Modeling for Strategy Design: Systems Thinking, Personnel Turbulence, and the US Coast Guard

Jennifer E. Dick O'Donnell
U.S. Coast Guard Research & Development Center
1082 Shennecossett Road, Groton, CT 06340-6096
TEL: 860.441.2741 FAX: 860.441.2792
EMAIL: jodonnell@rdc.uscg.mil

Abstract

Based on previous successes using systems thinking to investigate specific workforce problems, the U.S. Coast Guard decided to use the approach to analyze the interactions among the dynamic elements that comprise the total enlisted system. A team was created of researchers experienced in operations research, human resources and modeling, human resources personnel, master chiefs as subject matter experts and modelers experienced in systems thinking and military workforces. The Enlisted Workforce Turbulence Strategy Model will reproduce and simulate the interactions of the three major processes, training, advancement, and assignments, in the enlisted system to generate a mutual understanding among personnel policy-makers of how the enlisted system actually works. Steady-state equations model the flow of personnel through the enlisted system over time. The model is not intended to calculate explicit numerical results but rather as a strategic tool to assess impacts of personnel policies prior to implementation.

Keywords

military applications, personnel, enlisted workforce, U.S. Coast Guard, *ithink*

Introduction

In the mid 1990s, the US Coast Guard (CG) went through a period of downsizing its workforce. The result was a shortage of trained personnel to fulfill CG mission requirements. Despite an increase in recruiting in recent years, this shortage has persisted, exacerbated by a policy to hire personnel at the bottom and promote them through the ranks. The CG's personnel problems are most evident in its enlisted workforce. Unlike other branches of the military, the CG maintains widely dispersed, independent stations which are fully manned by enlisted personnel. Because of the small size of these stations, the gaps in experience and training between what is needed for mission readiness and what is available are extremely critical.

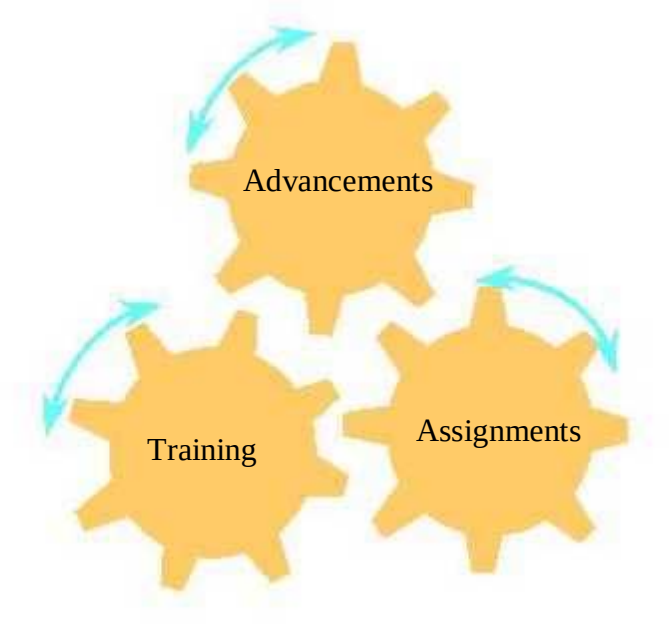
In the past, the CG has dealt with personnel problems in a piecemeal fashion. Specific problem areas were analyzed and addressed with little insight into the impact on the CG as a whole. Recently the CG used a systems thinking approach to analyze the problems concerning small,

well-focussed personnel situations. These efforts involved a small number of people in a specific area of specialty, stationed in a few geographical locations. The systems thinking approach enabled the CG to gain a better communal understanding of the system intricacies and has improved our ability to evaluate our options. Because of the success of this approach on managing these smaller, well-defined personnel situations, it was expected to have great value when applied to the rest of the workforce. Therefore, a systems thinking approach was used to model the enlisted workforce in an effort to help CG leadership and policy makers understand how the major processes of advancements, assignments and training interact to create problems within the enlisted workforce.

Problem Statement

The CG has recognized for some time that there are problems with our enlisted workforce. These problems have exhibited themselves in terms of lack of experience in the enlisted workforce, too much turnover, vacant billets, and claims of unfairness in the assignment process. For the past couple of years, there have been many initiatives and improvements to the enlisted system; the most visible of which has been increasing our recruiting and retention efforts, developing solutions to properly staff our newest cutters and restructuring the aviation workforce (Olsen, 2000). But the magnitude and complexity of the problems with the enlisted workforce demand an all-encompassing approach rather than our current method of addressing each situation individually.

The CG enlisted workforce is comprised of several dynamic elements. Some examples of these include: assignment policies, the advancement system, mission readiness, tour lengths, billets (job positions) and skills requirements, the role and size of the General Detail (basically slack in the system to allow for illness, permanent change of station, etc.), training and qualifications, temporary active duty deployments, and the relationship among different workforces (active duty, reserve, auxiliary, civilian). Although these elements function semi-autonomously, the performance of the enlisted system as a whole is determined by how efficiently these elements interact. Too often, these elements seem to be in conflict instead of working in concert to meet the needs of the service. Advancements, assignments and training are three major processes that often oppose one another. Each process tends to have its own direction and velocity without taking into account how it affects or is affected by the other two (you might think of this as each gear being driven by its own engine).



This misalignment reduces the performance of our system, as a whole, and leads to undesirable consequences such as lower than optimal time in grade before advancement that frequently leads to reassignment and excessive training with minimal return on investment. Individual improvements to any of these elements, without consideration of the effects on the other two, may actually worsen the overall system. Because of the complexity of the enlisted system, the CG does not adequately understand the interactions of these various components, and therefore we are hampered in our efforts to create policies to best shape and manage the enlisted workforce for the 21st century.

In addition to our lack of understanding of the ways these processes interact, there are many hypotheses as to what factors may cause problems in the enlisted workforce and how we might address them. Unfortunately, the CG did not have a way to test the hypotheses. Systems thinking provided a mechanism through which we could develop a general simulation model that allows policy makers to both understand the system and its dynamics and to generate "what-if" scenarios to ascertain long and short-term impacts to the system based on those dynamics.

Background

The origins of the CG's recent personnel problems can be traced to the early 1990s. Between 1992 and 1996, the number of enlisted billets dropped steadily from about 31,000 to 27,000, a loss of over 12%. Budget forecasts indicated a continuing decrease or at least no growth in the number of billets following this period, which the CG refers to as Streamlining. However, workforce predictions underestimated our actual needs, and decisions based on those forecasts led to the workforce problems that the CG is currently experiencing (Olsen, 2000).

During Streamlining, the CG explored various means for reducing the workforce including not replacing losses due to attrition, offering early retirement incentives and reducing recruiting

goals. Unfortunately, the reduction plan focused on reducing the gross number of enlisted personnel as quickly and inexpensively as possible without taking into account the personnel requirements for mission readiness in each rating (area of specialty). Also by design, we greatly diminished our recruiting capability. Moreover, when we began rebuilding our recruiting efforts, the economy was thriving. Recruitment changed from selecting the most promising applicants to aggressively competing in a tight labor market.

The perceived change in the enlisted workforce exceeded the actual difference in personnel numbers before and after Streamlining. As you can see in Figure 1, the strength of our enlisted workforce has been steadily increasing since 1997, so that presently it nearly equals the number of billets. What this figure doesn't show is the changes in the experience level of that workforce. Figure 2 and Figure 3 show the enlisted workforce broken down into Petty Officers (PO) and non-rates (E1s to E3s, including enlisted personnel in boot camp). While the PO strength has decreased with respect to the number of PO billets, the number of non-rates has increased. This can be seen even more dramatically in Figure 4 which shows the percentage of filled billets. Although nearly 100% of the enlisted billets are filled, Figure 4 displays the reduction in the level of workforce experience. This places a greater training demand on the more senior personnel and necessitates missions to be completed with less experienced personnel using procedures and expectations based on a more experienced workforce. As Streamlining ended and recruitment efforts closed the gap between workforce strength and billets using more junior personnel, the workforce has had to adjust not only to changes in numbers but also to changes in its capability.

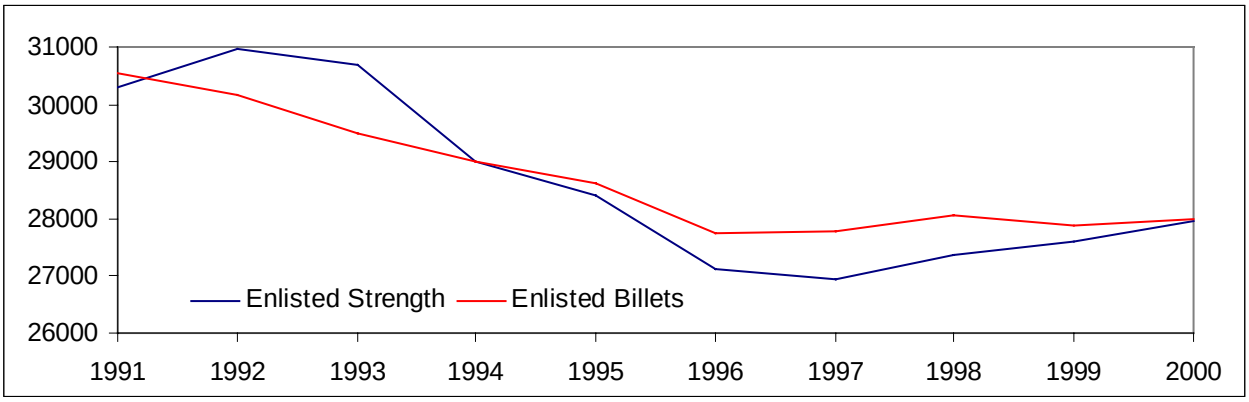


Figure 1. Comparison of the size of the total enlisted workforce with the number of allocated billets.

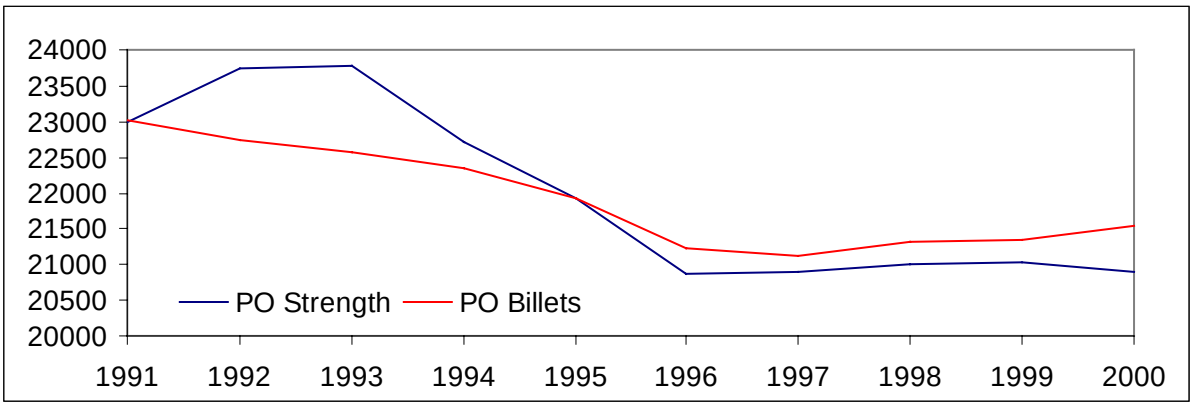


Figure 2. Comparison of the number of Petty Officers (PO) with PO billets.

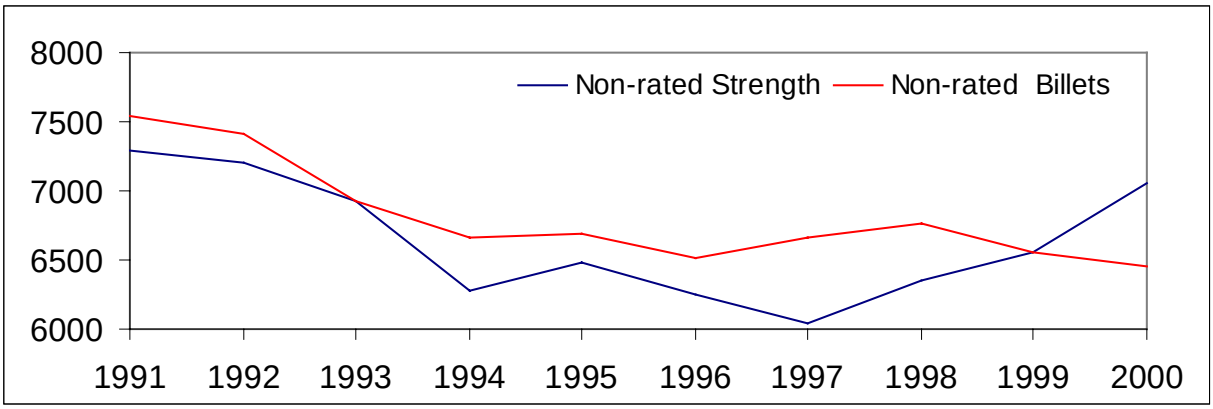


Figure 3. Comparison of the number of non-rates (E1-E3) with non-rate billets.

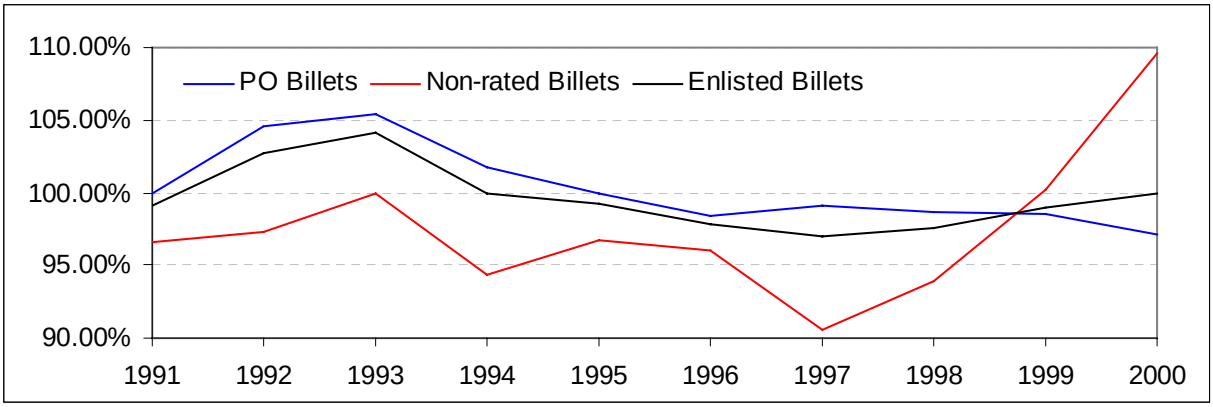


Figure 4. Percentage of filled billets for Petty Officers and non-rates.

The decreasing level of seniority shows itself in the increasing rate of turnover experienced by the enlisted workforce, the POs in particular. Most assignments in the CG are for two or three year tours. Therefore, in any given year, about one third to one half of the workforce is transferred. In addition to these anticipated transfers, personnel turnover results from promotions and attrition (losses due to personnel leaving the CG). In FY00 our total attrition was around 3000. So as well as filling over 6000 vacancies created by normal tour length completion, 3000

additional positions required personnel decisions. When the workforce is short and there are already vacancies, the CG is forced to decide which positions to leave vacant and for how long. We are also forced to speed up promotions to fill the more senior billets. Thus more junior people are not only expected, but also required to perform jobs that only recently required considerably more experience (Olsen, 2000). Advancing more junior personnel through the system creates a chain effect felt throughout the workforce. The end result is we are transferring an increasing percentage of our POs each year at a time when due to a variety of socioeconomic factors, there is more resistance to moving. There is even evidence that personnel may avoid promotion to reduce the possibility of a forced early transfer.

The shortage of experienced personnel has created problems in training. One problem is that in some ratings the differential between billets and personnel is so large that there are insufficient places in that rating's "A" school (where non-rates are trained in a particular rating or job specialty such as boatswain's mate or quartermaster) to close the gap. Another problem is that commands may be operating so short in experienced personnel that they can't afford to pull recently trained non-rates out of field billets.

The timing of the training of non-rates causes additional personnel problems. The current policy is to send non-rates to the field for at least four months immediately after completing boot camp. During this period, non-rates are trained to perform essential duties aboard ships and become contributing members of the crew. By the end of this period, these "experienced" non-rates are training newer non-rates and are eligible to apply to "A" school. The value of this to the non-rates is debatable. They may be able to make a more informed decision regarding their choice of rating, however, the rapid transfers from boot camp to ship to "A" school to new assignment may increase the turbulence in their personal lives. The impact to the field is less questionable. Immediately after training personnel to perform essential duties, the field loses this experience and must begin the training process again. This leaves the field in the position of constantly training new personnel, a particular hardship when the workforce is already experiencing shortages that may affect mission readiness.

While the CG faces many problems common to military organizations (recruiting, compensation, assignments in a world of dual-career families) some of these problems are magnified because of its small size, for example, sea versus shore rotations and vulnerability to loss of one individual. Unlike other branches of the military with personnel concentrated in a few places, the CG has numerous small stations, widely spaced, without much surplus in the workforce. The CG is unable to tap other commands to help close gaps and provide relief, so CG units must make due with what they have and not rely on outside help. Therefore, shortages in capability or talent are more challenging than in other branches of the military.

The CG also effectively has a closed manpower system. Like the other branches, the CG hires at the bottom. If more senior enlisted personnel are needed, the system must wait until individuals have sufficient time in service and have been promoted through the system. The CG also has to respond to changes in the number of billets, responsibilities and funding levels that may be part of congressional supplemental budgetary decisions and other consequences of the political process that are introduced at the last minute. All of these factors create tension in the system and

feed on each other in a vicious cycle, leading to the "turbulence" that the CG is now experiencing.

Model Development Process

Senior CG personnel had long been aware of problems within the enlisted workforce, but lacked a means of evaluating the situation. Recent efforts that used systems thinking to investigate specific workforce problems convinced senior personnel in the Human Resources Directorate that it would be a useful tool in attacking the total enlisted workforce problems. The Director of CG Human Resources approached the CG Research and Development (R&D) Center to discuss perceived "turbulence" in the enlisted workforce, and requested the R&D Center's assistance in creating a model to enable decision-makers to assess impacts of personnel policies prior to implementation. An anticipated outcome of the model development was insight and mutual understanding among personnel policy-makers of how the enlisted personnel system actually worked. It was believed that this "insight" would be gained by bringing CG personnel decision-makers together to discuss this "turbulence" and how their respective pieces of the personnel puzzle work and interact.

Thus, the R&D Center was presented with a vague problem statement and a short time frame in which to solve this problem, especially since the CG is a military organization. As the Director of Human Resources was scheduled to transfer to a new position within a year of the project initiation, he wanted a fully implemented end product in about six months. The Director's initial expectations for the project were low. He felt that CG Human Resources did not have a strong feel for the scope of the project. Given a problem statement of moderately narrow focus and working with a modeling contractor, the R&D Center felt we could create a timely model of a rate specific personnel system.

To address the "turbulence" problem, the CG put together a two layer team consisting of researchers experienced in operations research, human resources and modeling from the R&D Center, members of the Workforce Forecasting and Analysis Staff (G-WP-1) from CG Headquarters, master chiefs to serve as subject matter experts (SMEs) and modeling contractors experienced in systems thinking and the unique concerns of military workforces. The first layer was the senior level of the CG Personnel Command and the Human Resources Directorate, captains and admirals, who were the stakeholders of the problem. The Human Resources Directorate will end up "owning" the model and is striving to build a capability in this area. The second layer were SMEs: individuals most knowledgeable in key CG human resources processes such as advancement, assignment (relocation), training (movement through the system, not course content), accession and selection into specialty, staffing standards, and general detail. We also selected people who had the best insights into losses and loss types, general policies that create the constraints in our system (such as reassignment on advancement, tour length policies and their effects on both assignments and potential attrition, qualifications at the unit end, etc.).

Fifteen CG SME's in training, assignments, and advancements worked with the R&D Center staff and the contractor to establish the skeletal structure of the model and identify the logic of the enlisted personnel process. From that team we extracted a general problem statement and

lists of the variables involved and the behavior of those variables over time. Table 1 lists the participants and their functions on the team.

Table 1. Participants and responsibilities.

Key Stakeholder	Role	Indicators of commitment/barriers
Workforce Forecasting & Analysis	**Sponsor.**	*Commitment:* Flag-level support with 2 senior GS level participants, 2 Captains, and 1 Lt. Commander level participants. Coordinated meetings with detailers and force/ratings managers for effort.
Personnel Command	**User.** Insight received into assignments and detailing process will be used during assignment cycles.	*Commitment:* Participation of Enlisted Assignments Branch Chief. Participation of Enlisted Advancements Branch Chief
Reserve, Training & Leadership	**User.** Insight received will impact existing policies such as sending boot camp graduates to a first unit prior to having them attend an "A" school.	*Commitment:* Participation of Training Policy Branch Chief and Training Programs Assessment Branch Chief
Force Managers	**User.** Holistic understanding of each of the ratings will provide these senior enlisted members the ability to focus on long term health of their respective rating.	*Commitment:* Participation of machinist mate, yeoman, boatswain mate, and electronics technician force/rating managers.
Office of Human Resources Planning and Financial Management	**User.** Insight gained can provide ability to prototype policy changes including tour length concerns, and advancement/ assignment issues.	*Commitment:* Participation of Human Resources Planning Division Chief. Intent to use model as critical portion of assessing Future Force 21 recommendations.

A third component of our team was a Washington DC-based contractor with facilitation and system dynamics abilities. We particularly wanted a Washington-based firm for ease of meetings and to reduce travel costs. The firm contracted has a strong Systems Dynamic background and a relationship with *ithink* software makers (High Performance Systems, Inc.). Additionally, the selected modeling contractors have a background in military personnel issues (one was Enlisted Force Manager for the U.S. Navy and another person was involved in military personnel commands for the U.S. Army).

While part of the team was involved with identifying and hiring the contractor to assist us with the development of the model, the rest of the team used this period to clarify the problem statement and create a statement of work. The first task was to define "turbulence" as it relates to the CG enlisted workforce. Although "turbulence" initially appears to be a nebulous term, the SMEs agreed quickly on a definition: "the undesirable rate of movement through the advancement and assignment processes."

The next step was to determine the scope of the project. The fundamental task was to reach a common understanding of the causes and potential strategies for ameliorating turbulence

problems. However, the enlisted workforce consists of 22 separate ratings, each with unique characteristics in their assignments, advancements and training procedures. In an effort to make the project more manageable, particularly in light of the time constraint, our initial assessment was to consider a single rating which exhibited all the same dynamics we would see in the enlisted force as a whole.

The team had been charged with the development of a model that would provide “insight” on the enlisted personnel system. Thus, considerable time was spent determining what the sponsor envisioned as a final product. The team initially considered four variables as controlling the level of “turbulence”: training, assignments, advancement, and quality of life. Later it was determined that while quality of life may certainly be a driver, it would most likely be taken care of in other drivers, particularly as an assignment consideration, and therefore did not warrant a separate concern. The group further determined that our systems (assignment, advancement, training, recruiting, etc.) were not "timed" correctly. Each system has its own cycle uncoordinated with the other systems, creating the turbulence felt within the system.

The team also discussed how it would verify and validate the model. The team had to establish a reference behavior pattern and determine the time period representative of our current personnel problems. Potential measurements related to the phenomenon were identified: percent people qualified at unit (and time to payback the investment in qualifying), experience level (defined as time on task, time at unit or time in billet) and factors dealing with age or time in service of the force (tour lengths, policy versus actual; turnover; number of transfers). In general, the team thought that variables such as experience and percent people qualified were decreasing at a steady rate while variables that caused the decrease (turnover, number of permanent change of station transfers) were steadily increasing.

A kick-off meeting was held once the modeling contractors had been hired. During this meeting, the SMEs were introduced to the basics of systems thinking and the modelers were given an overview of the processes comprising the CG enlisted workforce. This meeting culminated in a rough map of the key enlisted processes. The SMEs provided suggestions of variables (i.e. number of billets, Selective Re-enlistment Bonuses (SRB) levels, change present structure to Apprentice-Journeyman-Master) that they would like to be able to manipulate in the model. Once the generic model was working, these suggestions were reviewed to see which ones were already captured in the model and what might need to be added.

Early in the development process, a combination of factors expanded the project from the analysis of one rating to the entire enlisted force. The sponsor strongly desired a review of the entire force and the contractor had the capability to meet this requirement within the time allotted. This expansion led senior management to conceive that it was possible to extend this effort to the officer corps as well. The integration of the other 20 enlisted ratings into the model had involved minor changes in the modeling of training, assignment and advancement interaction. The officer corps was not a simple extension of the enlisted system, however, and would have required major changes to the model. While this extension may be possible in the future, the scope of this project was constrained to ensure that our deadline was met with the product and quality desired.

Two weeks after the kick off meeting, a generic model that focused on the E6-E7 (specific enlisted ranks) portion was presented to the team. Using a small section of the larger model allowed the modelers to explain and demonstrate the generic structures and the modeling approach to be used in the total workforce version. This meeting provided an opportunity to revise the interactions among the processes and resulted in a revised model structure and interface. Once approval and feedback were obtained from the SMEs, the model was expanded to incorporate the entire enlisted workforce, E1-E9. A skeletal version of the total enlisted model was presented to the modeling team about a month after the kick-off meeting. This version had order of magnitude numbers but had not yet been populated with actual data. At this meeting, the technical team experimented with the model by exploring policies to confirm that the model responded appropriately when changes were made to a factor. This effort also increased confidence that the model would ultimately be useful in evaluating options to reduce the turbulence the enlisted workforce is experiencing. The SMEs observed how the model reacted to various inputs and that it produced results that were consistent with their expectations.

The Enlisted Workforce Turbulence Strategy Model will be employed to reproduce and simulate the interactions of the three major processes to explain and generate a shared understanding of the operation of the CG enlisted personnel system at a macro level. It uses steady state equations to model the flow of personnel through the enlisted system over a period of years. The model is not intended to be used as a predictive tool but rather as a strategic tool to provide insight on the consequences of personnel policy on the direction and magnitude of changes to key indicators compared to a baseline over time. The model will be used to help identify what policies or actions may be generating turbulence and what actions can be taken to decrease turbulence.

The end product will be a fully functioning model that simulates the processes of training, advancement, and assignments within the enlisted workforce. Additionally, this model is outfitted with variables that show the expected outcomes of personnel policy changes based on the interactions of the three driving systems (for instance, if Time in Grade requirements are changed, what impact would that have on training needs and assignments). All members of the CG Human Resource Directorate have advanced degrees in Operations Research and are accustomed to using modeling capabilities to solve problems. Additionally, a “run enabled” model will be given to the ratings force managers, Personnel Command (where day to day personnel actions are taken), and other stakeholders to allow them to run the model and make adjustments to the parameters using the installed levers to see the long-term (20 year) impacts of recommended policy changes.

Sample Model Structure

The Enlisted Workforce Turbulence Strategy Model is fundamentally an accounting system for tracking the progression of enlisted personnel through the advancement, assignment and training processes. The model focuses on the interactions among these three major processes. In the advancement process, the key indicator of turbulence within the system is the average Time-in-grade (TIG) for each paygrade, E1-E9. An average TIG that is too low indicates personnel are advancing too quickly and not gaining enough experience to adequately perform the requirements of the next higher paygrade. Conversely, an average TIG that is too high may indicate that the force is stagnating and advancement opportunity will be too low to retain enough quality personnel. The model allows the user to vary parameters such as the starting

inventories of each paygrade, the minimum TIG to advance to the next paygrade and additional constraints to limit the population that can advance to the next higher paygrade, by paygrade (Frank, 2001). Through the use of a graphical function, the user will be able to adjust the billet structure for each paygrade over the length of the simulation enabling CG policy makers to explore alternative personnel scenarios; a vital capability for any organization subject to congressional funding.

The key indicator of turbulence in the assignment process is the average time-in-assignment by paygrade, which is referred to as the average time-on-station (TOS). Since most assignment actions force a permanent change of station (PCS) transfer, an average TOS that is well below published tour lengths indicates personnel are moving too frequently. So, the goal is to determine what actions can drive the average TOS toward the published tour lengths, reducing annual PCS moves and the overall number of new assignments. Within this process, the user is able to adjust the published tour lengths that serve as the reference point for comparisons to the average TOS, and set the fraction of assignments (by paygrade) that generate an assignment action (Frank, 2001).

In the training process, the key indicator is the ratio of the total number in training to the total training capacity. Boot camp and A-school requirements take precedence over C-school (advanced training for E4s-E7s) requirements. However, many assignments require that personnel undergo pipeline training (required training that must be completed prior to starting new position) for specialized equipment or tasks. If the available training capacity is low, many of the newly assigned personnel will have to defer training to a later date when capacity is available. Deferring training means that personnel report to their new command without the proper training, negatively affecting the unit's mission and readiness. The model tracks the ability of the training process to meet the demand for training as a function of the total assignments generated by personnel moving through the system (Frank, 2001).

Figure 5 shows the model layer homepage for the Workforce Turbulence Strategy Simulator. This page clearly delineates the three major processes in the enlisted process. (Advancement & Hiring Logic are details in the Advancement Process.) A user interested in understanding or manipulating the model can go directly to the section of the model of interest. As an illustration of the model structure, we will examine the Advancement Process Main Chain for E6 and E7. From E1 to E4, the enlisted workforce is in a "push" mode. E1s start at boot camp and are pushed through the system, until they reach the E4 level. From E4 on up, the system "pulls." As higher ranks leave the system, either through promotion or attrition, lower ranks are "pulled" to fill the empty positions. Therefore, the E6 to E7 advancement process causes a chain reaction through the enlisted workforce. In a workforce short in experienced personnel, this ripple effect causes more frequent reassignments and transfers through the system, increasing the turbulence felt by individuals and the organization.

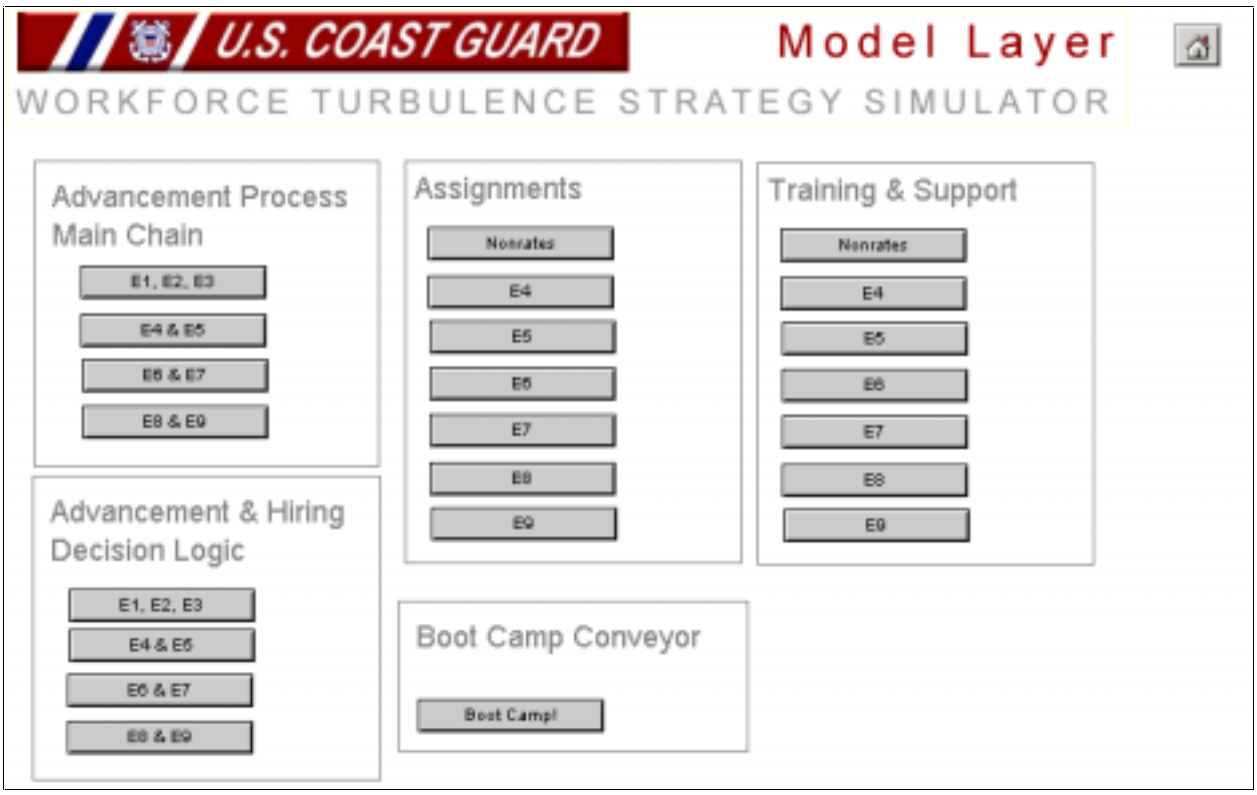


Figure 5. Home page for Enlisted Workforce Turbulence Strategy Model showing the three major processes. Advancement & Hiring Decision Logic and the Boot Camp Conveyor are represent details of the Advancement Process Main Chain and Training & Support, respectively.

The logic of the advancement process from E6 to E7 is shown in Figure 6. The stock of E6s is dependent upon five factors: the initial number of E6s, the flow of E5s promoted to E6s, the direct hire of E6s, the attrition of E6s and the advancement of E6s to E7s. If more detail is of interest, say in the advancing logic from E5 to E6, the user can examine the model structure of the Advancement & Decision Hiring Logic: E6 to E7 in more detail (see Figure 7). This section of the model allows the user to examine various methods for filling the gaps between desired and actual personnel levels in the E6 rank.

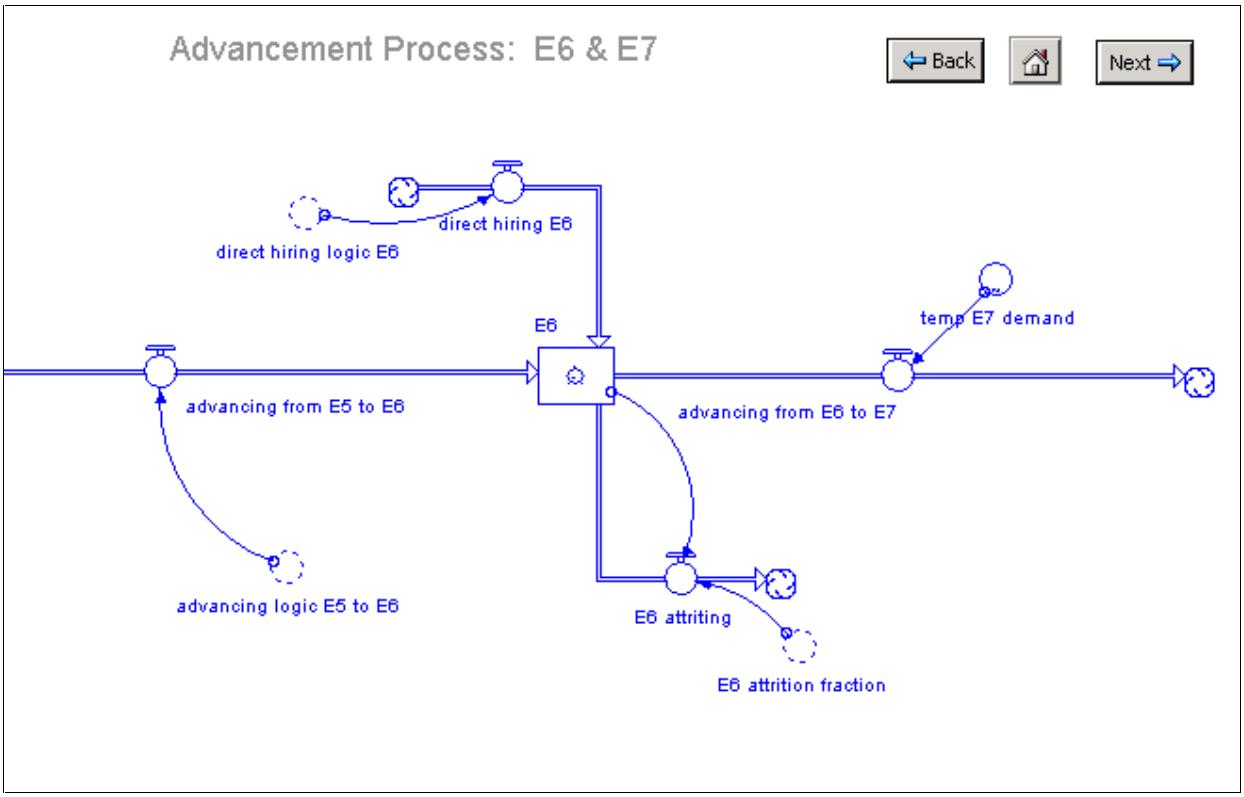


Figure 6. Section of the model showing the structure of the E6 to E7 advancement process.

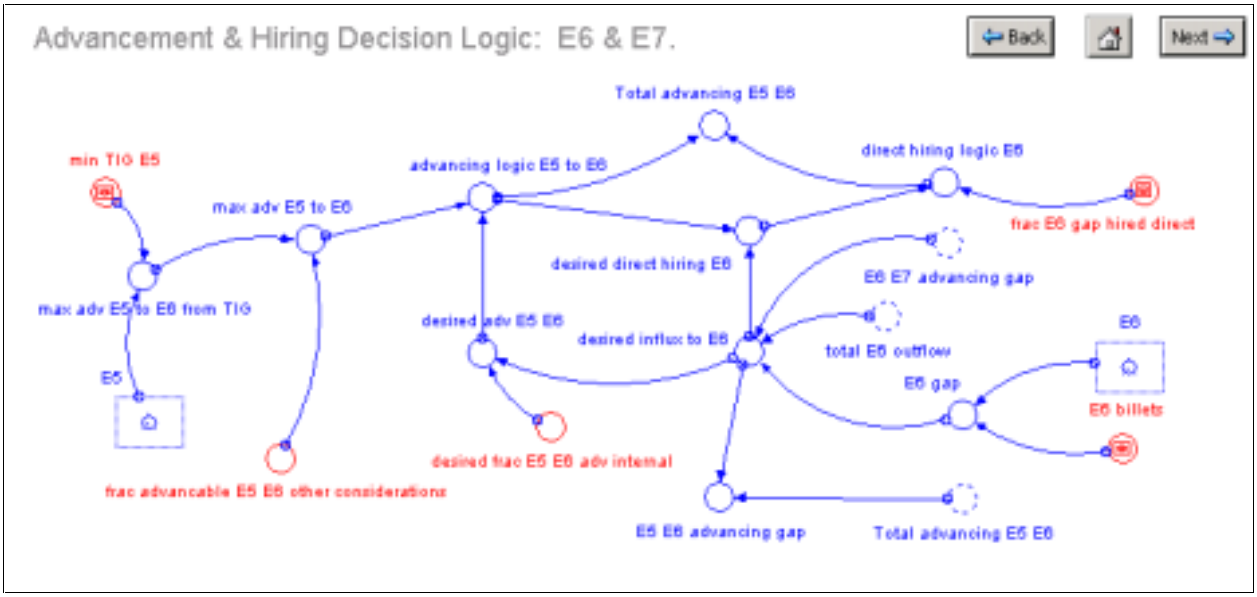


Figure 7. Detail of the Advancement Process Main Chain which represents the structure of the Advancing and Hiring Decision Logic for E5 to E6.

As the model is being run, the user can view the effects of policy decisions on the key indicators of turbulence in the enlisted workforce. The Enlisted Workforce Turbulence Strategy Simulator

user interface is designed as a flight simulator that allows the user to adjust the enlisted system by changing policies, parameters and scenarios (see Figure 8), through the use of sliders and graphical input devices, to explore the relationships among the processes. For instance,
Figure 9 illustrates how the user adjusts the initial headcount distribution. The interface graphically displays the key indicators (see
Figure 10) and uses comparative graphs to allow the results from various policy excursions to be compared to each other by paygrade.

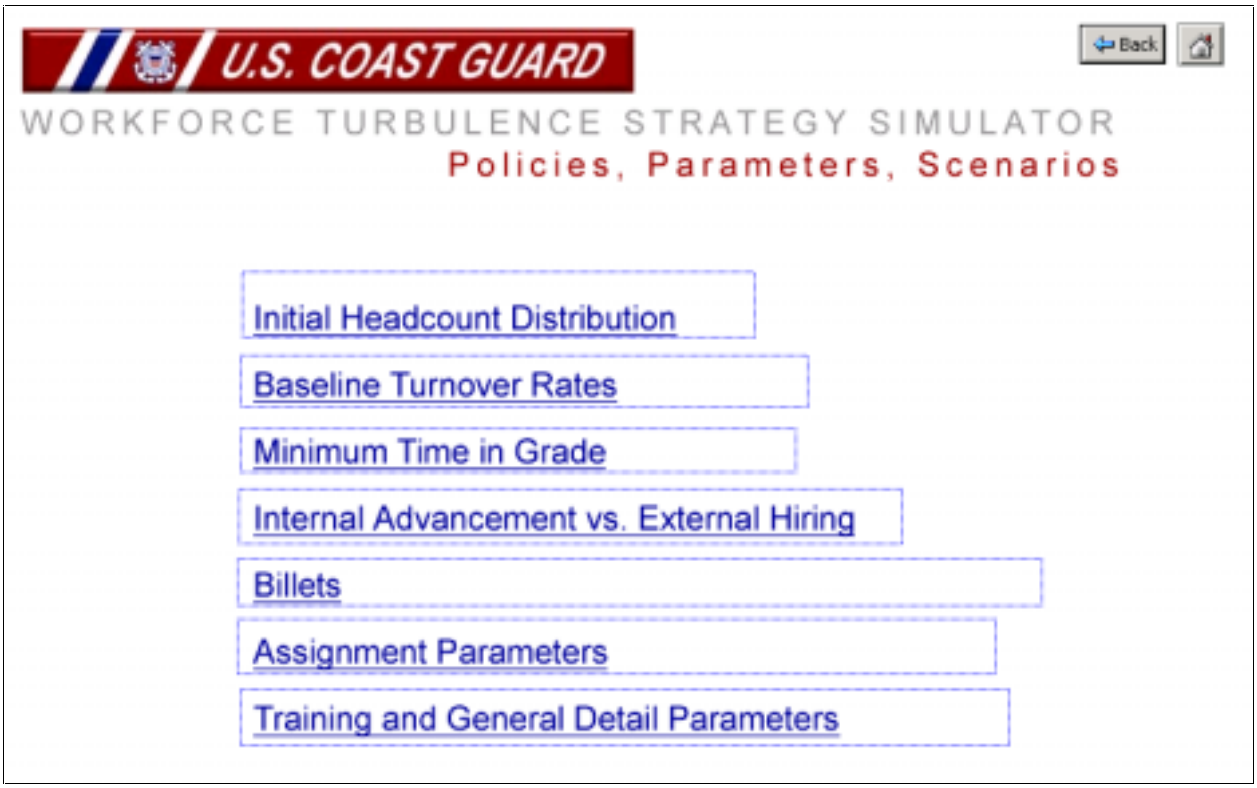


Figure 8. Home page for setting policies, parameters and scenarios.

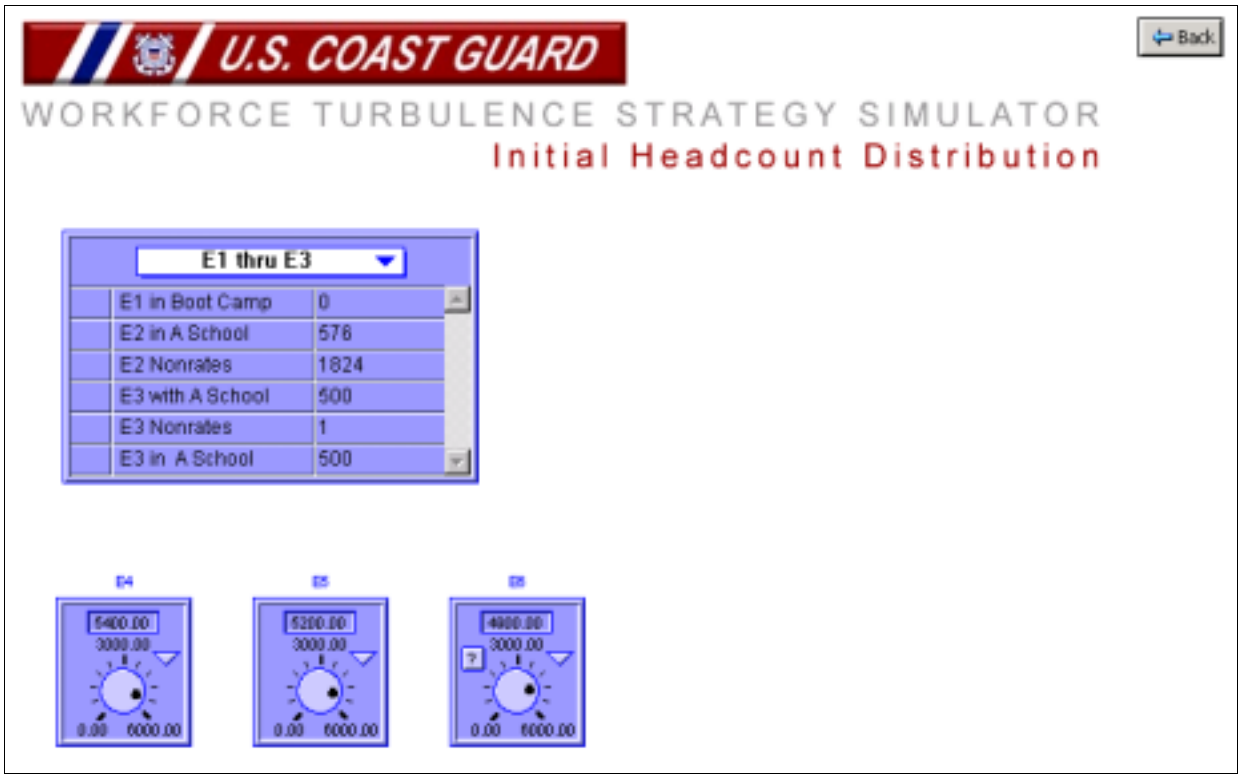


Figure 9. Section of the model where initial values for the enlisted workforce headcount by rank are set.

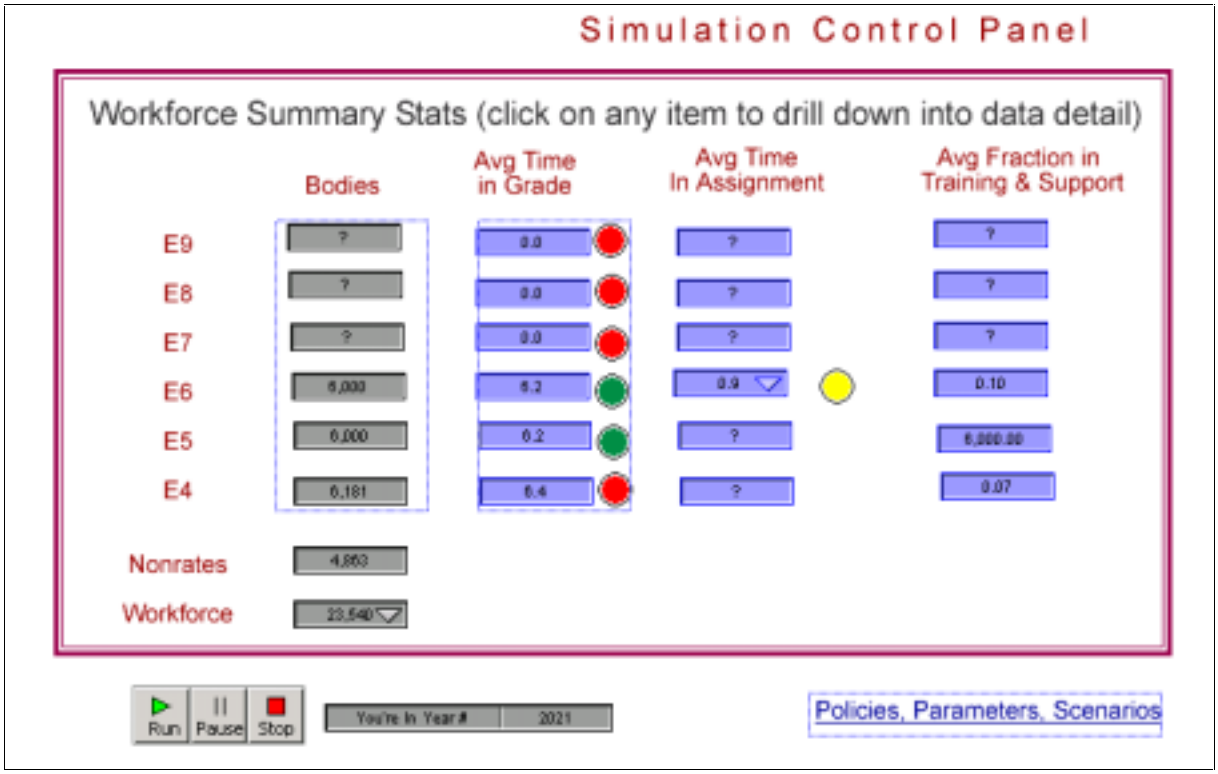


Figure 10. The simulation control panel provides information on measurement factors enabling analysis of impact of scenarios by rank over the predictive time frame of the model.

Mid-Course Commentary

At this point, the model is still in the development phase. We have not yet been able to use it as a strategy tool so there is little data to report. However, several observations are worth discussing.

This approach proved to be a very effective means to tackle such a complex personnel situation. The team the CG assembled was made up of officers with strategic planning skills and SMEs who are involved with the day-to-day operations of the enlisted personnel system. These two groups can have very different views of the same situation. By including both groups, we ensured that the resulting model would be mutually acceptable. Systems thinking provided a mechanism for the group to focus on a model-based discussion. Although members of the CG Human Resources Directorate had experience with system thinking and the *ithink* software, other members were new to these techniques. However, after a brief introduction to systems thinking concepts and the graphical methods of *ithink*, the team was prepared to address the problem. The software enabled them, as a group, to conceptualize the model. The stocks, flows, and feedback loops provided the organizing framework from which to discuss the enlisted workforce system. Without this sort of approach, it would have been very difficult to do, given the diverse people involved, yet it was the mix of players, the strategic planners and the operators, that have made this a success.

For a strategy model such as this to be successful, its structure must be clear and understandable to the user. This would have been unlikely if the team had been presented with a completed, functional model to evaluate. For the users to have confidence that the model correctly describes the enlisted personnel system, they had to be involved in its development. Another advantage to being involved in the conceptualization and development of the model was that the users were able to ensure that the end product meets their needs.

Stocks and flows form the basis of an incredibly powerful tool for talking about system structure and performance. People can pick it up via osmosis, and use it effectively with only a small amount of practice. Most of our SME had no formalized training in systems thinking, but did have considerable experience with systems drawings of engines, generators and hydraulics systems. They immediately understood the usefulness of using the systems thinking language of stocks and flows to describe the personnel system, and by using stocks and flows were able to articulate views which they had previously been unsuccessful in communicating to the group.

Stock and flow maps can be an excellent vehicle for focusing discussion. Unlike other modeling techniques where it can be difficult to follow the programmer's logic, the graphical representation of the model clearly communicates the model structure. When effort is taken to make the maps comprehensible, the discussions can focus on the problem and how accurately the model addresses it, rather than on understanding the modeling techniques used.

Lastly, we found that the most important attribute of the overall process was that it enabled a diverse group to discuss the enlisted workforce system in common terms. Rather than viewing the model as a product to be purchased from the contractor, the process of developing the model

became part of the product. Since the users were engaged in the process of developing and critiquing the model from the start, acceptance, and therefore, use of the model is more likely.

Conclusions

At this point, we consider the success of this approach rests on four factors. First, the team the CG assembled was fundamental to the project's success. By engaging all the stakeholders in the development process, strategic planners and operators, we increased the likelihood of the acceptance of the value of the model as a tool for addressing our personnel problems.

Second, the scope of the project was limited so that the end product could reasonably be achieved with the quality desired within the time constraint. Third, because the team had refined the problem statement and envisioned the final product prior to the arrival of the modelers, the modelers were presented with a much better defined problem to address. The CG was prepared to immediately respond to the modeler's needs to get the product completed in the shortest amount of time.

The final key to the success of the project was the contractor's background. The contractor was familiar with a military personnel system and experienced in systems thinking and *ithink*, the software package that the Human Resources Directorate knew. Because of his military experience, the contractor could speak the SME's language and they felt comfortable with him. This is particularly important in the military, a unique, cohesive group that needed someone that they felt could relate to and understand their situation. A contractor with little understanding of the military, their language and their particular concerns, would lack credibility with this group. That's not to say that the project would not have been success, it just would not have been as successful, nor would the tool be so well received by the users.

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