.3.1 Types of Locations

We categorized each location, or unit assignment, a 16T could be assigned to, into one of three types of locations: CONUS TOE, CONUS TDA and OCONUS. A CONUS TOE unit is a line Patriot unit in the Continental United States. A CONUS TDA unit could be a Drill Sergeant or Recruiting assignment, for example, in the Continental United States. Any assignment Outside the Continental United States is considered an OCONUS assignment for the purposes of our model.

The differences in the types of locations are the criteria personnel managers use to determine a soldiers eligibility to move and the type of move generated from that type of location. Movement out of a OCONUS or a CONUS TDA assignment is based on a soldier reaching a certain TOS. For an assignment to Germany, for example, generally when a soldier has been on station for 30 months, he or she will be looked at for reassignment. Assignments in Korea are normally 12 months and CONUS TDA assignments are 24-36 months in length. The difference here is that a move from a CONUS TDA assignment can be an "Operational move". Our model counts all moves to or from an OCONUS assignment as either Rotational or as an Accession or Separation move. Soldiers in a CONUS TOE unit are only moved when there is a requirement at another location, and usually only after 24 months TOS. If there is no requirement, a soldier remains at his or her current location.

3.3.2 Processing Blocks

We further break down the processing at the different locations into three blocks: Administrative, Orders, and Movement. The Administrative block is just what the title says. All administrative actions such as promotions, demotions and attritions are done in this block of code. In the Orders block, soldiers are "given" orders for reassignment to another location, or unit. Finally, in the Movement block, a soldier "PCSs" to his or her new duty location. We will discuss the actual coding of these blocks in a later section.

4 CHARACTERISTICS OF THE MODEL

4.1 Locations

For our specific model, we defined eight separate locations a soldier can "move" to or from. Soldiers can be assigned to the Advanced Individual Training location at Fort Bliss, a CONUS TOE unit at either Fort Bliss, Fort Hood, or Fort Polk. They can also be assigned to an OCONUS unit in Germany or in Korea. Finally they can be assigned to a CONUS TDA unit. We aggregated all the CONUS TDA assignments into one unit. We did this because our client was not interested in the cost of each move, simply the number of moves, by type. This allowed us to consider a move from the Wisconsin National Guard to Fort Bliss the same as a move from Washington, DC to Fort Polk, for example.

4.2 Entities

There is only one type of entity in our model: a soldier. We model each 16T individually. This requires more memory than aggregating the entities but allow for greater resolution as to the individual characteristics of a soldier. We account for the various characteristics of the soldiers by assigning different attributes to each entity.

4.3 Attributes

We defined four attributes for each individual soldier:

4.3.1 Skill Level (SL)

This is self-explanatory. As a soldier in this model is promoted to skill level 5 (E8), he or she leaves the system. This is because that soldier would then become a 16Z. This is an entirely different MOS and is managed separately.

4.3.2 Time on Station (TOS)

This is the number of months a soldier is at a particular location. This is incremented every month and is the key indicator to determine *when* a soldier is eligible for reassignment.

4.3.3 PCS Designator (PCS_CODE)

This a designator which is assigned to an entity to essentially, "put a soldier on orders" to another location. This is explained in the Movement Processing paragraph below.

4.3.4 Time Until Movement (TTM)

This is a value given to an entity to signify the number of months until that entity proceeds to its new assignment after being "put on" assignment instructions. Prior to putting a soldier on orders, this number is negative. After a soldier is put on orders, he or she is assigned a positive number based on the need of the gaining unit. We discuss the actual assignment algorithm later. An entity's TTM is decremented every time period (month). When it becomes zero, the entity moves to the new "unit".

4.4 Variables

Most of the variables we use in this model are defined to calculate which unit a solider ready for PCS should be assigned to. An assignment officer generally reassigns a PCS eligible soldier to the unit with the greatest "need". This is based on a priority fill plan. Under this plan, different units are designated to have a higher priority. Personnel managers attempt to keep these units at high fill percentages. To replicate the assignment process, we defined a great number of variables in this model. We defined each of the variables explained below for each skill level and location. For example, the actual number of skill level 1 soldiers at Fort Bliss is defined as Bliss_act1.

4.4.1 Target

Different units have different "fill priorities". Some units, such as rapid deployment units, have a high fill priority. Personnel managers try and maintain a fill level of over 100% for these units. This way, even with normal fluctuations in personnel levels, a high priority unit will never drop below 100% fill. There are "bill payers" for this over-manning. These are the low priority units. Personnel managers are willing to let these units fill levels drop below 100%, perhaps as low as 95%. To account for these different priority units, we used a "target" value instead of simply a unit's authorized strength. For example, if a unit is a high priority unit and has an authorized strength of 200 personnel, the target value would be 204 (200*102%). Similarly, if a low priority unit has an authorized strength of 100, its "target" could be 98 or even 95 depending on the priority. The usefulness of this definition will be more transparent when we discuss the "need" variable below.

4.4.2 Actual

The variable is simply the actual number of soldiers, by skill level, at a given installation. This variable is incremented when an entity arrives at a location.

4.4.3 Gain

This is the number of soldiers "on orders" for a given installation, by skill level. When an entity is assigned a PCS Code, thereby designating a location to where that entity will move, this variable is incremented. When the entity is considered and arrival (thus incrementing the actual counter at a location) this variable is decremented.

4.4.4 Loss

This is obviously just the opposite of a gain variable. When an entity is assigned a PCS Code, this variable is incremented as a loss at that location. Upon arrival a the new location, this variable is decremented.

4.4.5 Need

This is where all the variables come together to calculate a unit's "need" for a new soldier. The formula we use is simple: NEED = TARGET - ACTUAL - GAIN + LOSS. We calculate this for each skill level and each location. For example, the calculation of Fort Hood's need of skill level 1 soldiers is: HOOD_NEED1 = HOOD_TGT1 - HOOD_ACT1 - HOOD_GAIN1 + HOOD_LOSS1. Based on this calculation, a high priority unit would have a higher need even when its actual strength (measured against authorized) is higher than that of a low priority unit.

4.5 Processing

As we stated before, there are three "blocks" of processing in each location, Administrative, Orders, and Movement. When an entity arrives at a given location, the processing first increments the "actual" variable and decrements the "gain" variable for that location. A new "overall actual" value for that location is then calculated.

Once we have updated the variables properly, the entity enters a DO/UNTIL Loop. The entity remains in this loop until it is assigned a PCS_CODE of 1 (leave the system, or ETS) or its TTM = 0.

4.5.1 Administrative Processing

During any given month, a soldier either attrites, is promoted, demoted, or is continued at the same skill level another month. The rate at which soldiers in a given skill level and MOS complete one of these actions in a given month varies wildly depending on numerous factors. To simplify our calculations, we used parameters used in the Enlisted Loss Inventory Model, or ELIM. This is a widely recognized model with the personnel community. This model calculates a thirty-six month weighted average to compute rates for attritions, promotions and demotions by skill level and MOS. These values are given as deterministic parameters. We replicate the randomness of this process by generating a random number and comparing it to a "yardstick". This yardstick varies from 0 to 1. Within this yardstick are "bands" for attrition, promotion, demotion, and continuation as seen in the figure below:

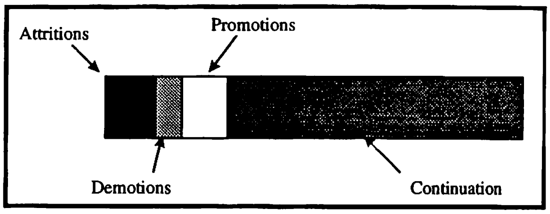

Figure 2: Personnel Action Bar

The model then compares the random value generated against this yardstick and depending on where it "lands", the appropriate personnel action is taken on the entity. For a promotion, the skill level is incremented and it is decremented for a demotion. In the case of an attrition, the entity is assigned a PCS_CODE = 1 and then leaves the system. This process of generating a new random number and then comparing a random number against a yardstick every time increment could allow an entity to be promoted one month, promoted the next month, demoted the next month, promoted again the net and then finally attrited (or any combination). This may not seem realistic for a given soldier. We are not concerned with this because though we are tracking individual entities, we are only interested in information from the aggregate. The individual promotions, demotions and attritions are unimportant to our analysis. We are merely interested in the fact that in a given installation, for a given month, for a given skill level and MOS, "roughly" a certain percentage will fall into various administrative actions. Refer to Annex B for the processing code in this block.

4.5.2 Orders Assignment Processing

Embedded with the Administrative Processing code is the Orders Assignment Processing. In the Army, when a soldier reaches a certain Time on Station (TOS) "threshold", an assignment manager begins to look at that soldier for reassignment. The trigger mechanism is different depending on the type of assignment or the location of the assignment. For example, if a soldier is assigned to Germany, an assignment manager will look for that soldier to redeploy based solely on that soldier's TOS, regardless of the readiness of his or her current unit or other units. The same can be said for most TDA assignments. These assignments last two or three years generally depending on the type of assignment. When those two or three years are over, the soldier moves to a new location. Again, the reassignment trigger is TOS.

For a soldier in a CONUS TOE unit, however, there is more involved. These soldiers will generally stay on station at least 24 months prior to being allowed to be reassigned elsewhere. Once this soldier attains that TOS threshold, he or she can be reassigned if there is a greater need elsewhere. In the case of moving the soldier to another CONUS TOE unit (thus generating an Operational move), this need must be much greater.

We attempted to account for these realities in our model. Once an entity reaches a given TOS threshold, it enters the orders processing block. Once in this block, the need for a given location is calculated for the given skill level. We do a pair-wise comparison and calculate the MAX NEED. This is the location with the greatest need for this skill level entity. For a OCONUS or a TDA location, the soldier is then assigned a PCS_CODE corresponding to the location with the greatest need. In the case of a CONUS TOE unit, the need at the MAX NEED location must be significantly greater than that at the current location. If it is just slightly greater, there is not need to move the soldier immediately. In this case, the entity is assigned a PCS_CODE of -1 (not on orders) and continues back to the administrative block for processing the next month with a higher TOS.

After an entity is assigned a PCS_CODE >1, the process then calculates the Time to Move (TTM) for the entity. AS the MAX NEED increases, the TTM decreases in a step-wise manner. If the MAX NEED is high, the entity will move in two months. If the need is low, the entity will move in six or more months.

In our simulation, we also must account for a soldier electing to remain at an overseas location for another tour. This is termed a Consecutive Overseas Tour (COT). For example, a soldier in Germany can request to have another 36 month tour immediately after his initial 36 month tour is completed. A soldier can request waivers to reduce the length of either the initial or subsequent tour. With these waivers, the overall tour length could vary from 48 months to 72 months. Under another program, soldiers can also extend their tours beyond the regular 36 months for months ranging from 2 to 24. We account for this in the model by again comparing the random number generated in the administrative block with a COT rate. [Black, Jul 96] Once an entity "accepts" a COT, his TOS is adjusted based on a distribution to reflect the variability in the length of the extension or new tour length.

After the entity is assigned a PCS_CODE and a TTM, it returns to the administrative block and continues to be compared to be attrited, promoted, demoted or continued. The TTM is decremented every month in this block. Upon reaching zero, the soldier moves to the movement processing.

4.5.3 Movement Processing

We liken the movement of entities around the simulation to a monorail system. After leaving the location processing, the simulation analyzes the PCS_CODE attribute of the entity. The entity is then moved to the location alluded to by this attribute. Prior to movement, the PCS_CODE is reset to -1, the TTM is reset to -1, The TOS is reset to 0, and the "actual" and "loss" variables for that skill level at the location are decremented. If the movement is between two CONUS TOE locations or a CONUS TOE and a CONUS TDA location, the move is an operational move. In this instance, the OPER_MOVE variable is incremented. Finally, the entity is told to wait either one (for a move between CONUS units) or two (for a move overseas) time increments to make the move.

4.6 Arrivals

Entities arrive to the system in only one location: Fort Bliss AIT. We do not manage the arrivals or the processing at this location. This model is not interested in recruiting rates or retention rates at Basic or AIT. Each entity which arrives at the AIT location, moves to the unit with the greatest need for skill level one soldiers immediately. We establish the arrivals at this location to correspond with the AIT graduation rates we received from the ELIM output [Hersh, 1995]. These rates can be modified once the interface of the model has been established to fully validate the model.

5 VERIFICATION OF THE MODEL

We have run the model a number of times under various initial conditions. The model seems to run well. Entities are being promoted as shown in the figure below. In this figure, the lines represent the actual number of soldiers, by skill level at Fort Bliss at a given time. Note that the time scale along the x-axis is in hours. This simulation package does not allow "months" as a time increment. We used minutes to represent months. Therefore, one hour of simulation time would equal 60 months of "real" time. As you can see, soldiers are being promoted and are attriting and/or moving out of the location. This is a graph taken directly from the ProModel® statistics package.

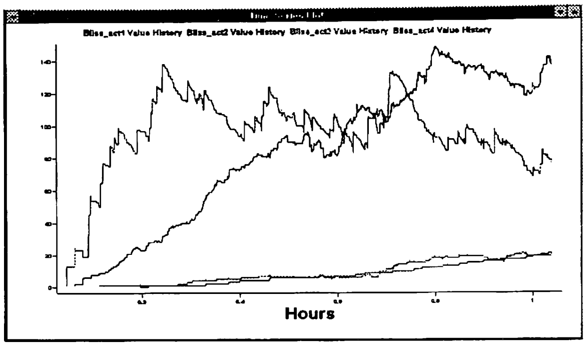

Figure 3: Simulation Output Graph of Fort Bliss by SL

Figure 4, below, shows the number of soldiers at the different locations. Note that these numbers begin to level out after about 30 months. This shows that the system is stabilizing. This verifies that the model is operating as we intended and should continue to do so when we modify the initial conditions.

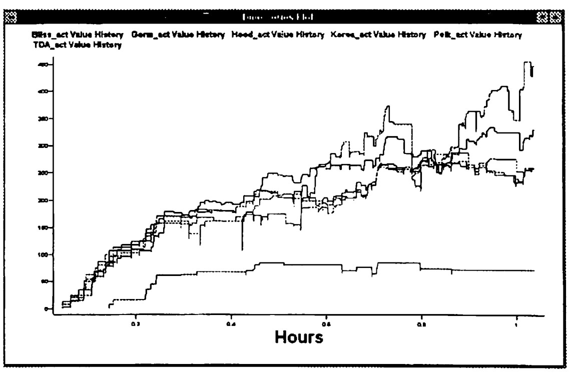

Figure 4: Simulation Output Graph for all Locations

6 VALIDATION AND FUTURE DEVELOPMENT

In order to fully validate the model we must begin with realistic numbers and other data. A front-end interface with the Enlisted Master File must be developed to do this. This should be an easy step for an individual with access to the database and programming skills. The database must be queried and sorted into 16T soldiers. The programmer must then modify this data so that it is in the format required by ProModel. For example, for each soldier with a Fort Bliss Unit Identifier Code (UIC), assign the entity with a 2 in the Location column.

Once this interface is established, we must modify the rates, the TOS thresholds and the TTM values to obtain realistic annual operational move numbers. We should also see the correct number of promotions, demotions and attritions. Since the model seems to be operating correctly, the only modifications should be in these rates. Once fully validated, the model can be used in analysis, but only for 16T MOS.

In order to use this simulation for evaluation of PCS policies for the entire Army, the model should be expanded to include all MOSs. On the surface this seems an easy task. To expand to different MOSs, simply assign another attribute to each entity delineating that entities MOS. The problem becomes computational. The sheer number of soldiers in the Army requires that some aggregation be done in order to expand this model. The question becomes: what do you aggregate? As you aggregate, you lose some resolution in the model. This will be a problem. The use of ProModel exacerbates the problem. ProModel is an easy-to-use, visual simulation package. The problem is that it requires a great deal of memory to use the animation and the other features of the package. A user might be able to do less aggregation with a different simulation package.

7 USE OF THE MODEL IN ANALYSIS

This simulation was designed to assist a personnel manager, or analyst, in determining the effect of changing TOS policies on the number of moves and level of readiness of a unit. After modifying the TOS thresholds to reflect the policy recommendation, a user simply runs the simulation. The simulation will track the number of operational moves required under this new policy. The user can then compare the number of moves under the current policy with the number under the proposed policy.

The user can also view the impact of the policy on readiness of a unit. After running the simulation, the user views the statistics from the run. By analyzing the graphs, (which is extremely simple to create in ProModel®), a user can see where the drops are in units readiness, how deep these drops are and how long the system will take to recover completely.

For example, suppose a decision maker recommends a policy which increases the tour lengths in Germany from 36 to 42 months. An analyst would first run the model under the current 36 month TOS policy and obtain the baseline results. Then the analyst would re-run the model after changing the TOS threshold for Germany. The analyst would simply have to compare the results of the two runs to determine the impacts of such a policy. One would expect that this would initially increase the number of operational moves because soldiers would not return from overseas on their "projected" rotation cycle. There may also be a noticeable drop in readiness of CONUS units. The analyst could easily show a decision maker (using the graphs in the ProModel® statistics package) the effects of this policy after one, two or five years.

8 CONCLUSIONS

This proof of principle is a worthwhile analysis tool for analyzing PCS policies for 16Ts. There is a long way to go, however, to make it a worthwhile analysis tool for the entire Army's personnel picture. Due to the modular design approach, this job will be considerably easier. The size of the model will be a problem but should not stall efforts to expand this model. In this time of ever-reducing budgets and personnel drawdowns, personnel managers need better analysis tools to provide meaningful answers to decision makers. This is a first step in that direction. It should not be the last. This project, or a similar effort, should be expanded to include all Army MOSs. We can no longer afford to analyze policies *after* we implement them.

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REFERENCES

Adelsberger, Bernard, *Troop budget needs fixing*, Army Times, Dec 4, 95

Army Training Requirements and Resources System (ATRRS) Selected Actual Summaries run, 16T FY94-96 Actual Grads, 27 Mar 96.

Bonder, Seth, *Impact of the New Global Environment on US National Security Planning - Challenges to the OR Community*, International Transactions in Operational Research Vol. 1, No. 1, Mar 94.

Costello, John, Major General, State of the Air Defense Artillery, slides from briefing to faculty, USMA, 5 Mar 96.

General Research Corporation (GRC), *Military Occupational Specialty Level System (MOSLS) Advanced Training Course*, course packet, 13 Mar 96.

Hersh, Doug, Office of the Deputy Chief of Staff, Personnel, unpublished message on Army Enlisted End-Strength data, 28 Sep 95.

Hix, Mike, *Assignment Stability: An In-Progress Review*, RAND briefing, 28 September 1995.

Interview with General Dennis Reimer, Army Chief of Staff on Nov 21, 1995, Army Times, Dec 4, 95.

Kwinn, B.T., Muhammad, A., *Continuous Time Simulation Approach to Developing US Army Enlisted Personnel Policy*, work in progress, submitted for 1996 MORS Conference.

McGinnis, M. L., Kays, J. L., and Slaten, Pamela, *Computer Simulation of US Army Officer Professional Development*, Winter Simulation Conference Proceedings, Dec 1994.

McGinnis, M. L., and Fernandez, E., *Initial Entry Training for the United States Army: Optimal and Heuristic Scheduling Procedures*, IEEE Decision and Control Proceedings, 1995.

Operations Management Division, EPMD, PERSCOM *Assignment Nomination Subsystem*, Briefing Packet, 10 Oct 95.

Office of the Deputy Chief of Staff, Personnel, MOSEL run, 20 Oct 95.

Park, Chan S., *Contemporary Engineering Economics*, Third Edition, Addison-Weslsley Publishing Company, New York, May 1994.

Stover, E., Tucker, B. and Zopelis, J., briefing to MG James Costello, *Enlisted PCS Simulation Model*, 5 Mar 96.

Thorpe, Robert, *Enlisted Distribution Target Model*, Information Paper, Planning and Analysis Branch, EPMD, PERSCOM, Sep 1, 95.

AUTHOR BIOGRAPHY

MICHAEL J. KWINN, JR. is an Analyst in the Operations Research Center at the United States Military Academy (USMA) at West Point. He received a BS from USMA in 1984, and an MS in Systems Engineering from the University of Arizona. The University of Arizona has accepted him into their Ph.D. program. His research interests are personnel management systems and force structure analysis through the use of optimization and simulation models.

ROBERT G. PHELAN JR. is an Analyst in the Operations Research Center at the United States Military Academy (USMA), West Point, New York. He received a BS from the University of Notre Dame in Aerospace Engineering in 1982, an M.E. in Manufacturing Engineering from Boston University in 1984, an MBA from Boston University in 1993 and an MS in Systems Engineering from the University of Virginia in 1994. His current research interests are simulation of command and control systems and use of expert systems for resource scheduling.