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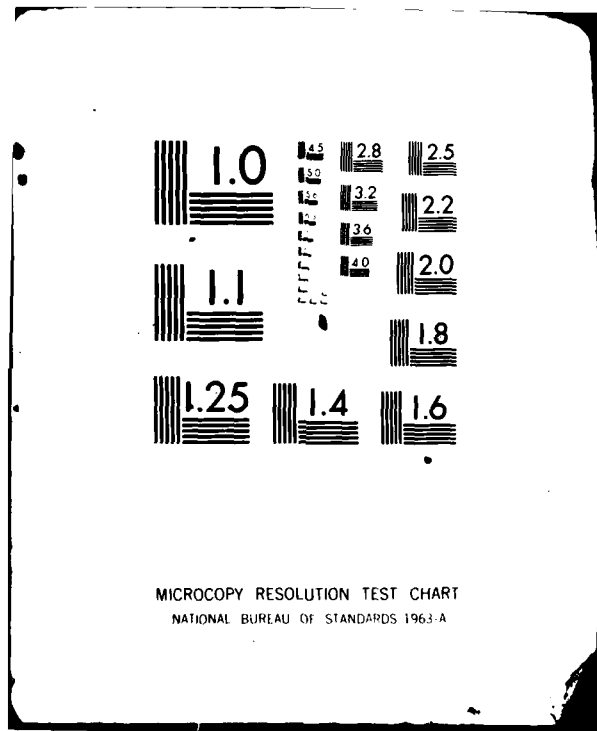
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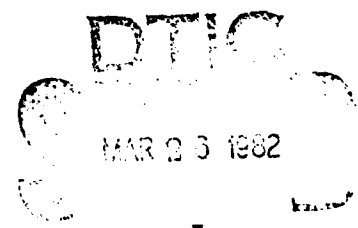
# PROJECTING THE NAVY ENLISTED FORCE LEVEL

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# PROJECTING THE NAVY ENLISTED FORCE LEVEL

Matthew S. Goldberg

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# PROJECTING THE NAVY ENLISTED FORCE LEVEL

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## Introduction

Compensation managers must be able to project the effects of alternative compensation packages in order to compare the desirability of these packages. For this reason, several models have been developed to project the size and composition of the military enlisted force as a function of military compensation and other variables. The most widely used of the current generation of projection models is the Annualized Cost of Leaving (ACOL) model, developed by John Warner at the Center for Naval Analyses. This paper assesses the accuracy of the ACOL model projections for the Navy over the period FY 78-FY 80. Although the model's projections are found to be quite accurate, several modifications are introduced which improve its accuracy still further.<sup>1</sup>

## Mechanics of the ACOL Model

The key variable in the ACOL model is the Annualized Cost of Leaving, or ACOL. This variable is defined as the annualized arithmetic difference between the pay that an individual would receive by staying in the military and the pay that he would receive by leaving the military. In computing the value of military pay, we include sea pay, Variable Housing Allowances, and reenlistment bonuses as well as Regular Military Compensation. In addition, we include the discounted value of military retirement pay.

The model computes the set of ACOL values by length-of-service that would result from any pay proposal. These ACOL values are transformed into projected reenlistment rates by means of a logistic supply equation, whose parameters have been estimated from historical data. The model then computes projected continuation rates as weighted averages of the projected reenlistment rates and the continuation rates of those individuals not making reenlistment decisions. In computing these weighted averages, the fraction of individuals making reenlistment decisions and the continuation rates of those individuals not making reenlistment decisions are assumed fixed at their base year values, so that only the reenlistment rate varies from one year to the next. Finally, the projected continuation rates are used to "age" the enlisted force, thereby arriving at a projected enlisted force one year later. In particular, we may compute the career force, defined as total end-strength in LOS cells 5 through 30. This is the summary measure of the enlisted force level that is preferred by most manpower planners. The entire projection procedure may be repeated iteratively for as many future years as desired.<sup>2</sup>

#### Validation of the ACOL Model

To validate the ACOL model, we used data through FY 77 to compute ACOL projections for FY 78 - FY 80. These projections were compared to those of an earlier CNA model, the PROPHET model, as well as to actual historical experience over the period FY 78 - FY 80. The PROPHET model

TABLE 1  
NAVY CAREER FORCE PROJECTIONS (THOUSANDS)

	<u>FY 78</u>	<u>FY 79</u>	<u>FY 80</u>
Historical	190.3	192.6	193.0
PROPHET	199.0	203.7	205.2
ACOL	195.4	198.0	200.8
ACOL with lagged bonuses	193.7	194.7	196.3
ACOL with lagged bonuses and civilian unemployment	191.7	189.8	192.4

differs from the ACOL model by not allowing continuation rates to vary in response to pay changes. Instead, PROPHET applies base year continuation rates throughout the projection period.<sup>3</sup> In fact, military pay declined by 5.9 percentage points relative to civilian pay over the period FY 78 - FY 80. Because PROPHET does not adjust continuation rates to changes in relative military pay, it overpredicted the career force by 5 to 6 percentage points.

By contrast, the ACOL projections are accurate to within 3 to 4 percentage points. Although an error of this magnitude may seem tolerable, it is nonetheless disturbing that the ACOL model consistently overpredicted the career force. Recall that relative military pay declined over the period FY 78 - FY 80. The ACOL model did adjust reenlistment rates downward in response to this trend, but perhaps did not do so to a sufficient extent. This suggests recalibrating the pay coefficient in the logistic supply equation in order to obtain greater conformity between the ACOL projections and historical data. However, the coefficients in the logistic supply equation have been independently estimated using several data sets, all of which yielded similar estimates. Therefore, we chose not to alter the pay coefficient in the model. Instead, we sought variables other than pay whose behavior over the period FY 78 - FY 80 could improve the ACOL projections.

It has been argued that bonuses paid to individuals who reenlist at the end of their first term of service will induce reenlistments on the

part of marginal individuals having lower tastes for service than those who would have reenlisted even without the bonuses. These marginal individuals will be less likely to reenlist again at the end of their second term of service.<sup>4</sup> To determine the magnitude of this effect, we pooled data on second-termers in 90 ratings over the period FY 77 - FY 80. We used these data to express the second-term reenlistment rate as a function of the first-term bonus multiple that prevailed five years earlier. The lag of five years was chosen to represent the average length of a first-term reenlistment. That is, first-term individuals who are induced by bonuses to reenlist will face their second-term reenlistment decision on average five years later. Hence it will take about five years until first-term bonuses have their effect upon the second-term reenlistment rate.

Using a generalized least squares technique, we estimated that a unit increase in the first-term bonus multiple will lead to 2.1 fewer second-term reenlistments per 100 eligibles five years later. We used this coefficient to incorporate the effects of lagged first-term bonuses into the logistic supply equation. The resulting ACOL career force projections are quite accurate, lying within 2 percentage points of the historical values in all three projection years.

We considered a final refinement which reduced the ACOL projection error virtually to zero. To accomplish this, we incorporated the effects of civilian unemployment into the logistic supply equation.

Increased civilian unemployment represents a deterioration in the alternatives to military service. Hence we expect that an increase in the civilian unemployment rate will lead to an increase in the reenlistment rate.

An important methodological problem arises with the inclusion of the civilian unemployment rate. The problem is that, unlike the case with lagged first-term bonuses, the actual values of the civilian unemployment rate in FY 78 - FY 80 would not have been available had the projections in fact been made in the base year, FY 77. These values are only available through hindsight, hence their inclusion gives the model an unfair advantage. Nonetheless, the ACOL projections which incorporate the effect of the civilian unemployment rate are illuminating because they indicate the extent to which the ACOL projection error may be attributed to variation in civilian unemployment over the projection period, and the extent to which the projection error must be attributed to other factors which are omitted from the model.

Using the pooled data set described earlier and a generalized least squares technique, we estimated that an increase of one percentage point in the civilian unemployment rate will lead to 2.7 additional reenlistments per 100 eligibles. The ACOL career force projections which take account of civilian unemployment are extremely accurate, lying within 1.5 percentage points of the historical values in all three projection years. Moreover, the model generates both positive and negative projec-

tion errors, so that the average projection error is approximately zero. This result is satisfying, since the model no longer appears to either systematically overpredict the career force or systematically underpredict the responsiveness of reenlistments to relative military pay.

### Conclusions

The ACOL model performed quite well in a validation exercise over the period FY 78 - FY 80. Moreover, we developed several refinements to the model which improve its accuracy still further. The ACOL model is now widely used by manpower planners and compensation managers in both the Navy and the Office of the Secretary of Defense.

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3. Marc D. Joseph, "The PROPHET System for Projection of Inventories in Ratings and Other Subpopulations," Center for Naval Analyses, Research Contribution 346, May 1978
4. Glenn Gotz and John J. McCall, "Estimating Military Personnel Retention Rates: Theory and Statistical Method," The Rand Corporation, R-2541-AF, Jun 1980

#### FOOTNOTES

1. Some of the technical details regarding these modifications are dealt with at greater length in the earlier paper by Goldberg and Hager (reference 1).
2. Additional technical details regarding the ACOL model are discussed in Warner (reference 2).
3. The PPHOPHET model is documented in reference 3.
4. This hypothesis was addressed in Warner (reference 2) and Gotz and McCall (reference 4).

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